PART 1

Data Collection

1

A Review of Statewide Traffic Data Collection, Processing, Projection and Quality Control

Three of the most essential metrics of highway system operation are the volume, composition and weight of traffic using the roadway and street network. Agencies need timely and reliable traffic information to perform their varied duties in the areas of planning, design, construction, maintenance and operation of roads. If the collected data are not current and accurate, decisions made by the agency may be delayed or incorrect. This study identifies appropriate measures to ensure that high-quality traffic data are collected, processed, analyzed and reported in an optimal and cost-effective way by the New Mexico Department of Transportation. This is achieved through an in-depth review of the Department's current procedures, including interviews with individuals, both inside and outside of the agency, who have traffic data responsibilities. A survey of best practices in traffic data collection at the national level, as identified in the technical literature and an examination of programs in selected states was also undertaken.

1.1. Introduction

One of the most essential metrics of highway system operation is the volume of traffic using the roadway and street network. The New Mexico Department of Transportation (NMDOT) needs timely and reliable traffic volume information to perform its varied duties in the areas of planning, design, construction, maintenance and operation of roads. If volume data collected by the NMDOT and others are not current, the decisions made by the department may be delayed or incorrect.

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On the other hand, if the data are current but erroneous, then any decisions made on the basis of faulty data will certainly be wrong. Part of the challenge, however, is that the collection, processing and storage of traffic volume data is decidedly not glamorous and, like all traffic studies, is subject to cutbacks in financial support when department resources are tight.

There can easily be adverse financial consequences for not collecting and maintaining traffic volume data in a manner consistent with recommended practices. To improve the results of other applications of traffic data, the NMDOT foresees a need to: (1) identify inefficiencies, inaccuracies and redundancies in the department's current practices of data collection, analysis, and forecasting and (2) develop justifiable recommendations for enhancing data collection, quality control and data use.

1.2. Current traffic data collection in New Mexico

The State of New Mexico has approximately 68,000 centerline miles of roadway (20). Over 14,000 of these miles are on non-local roads which are monitored by the NMDOT with both short-term volume (coverage) counts and approximately 150 active permanent count locations. The permanent count sites include both Automatic Traffic Recorders (ATRs) recording volume, speed and classification data; 15 Automatic Weight and Classification (AWAC) sites collecting weigh-in-motion data in addition to volume and classification, and 30 ITS/camera sites, primarily in the Albuquerque area. A map of the permanent site locations is shown in Figure 1.1 and a complete listing of the permanent sites may be found in a separate document. The number of active sites may vary slightly due to maintenance and construction schedules as well as down time caused by incidents.

Equipment installed at a typical volume, classification and speed site includes both inductive loops and piezoelectric sensors; the weigh-in-motion sites have either bending plates, piezoelectric sensors or load cells along with inductive loops while the ITS sites have Smart Sensors (microwave) and cameras installed to provide both volume and speed data. For data polling from the ATR and AWAC sites, the NMDOT uses TDP (Peek) and TRADAS software developed by Chaparral Systems for data processing and analysis. Traffic count data is stored in an Oracle database.

Based on the Department's Consolidated Highway Data Base (CHDB – recently replaced by TIMS – Transportation Information Management System), a total of 14,853 short-count (coverage count) roadway sections have been identified; it appears that these sections were established based not only on ADT (the TMG suggests that homogeneous segments have traffic volumes that remain within ±10%) but also by the lengths of various construction projects, the location of political

boundaries, and physical reference points such as interchange or intersection locations. Broken down by functional classification, these sites, along with their roadway mileages, as reported to FHWA for 2009, are shown in Table 1.1.

Counts at locations on these sections, except for the urban local system and minor rural collectors and local roads, are supposed to occur for 48 hours on a three-year cycle for the higher functional classes and on a six-year cycle for the lower functional classes. For example, in preparing the count program for the years 2012, 2013 and 2014, all of the high functional class sections counted in 2011 would be placed on the 2014 count program, 2010 sections would be counted again in 2013, and the remaining sections would be placed on the 2012 program. The traffic technician conducting the count may place the counter anywhere in the section where it is safe to do so. While the department has approximately 120 portable counters, only about 90 are currently being used because of staff shortages.

