

National Park Service
U.S. Department of the Interior
Field Operations Technical Support Center (FOTSC)

Quality Assurance for Recreational Traffic Count Data in National Parks

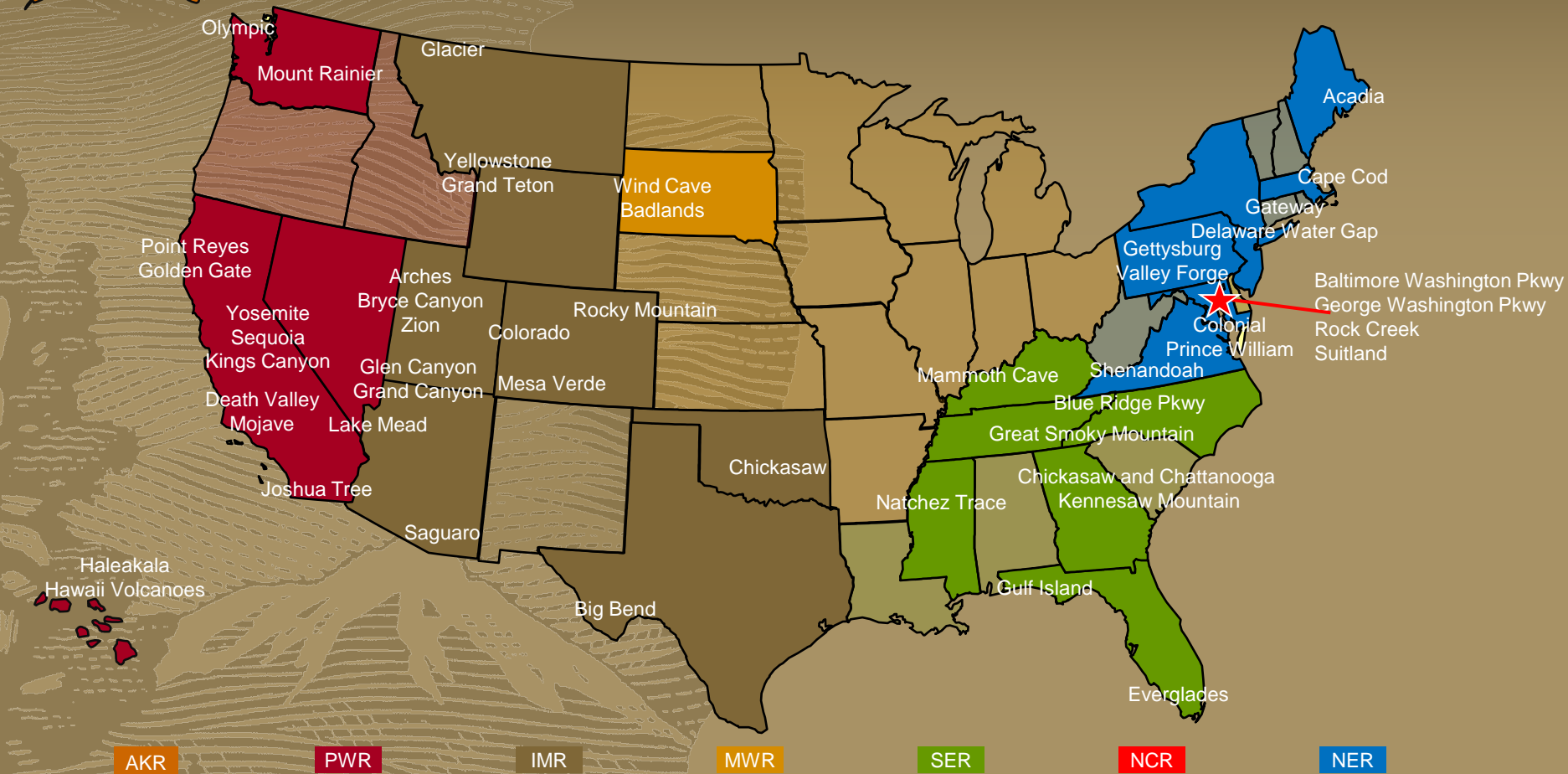
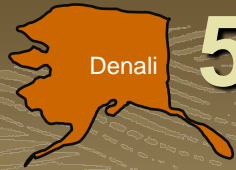
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50 Park Units in the FOTSC Program



