Managing Decisions Regarding Rural Expressway Routes and Associated Highway Bypasses

MTC
MIDWEST TRANSPORTATION CONSORTIUM

Final Report
October 2009

IOWA STATE UNIVERSITY
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16. Abstract

For several years, the Iowa Department of Transportation has constructed bypasses along rural highways. Most bypasses were constructed on the state's Commercial Industrial Network (CIN). Now that work on the CIN has been completed and the system is open to traffic, it is possible to study the impacts of bypasses. In the past, construction of highway bypasses has led community residents and business people to raise concerns about the loss of business activity. For policy development purposes, it is essential to understand the impacts that a bypass might have on safety, the community, and economics. By researching these impacts, policies can be produced to help to alleviate any negative impacts and create a better system that is ultimately more cost-effective.

This study found that the use of trade area analysis does not provide proof that a bypass can positively or negatively impact the economy of a rural community. The analysis did show that, even though the population of a community may be stable for several years and per capita income is increasing, sales leakage still occurs. The literature, site visits, and data make it is apparent that a bypass can positively affect a community. Some conditions that would need to exist in order to maximize a positive impact include the installation of signage along the bypass directing travelers to businesses and services in the community, community or regional plans that include the bypass in future land development scenarios, and businesses adjusting their business plans to attract bypass users. In addition, how proactive a community is in adapting to the bypass will determine the kinds of effects felt in the community.

Results of statistical safety analysis indicate that, at least when crashes are separated by severity, bypasses with at-grade accesses appear to perform more poorly than either the bypasses with fully separated accesses or with a mix of at-grade and fully separated accesses. However, the benefit in terms of improved safety of bypasses with fully separated accesses relative to bypasses with a mixed type of accesses is not statistically conclusive.

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EXECUTIVE SUMMARY

For several years, the Iowa Department of Transportation (Iowa DOT) has constructed bypasses along rural highway routes. Most bypasses were constructed on the state's Commercial Industrial Network (CIN), which is the system of primary highways that connect Iowa's regional growth areas. Now that work on the CIN has been completed and the system is open to traffic, it is possible to study the overall safety, community, and economic impacts of bypasses. In the past, construction of highway bypasses has led community residents and business people to raise concerns about the loss of business activity, since highway traffic is re-routed around the community instead of through it. For policy development purposes, it is essential to understand all of the impacts that a bypass might have on safety, the community, and economics. By researching bypass impacts, policies can be produced that will help to alleviate any negative impacts and create a better system that is more cost-effective.

In this study, researchers found that the use of trade area analysis does not provide proof that a bypass can positively or negatively impact the economy of a rural community. However, this analysis does show that these communities are not generating potential sales based on their population and per capita income. The trade area analysis shows that even though the population of a community may be stable for several years and per capita income is increasing, sales leakage still occurs.

From the literature reviews, site visits, and the data, it is apparent that a bypass can positively affect a community. Some conditions that would need to exist in order to maximize a positive impact include the installation of signage along the bypass directing travelers to businesses and services in the community, community or regional plans that include the bypass in future land development scenarios, and businesses adjusting their business plans to attract bypass users. In addition, how proactive a community is in adapting to the bypass will determine the kinds of effects felt in the community.

Results of statistical safety analysis indicate that, at least when crashes are separated by severity, bypasses with at-grade accesses appear to perform more poorly than either the bypasses with fully separated accesses or with a mix of at-grade and fully separated accesses. However, the benefit in terms of improved safety of bypasses with fully separated accesses relative to bypasses with a mixed type of accesses is not statistically conclusive.

1. INTRODUCTION

1.1 Historical Background

Iowa has constructed highway bypasses around approximately 50 cities since 1964. Many bypasses were constructed as part of the state's Commercial Industrial Network (CIN). Some of the bypasses were built as freeways with full access control, while others were built with priority 3 or lower access control. Priority 3 is a classification designated by the Iowa Department of Transportation (Iowa DOT) for either a two-lane or multilane facility that allows access at both interchanges and at-grade locations. Under this classification, access locations are spaced at a minimum of 1,000 ft, with one-quarter mile spacing preferred (Iowa Primary Road Access Management Policy).

These bypasses are located throughout the state and are routed past both larger urban areas and smaller rural communities. With the CIN now complete, few if any bypasses are underway or planned in the state of Iowa. The purpose of this study is to evaluate the longer-term impacts of bypasses from both economic and safety perspectives and to provide guidance for future consideration of constructing bypasses.