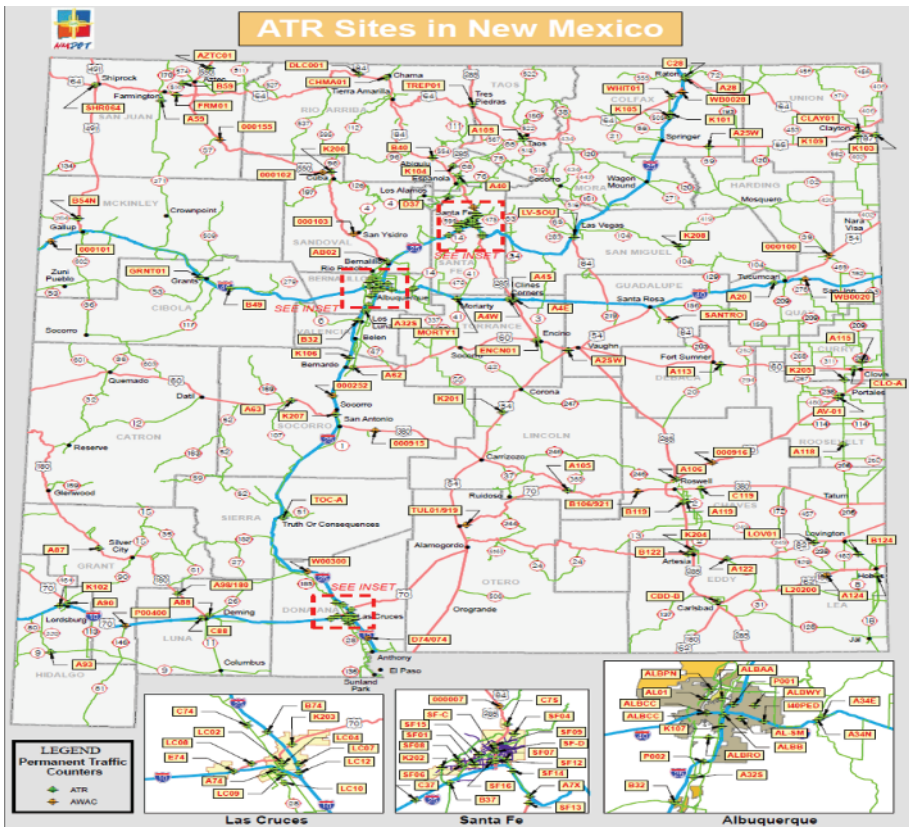

Figure 1.1. *ATR and AWAC sites in New Mexico. For a color version of this figure, please see www.iste.co.uk/jacob/traffic.zip*

While the current number of identified short-count roadway sections is adequate given the rural nature of the state, not enough sections in the lower functional classifications (minor arterials, collectors) are actually being counted because of staff and funding shortages. In fact, information from the Data Management Bureau indicates that a total of only 1,597 short-term counts from all agencies were conducted in 2009 and 1,690 in 2010. While these numbers may indicate adequate coverage of the Principal Arterials on a three-year cycle, they show that little coverage was provided to the lower functional classes.

Within the NMDOT, the counter shop at the General Office in Santa Fe conducts the counts statewide. District offices do not provide count data to the General Office although they may conduct specific counts (turning movements, speed, etc.) within their jurisdictions. Although there is no seasonal rule on when short counts are performed, the technicians try to avoid snow plows which tend to tear up the road tubes. Otherwise, counts are performed anytime the technician is in the area.