Counting in 27 jurisdictions (26 states and DC): AK, AZ, CA, CO, DC, FL, GA, HI, KY, ME, MD, MA, MS, MT, NV, NJ, NY, NC, OK, PA, SD, TN, TX, UT, VA, WA and WY

Variation in the FOTSC Program

- AADT range 100 – 109,000 vpd
 - Big Bend: 100 vpd
 - Gettysburg: 650 vpd
 - Acadia: 1500 vpd
 - Glacier: 1900 vpd
 - Great Smoky Mountains: 7800 vpd
 - Baltimore Washington Memorial Parkway: 109,000 vpd
- 43 suburban/rural park units - 7 urban park units
- 44 recreational traffic - 6 commuter traffic



Two Different Types of Visitation

- Recreational – the entry of a person onto lands or waters administered by the NPS for recreational purposes
- Non-Recreational – government personnel, through traffic (commuters), tradespeople, and people residing within park boundaries



Recreational Traffic – It can Vary

- Season (which can shift year from year)
- Weather
- Economy
- Special Events
- Wildlife

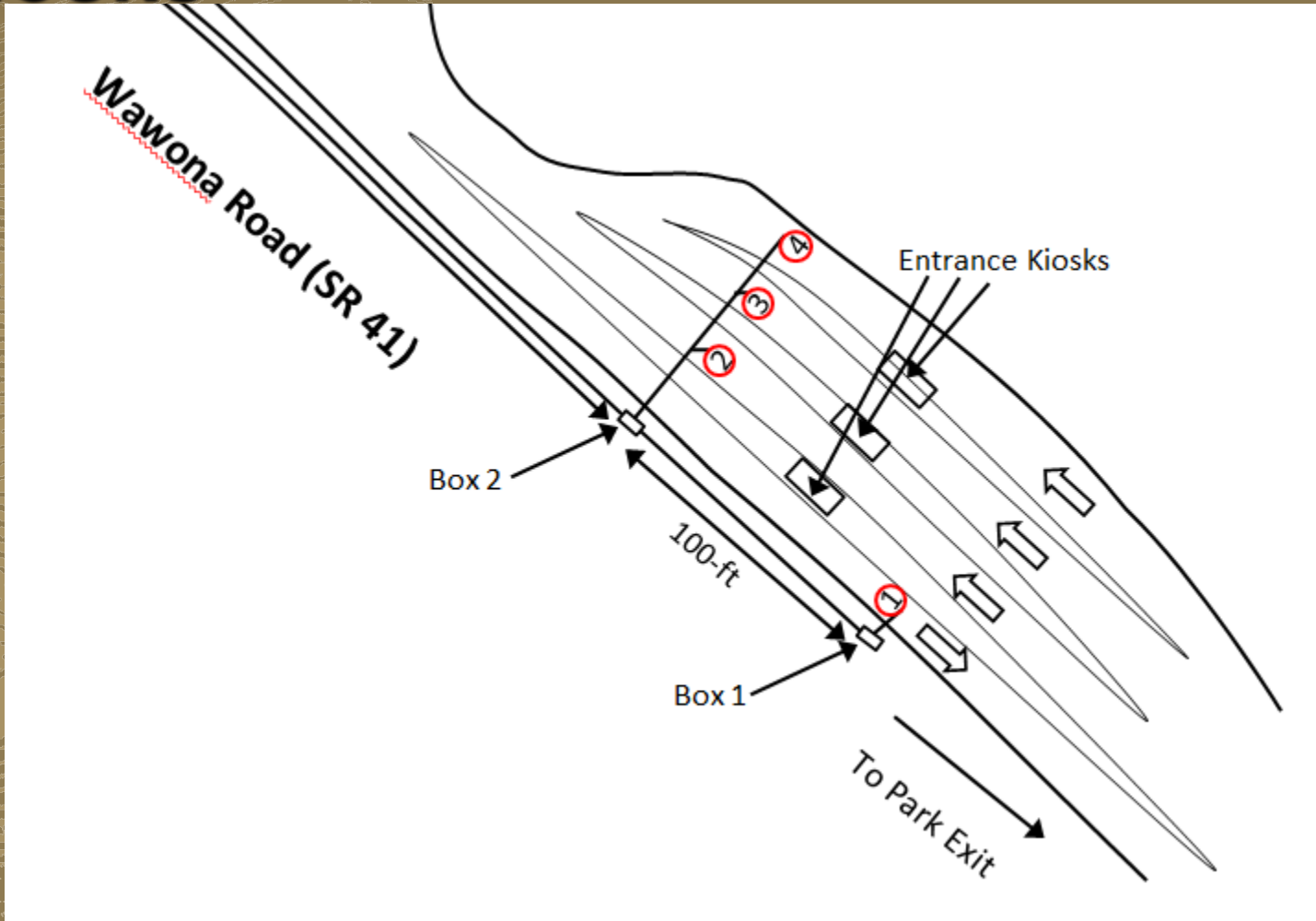


To Make Things More Interesting

- Roads close seasonally (~Nov 1 to ~Apr 15)
- Some roads close for snow (no plowing), then reopen when melted
- During heavy congestion, some lanes turn into bus lanes
- Some counters installed to close to entrance kiosk



Loops too Close to Entrance Kiosks



Erratic Driving



Unexpected Delays



The Problem

- Existing validation rules geared towards higher functional classifications roads

The Solution

- Need validation rules for recreational traffic that accounts for low volumes, high count variation, abrupt changes in counts

The Process

- Reimbursable Agreement through FHWA's Central Federal Lands Highway Division with Texas Transportation Institute (TTI)