1.2 Problem Statement

This research focuses on the following two inter-related topics: **(1) whether to build highway bypasses around communities** and **(2) if so, what level of access to provide**. Bypasses are both controversial and expensive. Therefore, their impacts need to be studied and better understood to improve planning and design, minimize negative impacts, and capitalize on potential opportunities to improve safety/operations and the economy.

Regardless of past experience and research, residents and business people in prospective bypass areas remain concerned that a bypass will draw potential business away from the current route through the town to other locations. Better understanding impacts should help allay the fears of residents and business owners and demonstrate to them why a bypass may be the best option.

Studies on the economic impacts of highway bypasses in Iowa have been completed over the years; however, none of the studies have comprehensively addressed safety impacts. This research examines the broader impacts, including safety.

2. RESEARCH METHODOLOGY

2.1 Research Purpose

The purpose of this report is provide guidance in making the planning of highway bypasses more efficient, while improving safety and reducing any negative impacts a bypass may have on a community and its economy.

2.2 Research Approach

The research included:

1. Preparing a detailed review of literature on the impacts of bypasses; including economic impacts, community development impacts, and safety impacts.
2. Developing an Iowa geospatial database that allowed for an analysis of factors that contribute to variations in safety performance over the network. Data gathered included roadway inventory items, land use/land cover, traffic volumes, and crash data over a multiple-year period. Many of these data items were integrated from various formats.
3. Conducting a safety performance evaluation. Both design variations such as level of access control and factors in the environment (such as land use) were considered. This task resulted in an interim report reviewed by the TAC.
4. Selecting a number of Iowa case study bypasses for detailed analysis of safety, and four bypasses for assessment of community and development impacts.
5. Preparing case studies of the selected Iowa bypasses.
6. Describing the characteristics of successful highway bypasses based upon an analysis of best cases (performed as well as or better than expected in the project planning documents).
7. Preparing suggested “freeway or expressway” decision guidance.

3. LITERATURE REVIEW

Literature reviewed for this project consists of case studies conducted by transportation departments and universities, newspaper articles on the bypassed communities, and journal articles.

3.1 Overview of Bypass Impacts on Communities

Bypass projects often have long been known to have mixed results. There is the reduction of traffic, noise, and air pollution, and an increase in safety; however, the loss of traffic in the community may negatively affect certain types of businesses. Negative effects may be greater in smaller communities or communities with an economy more dependent on through traffic. Bypass propositions have consequences that include opposition from business people who were not made aware of the potential benefits (Winfrey 1969).

Opposition to bypasses exists for almost all projects. For example, opposition to the U.S. Highway 34 expressway project in 1992 included claims that the project would destroy homes, take up farm land, and was a governmental attempt to force change on people (Parker 1992). However, as more bypasses are constructed and residents and business owners are better informed and included in the planning process, some communities now see a bypass as a potential benefit. As an example, Le Mars, Iowa saw the completion of the U.S. Highway 75 bypass as real opportunity for development. In an attempt to capture potential business from travelers on the bypass, the Chamber of Commerce planned to install signs along the bypass to direct travelers to the downtown business district (Horlyk 2007). New Hampton, Iowa, residents also saw potential benefits from their planned bypass and, through meetings with the Iowa DOT, requested and obtained a bypass featuring grade-separated interchanges along the entire route to allow safe access to the community and businesses (Conners 1996).

Bypass effects on traffic are easily observed and measured (Winfrey 1969). People in the small town of Otley, Iowa, were pleased to have traffic routed around town because traffic on the old route came within 50 feet of some homes. The vibration from trucks and other heavy vehicles was damaging homes and structures, and congestion made crossing the highway difficult for pedestrians and vehicles alike (Siebert 1998).

3.2 Safety Impacts

Bypasses can offer safety benefits resulting from a reduction in overall traffic on the old route, fewer access points, and, in the case of multilane bypasses, safer passing and road safety features. Safety impacts have been studied on bypasses in Norway. In one study, the researchers found that, on average, a statistically significant reduction of 19% in the number of police-reported injury accidents was attributed to the bypasses. These results were similar to previous study results that showed an average reduction in accidents of 25%. Researchers can control for trends in the number of accidents by using the total number of accidents in the county in the before and after periods as a comparison group (Rune).