Functional Classification	**No. of Sites**	**Miles of Rwy.**
Urban		
Principal Arterial – Interstate	529	156
Principal Arterial – Other Freeways	1	5
Principal Arterial – Other	1,117	706
Minor Arterial	1,111	611
Collector	1,552	1,503
Local System	987	5,012
Total Urban	5,297	7,993
Rural		
Principal Arterial – Interstate	966	844
Principal Arterial – Other	298	1,841
Minor Arterial	252	1,953
Major Collector	513	3,882
Minor Collector	598	3,150
Local System	6,929	48,721
Total Rural	9,556	60,391
GRAND TOTAL	14,853	68,384

Table 1.1. *Short-count sections by functional class*

NMDOT traffic monitoring efforts are also supplemented by MPOs which provide data on many road sections within their jurisdictions. In the Albuquerque metropolitan area, for example, the Mid-Region Council of Governments (MRCOG) collects traffic data for all major state and non-state roads in Bernalillo, Valencia, Torrance, Sandoval and southern Santa Fe counties. MRCOG collects 48-hour data at a location every three years, usually on a Monday or Tuesday. Growth factors are applied to the counts during off-years and classification data from MRCOG is also

available. Among the products produced by the MRCOG are annual traffic flow maps. Currently, traffic monitoring activities have not been contracted to any consultants by either the state or the MRCOG.

1.2.1. *Data collection at the NMDOT ITS Bureau*

The ITS Bureau maintains a number of camera and sensor locations in the Albuquerque metropolitan area, primarily along Interstates I-25 and I-40. XML data feeds from sensor locations provide lane by lane count, speed and occupancy information by one-minute intervals. Average speeds and volumes are also computed and a four-bin length-based classification system is collected. The data collected is used primarily for traffic management and emergency response applications and is being archived and shared with MRCOG for Federal reporting and other purposes.

1.2.2. *Other agency programs*

The New Mexico Department of Public Safety (NMDPS) Smart Roadside program uses electronic screening to improve its commercial vehicle enforcement operations. It employs imaging systems for automatic USDOT number and license plate recognition and provides alerts to roadside inspectors for high risk vehicles. Real-time safety information, as well as pass/fail indications for compliance with weight/distance tax requirements and various registration requirements, are gained. Three fixed sites (at the ports of entry at San Jon, Gallup and Anthony) and one mobile reader (in the Albuquerque area) are operational, with an additional seven fixed and two mobile sites planned.

Short-term counts for volume and classification (because of unreliable data, no short-term (portable) WIM data is collected) take place over a 48-hour period of time, while speed data, when required, is ordinarily obtained over a 24-hour period. Turning movement data, typically used by the Districts or by consultants for traffic impact analyses, is collected for a total of nine hours, focused around the AM, Mid-Day and PM peaks. AADTs and AAWDTs, however, are never calculated from turning movement counts.

Equipment failure prior to the completion of the indicated data collection time requires the entire count to be retaken for the entire 48-hour period. Missing values from permanent counters are never estimated; that day's data is left blank. Seasonal correction factors are calculated from similar functionally classified routes and are applied to all short-term counts. Axle correction factors are calculated from the ATR classification sites and are also applied to all short-term counts.

Vehicle occupancy data is required by 23 CFR 500 Part B. 500.202(e) further states that this data is to be collected on the average number of persons per automobile, light two-axle truck and bus, as appropriate to support the data uses identified in 500.203(a). One of those uses is in transportation management systems, such as those at the MRCOG. Similarly, while speed data can be collected at ATR sites, it is not clear whether/how this information is reported/used.

1.2.3. *Current WIM technology in NM*

Currently, the type of sensors that NMDOT are using for their 15 WIM stations are: piezo sensors (Mikros Raktel 8000, all except US 550) and bending plates (IRD 1058, three locations on US 550). In 2011, the bending plates at the three US 550 locations (San Ysidro, Cuba and Bloomfield) will be replaced by PAT plates. Also, the three counters will be replaced at the same time at these three WIM sites. Table 1.2 shows the name, code, location and type of technology of each of the WIM sites.