- Lit review identified 22 existing validation rules from five different sources
- Thought unique rules would be needed but found it better to modify existing rule thresholds

The Six Steps

1. Modify initial rules based on judgement and experience
2. Apply the “beta” rules to 6 years of count data
3. Evaluate performance of beta rules using visual review, context research (e.g., weather, special events) and judgement
4. Refine beta rules based on “false alarms” in Step 3
5. Conduct statistical analysis to determine observed variation in “cleaned” data; set thresholds based on this variation
6. Compile final rules and thresholds

Start with 22 Rules

Number of Rules	Outcome
7	Work for all sites <i>(Three rules w/ changed thresholds)</i>
3	Thresholds based on rec vs non-rec sites
8	Thresholds based on rec vs non-rec sites, specific thresholds by site
4	Not recommended for use since hourly, daily, weekly and monthly recreational volumes can vary significantly

Seven Rules that Work for All Sites

Rule	Threshold
Percent Complete	
Dataset Includes at Least Two of Every Day of Week	2
Dataset Includes 24 hours of Data	24
Number of Consecutive Identical Non-Zero Values*	4
Total Daily Count	<1
AADT Percent Difference by Lane	(±20%)
Site Percent Difference	(±15%)

* Do not apply when hourly volume < 15 vph

Red text indicates limits are changed from standard rules

Three Rules: Rec vs Non-Rec Sites

Rule	Rec Threshold	Non-Rec Threshold	Comment
Number of Consecutive Zeros	20	8	Rec roads can close each night
7am to 7pm allowable Zeros	>4	>2	Do not apply if ADT < 200 vpd
Ratio of Noon to Midnight Counts	<1	<1 or >120	Do not apply if ADT < 200 vpd

Eight Rules: Rec vs Non-Rec Sites

(thresholds site specific)