Rural highways also pose a special access problem. Farm field access and the movement of slow moving farm machinery is common, and field entrances are requested by landowners. In this case, access points should be situated so as to minimize their effects on through traffic. Access points across the street from each other should be situated directly across from each other to allow short vehicle crossing time. In addition, access point proximity to intersections and areas of sight distance restrictions should be considered (AASHTO 2004).

Wisconsin Department of Transportation (WisDOT) officials found that a new bypass didn't necessarily mean a safer route around the city of Oconomowoc. Within a few months of opening, two fatalities were reported at two separate at-grade intersections on the Wisconsin Highway 16 bypass. In order to address safety issues, WisDOT installed better street lighting and signage. One intersection was also to have a traffic control signal installed. A federal report found no design flaws in the intersections and recommended improvements such as intersection warning, road name signs, no intersections at curves, and better signage and lighting (Red Orbit).

Iowa DOT research conducted in the 1980s showed that many communities did notice a drop in accidents in the community and safer streets for pedestrians. However, the studies did not look at accident rates on the new bypass compared to the old highway. Elias found that the construction around Majd-Elcrum, Israel, had a significant impact on the number and severity of accidents (Elias 2006).

3.3 Social and Economic Impacts

Economic and social impacts are more difficult to measure. Economic and social indicators used in past research measure bypass impacts on activities such as retail trade, number of retail establishments, retail trade employment, and land use changes. This information has been compared to a control community with similar characteristics such as population, highway conditions, and traffic counts (Winfrey 1969).

Development of a methodology for investigating economic impacts of highway bypasses on small communities was attempted by the Oklahoma Department of Transportation (ODOT) using quasi-experimental control group methods, a difference-in-difference approach, and anecdotal methods. The results showed that a highway bypass had no influence on a community's sales tax base but were deemed inconclusive due to a lack of treatment cases. Nevertheless, the researchers maintained their belief that bypasses do influence the economic performance of communities due to multiple factors, including distance from community to large discount stores (Rogers 2001).

Research relating highway expenditures to employment in Minnesota showed that the relationship between highway expenditures and employment is weak, except in cases where the county acts as an economic center and is analyzed separately. Increased expenditures in those counties lead to a statistically significant increase in employment levels (Eagle 1987). In the Minnesota study, regression analysis was used to measure the effects on total employment in the bypass town, and interviews were conducted with the owners of travel-related businesses to measure the effects of the remaining objectives. The researchers concluded that the regression analysis showed no statistically significant effect, positive or negative, on the total employment of the communities except for one.

Respondents to the interviews believed that the bypass negatively affected their businesses and that their retail sales and employment would have been higher had the bypass never opened. This notion that employment and retail sales would have been better without the bypass was shared by convenience stores and motels, but not so much by auto service stations. This study shows that the removal of through traffic from a bypass community reduces the demand for travel-related businesses, such as convenience stores and motels (Babcock 2004).

Some measures used in past analyses include retail sales per capita adjusted for income, city size as a measure of retail sales performance, and pull factors which are actual per capita retail sales for the sample city divided by the expected per capita retail sales for control cities. Although overall sales do not appear to be significantly affected by the bypass, individual retail businesses, such as gas stations, may be affected because of their reliance on through traffic. In one study, pull factor analysis was used for each business category in both bypassed and control cities to investigate the impacts of the bypass. The results show bypassed cities, in contrast to cities that weren't bypassed, did experience some loss in auto sales, furniture sales, miscellaneous sales, and wholesale trade but showed gains in apparel, building supplies, and general merchandise sales (Otto 1995).

Otto (1995) conducted a survey to gain perspective from individual business owners about how they thought the bypass affected them. The survey inquired about changes in traffic noise, traffic volume, accident rates, parking problems, shopping environment, number of customers, and overall quality of life in the community. Results varied by the type of business, location, and other factors related to their community and personal situation. Otto argues that, over time, merchants learn to adapt to the bypass and adjust marketing strategies. The survey results showed that, overall, people believed quality of life was better or the same and that noise and truck traffic had been reduced, resulting in improved community shopping environments. Respondents believed that if business had dropped off it was because of a general downturn in the economy or other events in motion before the bypass. Owners of eating and drinking establishments, motels, and service stations were most likely to say they had experienced a reduced number of customers due to reduced traffic. Businesses in two communities did report negative impacts on businesses, customers, and the overall shopping environment, and one community was very opposed to the bypass because the economy is reliant on tourism (Otto 1995).