Site Name	Site Code	County	Road Name	Milepost	Technology
Hatchita	4	Grant	I-10	50.05	Piezo
Logan	100	Quay	US-54	328	Piezo
Gallup	111	McKinley	I-40	10.7	Piezo
Hobbs	202	Lea	US-62/180	84	Piezo
Lemitar	252	Socorro	I-25	158.8	Piezo
Rincon	300	Dona Ana	I-25	37.2	Piezo
Tucumcari	B20	Quay	I-40	340.9	Piezo
Raton	B28	Colfax	I-25	445	Piezo
Roswell	916	Roosevelt	US-70	354.3	Piezo
Vado	74	Dona Ana	I-10	155.6	Piezo
Tularosa	919	Otero	US-70	231.65	Piezo
San Antonio	915	Socorro	US-380	15.7	Piezo
San Ysidro	103	Sandoval	US-550	24.738	Bending Plate
Cuba	102	Sandoval	US-550	71.051	Bending Plate
Bloomfield	155	San Juan	US-550	121.5	Bending Plate

Table 1.2. *Location and type of WIM technology in NM*

The performance and accuracy of the bending plate sensors is much better than that of the piezo sensors, but they are much more expensive and difficult to install. However, the reliability and accuracy of piezo sensors is good regardless of the surface of the road if calibration is performed often.

The main reasons for inaccuracy in collected WIM data appear to be lack of calibration and the influence of temperature. Changes in temperature produce a bias

in the weight measured by the sensor. If the temperature gets lower, the weight measured decreases, and vice-versa. Temperature sensors at all piezo WIM sites could correct the error due to temperature; currently, these stations do not have such a sensor.

Bending plate sensors are calibrated twice a year. Piezo sensors have not been calibrated since 2008, although it is recommended they be calibrated at least once a year. Therefore, some inaccuracy in the weight data collected by piezo WIM sites is not surprising. Calibration is not being carried out more frequently due to budget constraints. There are two new WIM sites that are planned to be installed soon, one on I-25 and one on I-40.

The Long Term Pavement Performance (LTPP) program also has two WIM sites located in New Mexico for specific pavement studies (SPS). These two sections are: 350110, located on I-25 North at M.P. 36.1, and 350500, located on I-10 East at M.P. 50.2. The data at both sites is processed and the corresponding axle load spectra are available in the LTPP database.

1.3. NMDOT data processing and reporting

In addition to the monthly data submitted to FHWA for truck weight studies and volume trends, Highway Performance Monitoring System (HPMS) data for the previous calendar year is required to be submitted annually to FHWA by June 15. This data is used not only by the DOT for pavement design but is also input at the Federal level for apportionment of highway funding, the development of performance measures, such as crash rates, and summary reports to Congress.

The traffic survey data collected by the NMDOT is broken down into classification, volume and weight categories. Classification data is further divided into annual class summaries and percentages, both overall and by day of the week. Class percentages of monthly average daily traffic (MADT) at all continuous count sites are also provided, as is the overall percentage of traffic statewide at the permanent sites by functional classification. Typical examples for 2009 are shown in a separate document.

Volume information is also broken down into several categories. In addition to annual volume summaries by site which compare AADT, AAWDT and AAWET totals to the previous year, annual day of week, the 500 highest hours and hourly day of week tables are provided. Tables listing day-of-week percentages, a commercial AADT summary and the highest hours by direction are also reported. Typical examples are again provided separately.

WIM data, by lane, direction and for the entire roadway, are provided from each AWAC site for each of the 13 FHWA classifications. "Off Scale" and "Unclassified" data columns are also listed. The tables list number of vehicles, EASLs for both flexible and rigid pavements (calculated by equations provided in the table) and gross vehicle weight.

Tables providing growth factors, axle factors and daily/seasonal factors, all by both site and functional class, are also provided as part of the annual report. Tables of daily vehicle miles of travel (DVMT), by county, NMDOT district and functional class are also provided. Examples of all are included in attachments.