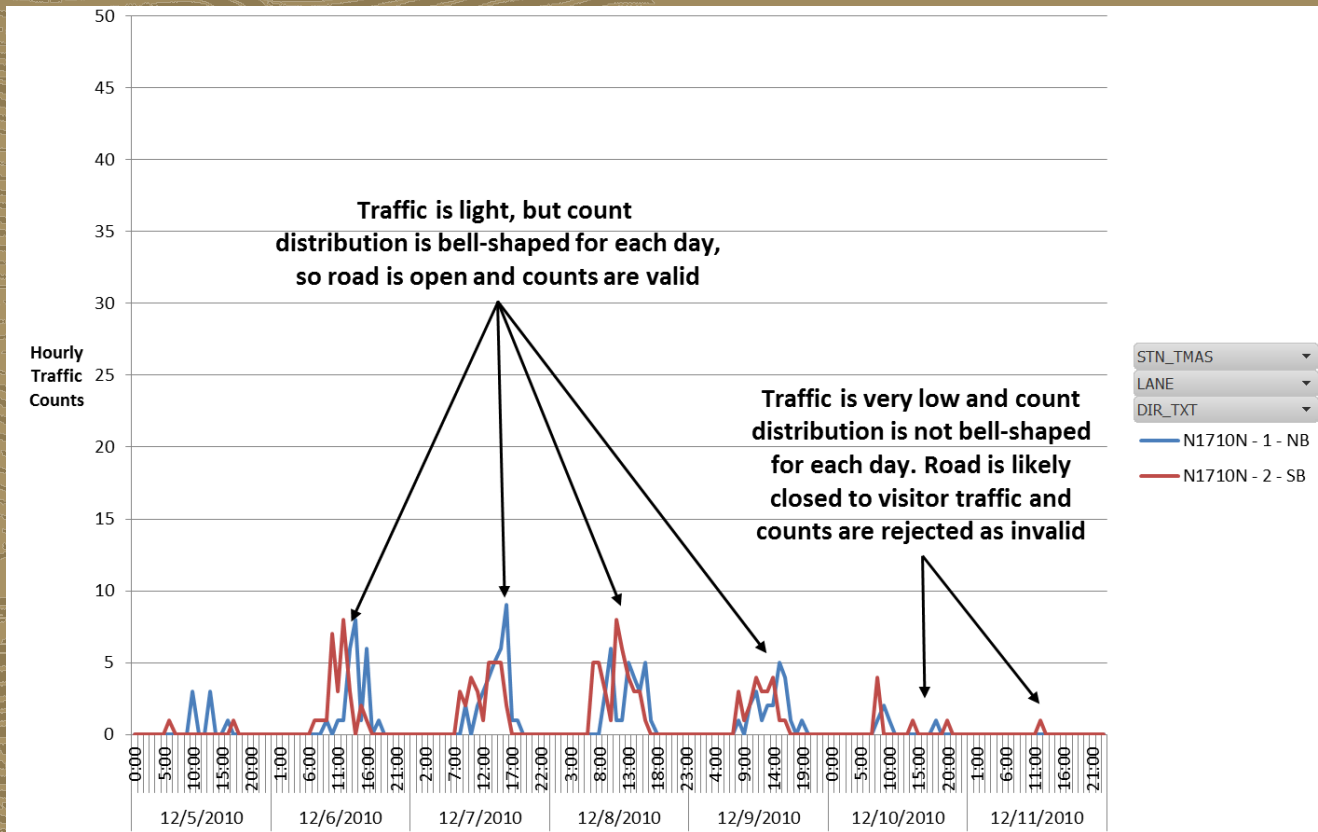
Rule	Rec Threshold	Non-Rec Threshold	Comment
Maximum Vehicles	600 vph	2400 vph	*
Ratio of Lane 2 to Lane 1 Counts	Do not use	*	*
Interval Boundary Hours	50 vph	50 vph	Certain rec and non-rec sites use 100 vph
Ratio of Peak Hour to Daily Count	>35	>25	Do not apply if ADT < 200 vpd
Daily Directional Split	*	*	*
ADT vs AADW	*	*	*
Interval - Weekday	*	*	*
Interval - Weekend	*	*	*

* Different thresholds at each site

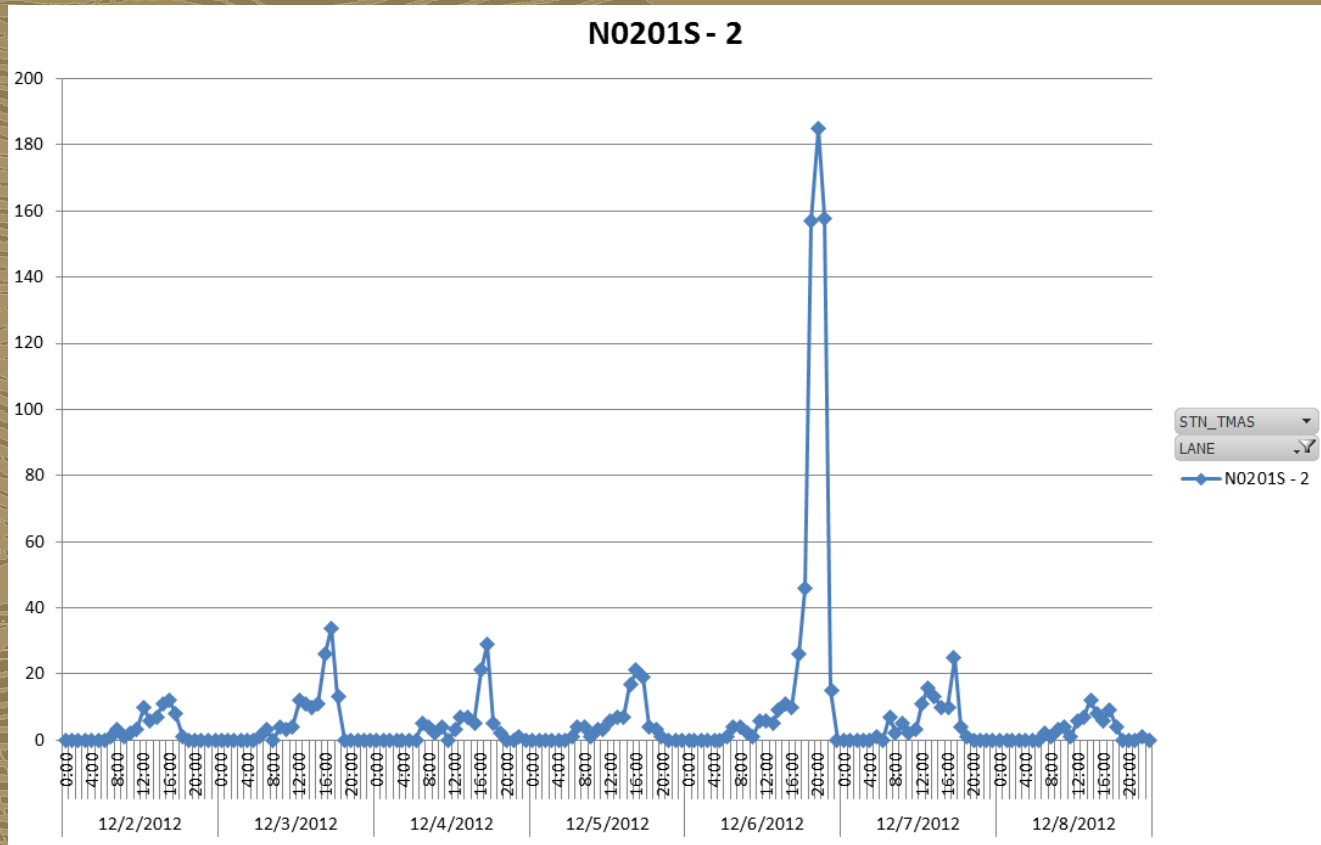
Four Rules not Used for Rec Traffic

Rule	Comment
Hourly Directional Split	Too much variation
MADT Percent Difference	Too much variation
Weekly versus MADT Percent Difference	Too much variation
Site Percent Difference – AADT	Too much variation