1.3.1. *Summary of New Mexico practice*

The documents describing New Mexico's traffic monitoring program appear to be in compliance with both Federal Regulations and the several guidelines and standards available at the national level; in actual practice, however, the state is not. For example, while the number of counts on those roads classified as urban or rural Principal Arterials appears to be adequate, this is not the case on roads of lower functional classification. This is somewhat surprising since the State has been a leader in the development and enhancement of traffic monitoring activities since the late 1980s.

However, like many agencies currently, the traffic monitoring program suffers from a lack of resources, both personnel and equipment, necessary to increase and improve data collection efforts on minor roadways in both urban and rural areas. Additional resources are also necessary to improve data collection activities at weigh-in-motion sites. This critical item could be provided either in-house or through contract personnel.

1.4. Traffic data projection and quality control

In order to identify current NMDOT traffic data procedures, policies, practices and qualities, interviews and written surveys were conducted with NMDOT employees and selected individuals from other agencies, both public and private, who collect, process, store or utilize traffic data.

The project technical panel members were asked to recommend a set of individuals who should be interviewed. The recommendations included 26 individuals, including persons from the planning bureau, traffic engineers at headquarters and in the districts, pavement engineers, ITS experts and individuals from three consulting firms, FHWA and MRCOG. Additional interviews were

conducted via an email survey of individuals not previously contacted in person. A second round of surveys with a more detailed questionnaire was conducted. The following sections summarize the input the researchers received from all of these efforts.

1.4.1. *In-person interviews*

Question 1 asked if the individual or his/her office collected traffic data. Not surprisingly, all except one reported that they did. Some actually did collect data, others processed the data and still others supervised the data collection.

Question 2 inquired about the types of data collected. The emphasis of the planning bureau was on traffic volume, vehicle classification and weigh-in-motion (WIM). According to the interviewees, the department maintains about 122 permanent count stations, and conducts shorter-term counts with portable counters, principally in the southern part of the state during the late fall, winter and early spring and in the northern part of the state during the remainder of the year. NMDOT has 120 portable traffic volume counters, but is currently using only about 90 due to staffing shortages. The department has 15 permanent weigh-in-motion sites; formerly, the department employed portable WIMs on a 3-year cycle at about 95 sites. The bureau is able to collect speed data, in bins, and believes that it may be required to do so in the future.

The district traffic engineers collect a more diverse traffic data set; in addition to daily traffic volume, they routinely collect manual traffic volume counts, spot speed data and vehicle delay for traffic signal warrants, citizen complaints, speed zoning and lane blockage/lane rental in construction zones. None of the individuals interviewed reported that they conducted travel time studies.

Question 2a asked why the individuals/offices collected the traffic data. Individuals at the planning bureau gave two primary reasons for the data collection: Federal reporting requirements, both monthly and annual, and in support of engineering purposes. The traffic engineers had more varied reasons for their data collection. In addition to concerns expressed by citizens, these engineers must conduct studies to document the need for traffic control devices, as specified in the *Manual on Uniform Traffic Control Devices (22)*. They reported that data for turning movement volume counts at intersections and short-term counts at other locations are not available from Santa Fe, although these data were more commonly available in the past.

Question 2b addressed the issue of processing the traffic data. Planning indicated that they use the TRAffic DAta System (TRADAS) from Chaparral Systems

Corporation for collecting, editing, summarizing and reporting traffic data. The software meets the data processing requirements of AASHTO's *Guidelines for Traffic Data Programs* and FHWA's *Traffic Monitoring Guide*. Because of the diversity of traffic data collected by the district traffic engineers, their data processing was more varied. For example, the data collected by consultants for traffic impact analyses (TIAs) is processed in accord with the state's *Access Management Manual (23)*. These studies also make use of ITE's *Trip Generation Manual (24)*. Except for special circumstances, traffic volume data in the districts are only collected on Tuesdays, Wednesdays and Thursdays. None of the state's counts are done using traffic cameras. The pavement engineer reported the need for data processing to address future MEPDG requirements.

Question 2c asked who the data are reported to. The planning bureau indicated that a primary use of the data was for making reports to FHWA, although they also respond to requests for data from others within the department as well as consultants and the public. The reporting by the district traffic engineers appears to vary among the districts. For the most part, the data are used by the districts for the purposes for which it was collected, but are rarely, if ever, shared with Planning. As a result, there is no central database that contains all the traffic data collected by the NMDOT, other agencies or consultants.

Question 3 inquired about documents prepared by the interviewees or their offices related to traffic data collection, policies or practices. The planning bureau relies on the state's traffic monitoring standards, which are essentially an updated version of the standards developed by the Planning/Research Bureau in 1989–90. None of the districts have developed their own documents; they reportedly rely to some extent on guidance from ITE's latest *Manual of Transportation Engineering Studies (25)*.

This question also elicited the response that there is no communication among those in different districts collecting traffic data. The researchers believe that information sharing among the districts and between the districts and the General Office could be beneficial.

Question 4 asked about the use of documents on traffic data collection prepared by others, either inside or outside of the department. Planning reportedly uses AASHTO's *Guidelines*. The districts do use ITE's *Manual*, but individuals suggested that there is a need for a department manual on setting up equipment so that data are consistent among the districts and to allow input to a common database. Engineers involved with pavement design rely on AASHTO documents regarding traffic volume, vehicle classification, weight and related issues.

Question 5 sought input on the use of traffic data. Planning primarily collects the data, reports it to FHWA and upper management and shares it with others inside or outside the department who request it. The districts clearly use the traffic data for making decisions regarding design and operations. District 3 has some interaction with MRCOG regarding traffic data.

Question 6, regarding the types of data used and the purposes for using the data, was essentially addressed in the responses to other questions. However, the pavement engineer mentioned the specific needs for ESALs, vehicle volume and classification and traffic growth rates as essential parameters for the work of his office.

Question 7 asked the individuals how they accessed the information and the format in which it is stored. Planning indicates that they respond to requests from individuals within and outside the department. Based on the researchers' experience on previous projects, an email request to the bureau for volume information is typically accommodated in two days or less. The department is working to get the information available online for all to use. In Santa Fe, the data are stored in TIMS, which is the new version of the former consolidated highway database.

Question 8 inquired about the completeness, reliability, accuracy and timeliness of the data. With respect to completeness, some concerns were expressed about the WIM devices. The devices used in New Mexico include bending plates and piezoelectric sensors. The specific problems mentioned include power failures and the tendency of both devices to lose their calibration, sometimes after just a short period. Portable counters are placed for a 48-hour count and are deployed on a three-year cycle. The traffic engineers commented on the lack of turning movement counts and the lack of "k" factors, the ratio of the thirtieth highest hourly volume to the average daily traffic. The pavement engineer felt that the data were complete for AASHTO's current design policy, but incomplete/insufficient for the MEPDG.

With respect to reliability, planning reports that the traffic volume counts are adjusted to AADT using computed daily and seasonal factors. Procedures exist to promptly identify ATRs that are producing suspicious or erroneous data, and technicians are dispatched to resolve the problems. The interviewees note, however, that the ATRs are aging and that some need replacement. A concern was expressed about the quality control for traffic data.

Regarding the accuracy of the traffic data, there was a sense that the data meet current needs but are not perfect. Planning is considering the use of manual or portable counters near permanent ATRs to verify accuracy. There were no comments on the accuracy of vehicular speed or traffic delay data.

The respondents seemed to be pleased with the timeliness of traffic data. The WIM data are reported monthly and the ATRs are autopolled on a daily basis. The traffic engineers were satisfied with the timeliness of data that their offices collected, but somewhat less with data collected by others. The proposed move to making traffic data available online was welcomed by all as a means of enhancing both timeliness and accessibility.