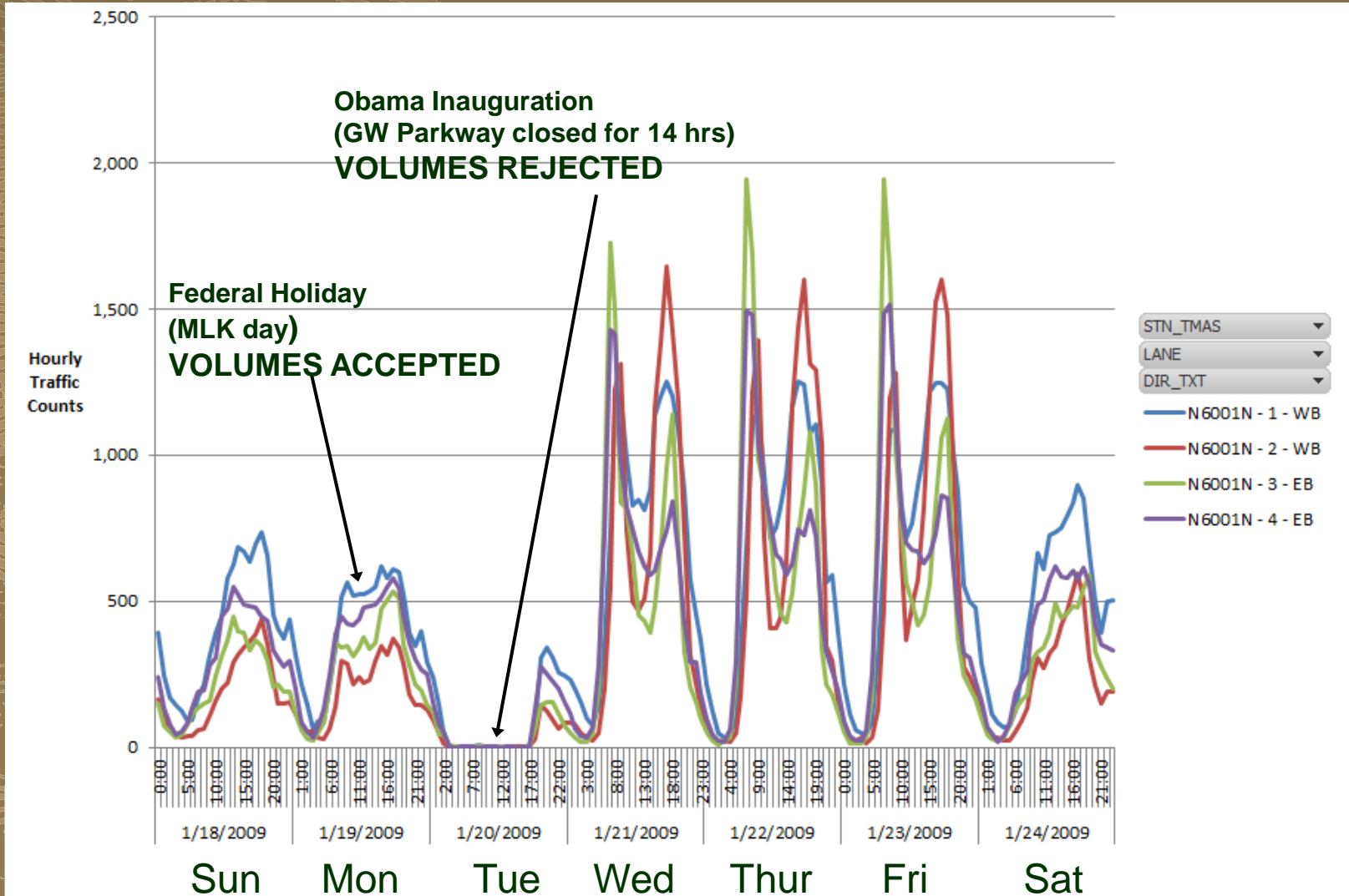
Weather Related Road Closure



Erratic Volume; Mesa Verde



Erratic Data; GW Parkway



Some Guiding Principles

- Rejected count values should be proven “beyond a reasonable doubt” before rejection
- True and accurate count values should be accepted, even when they are non-typical and influenced by extreme weather or other factors
- Traffic count data should be review in a spatial and temporal context
- When park visitor traffic is restricted from the monitored road by a park or road closure, then the count data should be marked as invalid