The final question sought input on current or projected data needs that are not being met by the existing system. The pavement engineer expressed a need for the inputs required for MEPDG, including axle load spectra, seasonal adjustment factors and speed data. The limited number of WIM sites was also a concern; the need for the use of portable WIM sites to provide data for MEPDG was mentioned. Traffic engineers felt there was a greater need for TIA data for proposed developments. Some concern was also expressed about the reliability of traffic projections.

1.4.2. *Additional written interviews*

In addition to the interviews described in the previous section, inputs were obtained from 13 additional individuals. These individuals represented not only NMDOT personnel from the General Office, the ITS bureau, MRCOG and District Traffic Engineering staffs, but also several private consultants. Particularly helpful was a very detailed response provided by the New Mexico Division of FHWA. Additional input was also provided by a representative of the NM Department of Health with an interest in traffic data from an epidemiological standpoint. The responses to the survey form are summarized below.

Question 1: All but one of the additional respondents indicated that they either collect, process or use traffic data. One of the engineering consultants indicated that they do not collect the data themselves but rather hire sub-consultants who specialize in data collection. Only one response, from the software firm that developed TRADAS, indicated that while they do not collect data, they develop software related to data collection.

Question 2: Planning groups, especially at the NMDOT and, to a lesser extent, at the MRCOG, report collecting volume, speed, classification and WIM data. Consultants, in addition, collect turning movements and also some crash and pedestrian volume data. One consultant reported collecting origin-destination data through license plate surveys as well as GPS-based travel time studies. Another consultant expressed a need for gap data. The NM Department of Health routinely collects data on EMS (ambulance) patient data.

Question 2a: Data is used internally for project planning and design, as well as for Federal reporting requirements.

Question 2b: The NMDOT Planning Bureau processes the data through TRADAS, their traffic data software. One consultant uses video data collection software from Miovision Technology, while the NMDOT ITS bureau uses a third party who configures and manages the data from their Traffic Management Center in an SEQUEL environment.

Question 2c: Data from the ITS Bureau is shared with MRCOG and with contractors who are posting travel times on NMROADS. Consultant data is for internal use or is shared with clients. NMDOT district counts are used internally and not usually shared with the General Office. MRCOG data goes into its database and is shared with NMDOT Planning.

Question 3: Some consultants routinely detail data collection and processing procedures in reports to their clients.

Question 4: The AASHTO *Guidelines* and the FHWA *Traffic Monitoring Guide* were mentioned by several respondents.

Question 5: Traffic data is used for design decisions at the NMDOT. It is also used by Traffic and Planning groups within consulting firms. The NMDOT ITS Bureau uses data to configure its Dynamic Message Signs.

Question 6: Consultants use data for their own studies including classification and WIM data for LTPP studies. They also report using volume data for marketing studies as well as engineering analyses.

Question 7: Data is typically stored on agency/company servers in Excel, pdf or csv formats. Backup is by hard copy in project folders. GIS shape files and dbt tables are also used for storage. NMDOT ITS has data accessible in a web environment; its contractor stores in a SEQUEL database.

Question 8: Most responses indicate completeness, accuracy, reliability and timeliness as "sufficient for our needs", particularly if the data were collected in-house. There was some concern relating to WIM sensors going out of calibration and the need for better monitoring. Some consultants also expressed concern with the currency of the MRCOG database and the need for more frequent volume counts. MRCOG, for its part, laments the "significant lack of ATR or continuous count locations", and NMDOT's inability to preserve the ATRs that it does have.

Question 9: NMDOT ITS still has some gaps in Interstate coverage, particularly on flyovers; it expects to have these completed soon. Some respondents would like to see

turning movement counts to be a "standard inventory requirement", (stored in a central database, along with weights, classifications, etc.) as well as the establishment of a central data collection tool. The MRCOG would like link speeds and travel times on non-interstate facilities to aid in their congestion management process.

1.4.3. *NMDOT project panel responses*

A series of advanced questions, based on Transportation Research Circular E-C120, Traffic Monitoring Data and Successful Strategies in Collection and Analysis [EC 07], was distributed to the project's Technical Panel. This section is an attempt to summarize the four completed questionnaires that were returned, three from NMDOT personnel and one from a representative of the Federal Highway Administration. A summary of the Technical Panel's responses with those detailed in the Circular is described below.

NMDOT Responses – The problems facing the NMDOT in regard to traffic monitoring revolve around money, politics and the resulting inability to ensure that the data collection meets all of the Federal requirements. A longstanding lack of funding has affected both the ability to collect the data that is required by Federal agencies through insufficient staff as well as through inadequate installation, calibration and repair of data collection equipment. Funding constraints have also resulted in little or inadequate staff training involving proper data collection procedures as well as inadequate database maintenance and reporting, with only static annual reports available on the web. WIM data is downloaded weekly, although no automated quality control checks are performed. Manually flagged data are investigated and a technician is sent to review conditions at the site.

Other traffic data from continuous monitoring are downloaded and reviewed daily; automated data quality checks are applied, and flagged or suspect data is investigated, including sending a technician to examine the site. Unexplained large data variations are purged and recounts scheduled.

NM FHWA Response – There is concern at the FHWA as to whether some of the Federal reporting requirements are being satisfactorily addressed; this may be attributed to the department's less-than-complete understanding of the *Traffic Monitoring Guide* (TMG). For example, the TMG calls for a three-year counting cycle on the National Highway System (NHS), on Principal Arterials, and on HPMS sample sections. Every major system section should be monitored to provide truck counts. The Traffic Monitoring System (*TMS/H, 23 CFR 500 Subpart B*) also calls for vehicle occupancy monitoring and a testing program for field equipment. These requirements are not currently being met. Finally, while realizing that keeping counters working is always a challenge, operational counters used to determine the annual growth rates need enhancement and additional counters are needed to provide statistical validity [BRO 11].

1.5. Conclusions

The survey of traffic data collection professionals in the state was used to both identify current problems and describe possible opportunities, and to provide a summary of both the technical literature and the best data collection and analysis practices employed at the national level. Several conclusions associated with both data collection and analyses are presented and recommendations for improving the processes are given below:

New Mexico's involvement with issues associated with traffic monitoring dates back to the late 1980s when the NMDOT uncovered significant quality and reliability problems in its data collection and analysis processes. Rather than conducting a recount when missing or suspicious data readings were observed, for example, staff often used "engineering judgment" to replace the missing or questionable values. This revelation led to a national effort, in many ways spearheaded by New Mexico, to standardize data collection processes and improve data quality.

Since that time, the state has continued to make progress in its traffic monitoring activities and, in most instances, its documents appear to be in compliance with both Federal requirements and the several published national guidelines and standards. That is not to say, however, that areas of concern have not been identified through interactions with traffic data specialists in the state. Like many public enterprises nationwide, the department's traffic monitoring program is in need of additional funding to acquire both additional staff to oversee program activities and to conduct additional counts as well as to purchase additional and upgraded equipment.

The traffic data needs associated with new pavement design procedures as well as the possibility of additional data requirements related to the speed and vehicle occupancy data also point to the importance of collecting timely and accurate data.

Interviews with department staff and others also pointed out the need to address additional data requirements. District personnel, in particular, expressed a need to collect and, equally importantly, store intersection turning movement counts and other manually collected data. Archiving of these data, which are typically collected as part of a traffic impact study, are also critical for other engineering applications.

1.6. Acknowledgments

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1.7. Bibliography

[BRO 11] BROGAN J., TAREFDER R.A., RODRIGUEZ-RUIZ I.J. *et al*., "Statewide traffic data collection, processing, projection and quality control", Final Report, ORA 456-310, Research Bureau, New Mexico Department of Transportation, pp. 1–175, 2011.

[EC 07] E-C120, Traffic Monitoring Data: Successful Strategies in Collection and Analysis Transportation Research Circular E-C120, 2007.