All Final 22 Validation Rules

- Transportation Research Record 2593
- Quality Assurance for Traffic Count Data in National Parks

Quality Assurance for Traffic Count Data in National Parks

Ensuring Quality When Traffic Variability Is High

Shawn Turner, John Wikander, and A. J. Nedzesky

This paper describes a process to develop data quality validation rules, in a national park context, for traffic counts that are primarily recreational. An initial set of validation rules was used to automatically review 6 years of hourly traffic count data at 113 National Park Service (NPS) monitoring locations in 32 national park units spread across the United States. The initial validation rules were calibrated on the basis of a visual review of all data flagged as invalid by the rules, and statistical analysis of the quality-reviewed data resulted in several more validation rules that were designed to identify traffic counts that fell outside the normal expected variation (on the basis of the previous 6 years). A final recommended set of traffic count validation rules is summarized in the paper. The visual review of extensive traffic count data resulted in a set of guiding principles, which were documented in an operating manual that will be used by NPS data reviewers to ensure consistency in data quality reviews. The resulting validation rules and operating manual will be of interest to those who want to ensure the quality of traffic count data in similar contexts (i.e., recreational, with low to moderate levels of traffic and high variation).

Like state departments of transportation (DOTs), the National Park Service (NPS) maintains a traffic monitoring program that collects continuous counts from permanent monitoring stations and short-duration counts from portable traffic counters. The NPS traffic monitoring program is maintained through the Field Operations Technical Support Center, located in Denver, Colorado, and part of the NPS's Washington, D.C., office.

There are several unique challenges in the NPS traffic monitoring program. The monitoring sites are spread geographically across the United States, in a wide variety of roadway settings and climates and sometimes in remote areas with challenging access to power and communications. Furthermore, the monitoring sites have a wide range of traffic levels: average daily traffic counts range from 100 to over 100,000 vehicles per day (vpd).

Recent efforts have focused on reinvigorating the NPS traffic monitoring program: repairing malfunctioning counters, developing standard specifications for counter equipment installation, upgrading the back-end traffic monitoring database, and improving the data

quality validation rules for incoming NPS traffic counts. This last enhancement—improving the data quality validation rules—is the subject of this paper.

PROBLEM STATEMENT

Existing guidance on traffic monitoring (i.e., FHWA's *Traffic Monitoring Guide* and the *AASHTO Guidelines for Traffic Data Programs*) is focused mostly on high functional class roads in urban settings. As such, the vehicle traffic is typically higher and more commuter based, has less variation between the days of the week and the months of the year, and is less susceptible to abrupt changes from external events (e.g., economy and weather) than recreational traffic in national parks. The nature of recreational traffic counts—typically, low count levels, high variation, and susceptibility to abrupt changes—makes it very challenging to assess data quality and identify data errors versus plausible traffic count oddities.

Because of the challenges associated with assessing the quality and validity of recreational traffic data, the Texas A&M Transportation Institute (TTI), Texas A&M University System, was contracted to

1. Develop initial data quality validation rules for continuous traffic counts in national parks.
2. Use the initial validation rules to assess and review 6 years of traffic counts, and
3. Refine the validation rules on the basis of this practical data review experience.

The outline for the rest of this paper is as follows:

- **Methods:** describes the overall approach and steps taken to develop the data validation rules and review the 6 years of NPS traffic count data.
- **Findings:** summarizes the findings of the research, including the specific data validation rules and thresholds. Also includes several examples that illustrate the challenges of quality assurance with recreational traffic counts in the NPS setting.
- **Conclusions:** provides concluding remarks, important considerations, and plans for implementation.

METHODS

This section describes the steps used to develop and apply data validation rules for the NPS traffic count data. The steps were as follows:

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