In Otto's study, surveys showed that towns had opposition to the bypasses before they were built because of fears the town economy would be devastated by the removal of through traffic. Many attitudes changed after the bypasses were completed, with people embracing the bypass because of its positive impacts on the quality of life in the community that were demonstrated through reductions in noise and air pollution and safer travel for local traffic and pedestrians. Survey results also showed that gas station owners did not blame the bypass for loss of sales so much as they blamed vehicles getting better gas mileage (Otto 1995).

Research conducted by the Iowa DOT in the 1980s on the economic impacts of bypasses showed that many communities were against a bypass because of the perception that their economy would be adversely affected. However, the research shows a change in attitude after residents and businesses realized the positive change to the community because of the removal of traffic from the community.

It was commonly felt among the study communities that there were no or very few business failures due to a bypass, but instead loss of businesses was due to general economic conditions, management of the business, or retail development in nearby cities. Businesses did not experience anticipated losses and saw the bypass as providing a more welcoming shopping environment to their communities. Business owners also believed that through travelers rarely stopped to purchase goods in a community, and if the travelers did stop, they did not make sizeable purchases. As found in the survey completed by Otto, gas station owners don't attribute loss of business to the bypass, but instead point out improved automobile gas mileage. Some communities felt that they lost potential industries that may have relocated to their communities if the community was near a bypass or multilane facility (Iowa DOT 1992).

Almost all studies of bypass impacts on retail trade show that the volume of business coming from through travelers is much less than local merchants and officials thought (Winfrey 1969). In summary, the articles and published reports presented here show that people in bypassed communities may be reluctant to allow a bypass of their community to be built because of economic concerns. Several different methods have been attempted in order to measure bypass impacts on economies, but regardless of what method is used, data can be difficult to gather when focusing on rural communities. The method utilized in the study of rural bypasses in Iowa and Minnesota (Otto 1995) works well for rural community applications because the small number of businesses in a rural community makes the categorization of businesses by type more simple, which aids in the analysis of the data. In addition, the use of a survey of business owners supports the business category findings by collecting data from those who know firsthand how the bypass affected business in their community. The research conducted in Kansas and Oklahoma shows alternative methodologies that could be implemented under various conditions.

3.4 Policy State of the Practice/Survey

Several states were contacted for information pertaining to bypass policies and guidelines. The few responders reported that their transportation department policies towards bypasses include anything from the bypass policy in Oregon's its highway plan to the policies of other states that have no guidelines and say that bypass building depends on the project. For the purposes of this report, the following three states were selected because of their attempts at bypass policy: Iowa, Wisconsin, and Oregon.

The State of Iowa does not have an official bypass policy. An effort was made in 2002 to enact a bypass policy, but the draft lost support when it was sent to committee at the state house. The Associate Director for the Office of Location and Environment with the Iowa DOT provided a copy of the remaining document, titled "Things to Consider in the Evaluation of the Need for a Bypass." This document gives a brief summary of highway characteristics to consider when deciding whether or not to build a bypass. The characteristics include highway classification, corridor design/access control, amount of through traffic (including percentage of trucks),, land use plans, cost, and potential environmental project stoppers. In addition, the document contains a series of "pre-location study" questions about the anticipated characteristics of the bypass.

In lieu of a bypass policy, the Iowa Primary Road Access Management Policy addresses a major problem with bypasses: access locations, type, and number. This policy was developed, "Regulation and overall control of highway access are necessary to provide efficient and safe highway operation and to utilize the full potential of the highway investment." Should bypass specific policy become necessary the access management policy could be integrated into such a policy. Understanding the Iowa DOT's definition of highway priorities is important when planning a bypass because of the need for access by communities, industry, agriculture, and local road access. (Iowa Primary Road Access Management Policy 2005)

WisDOT is also without a bypass policy although its *Transportation and Land Use Coordination Report* (2002) states the following:

> A policy is needed on when bypasses should be planned, designed, and ultimately built as freeways so they do not eventually become congested urban arterials…In some cases, bypasses around bypasses are needed to resolve the situation a second time. Building bypasses as freeways preserves the regional and state transportation function of the highway. A bypass policy should include clearer definitions of types of bypasses. The need for exceptions should be considered in policy development. (WisDOT 2002)

The main issue being addressed is the controlling of access to the bypass. Past experience in Wisconsin has shown that without proper access controls in place a bypass can become congested, possibly re-creating what the bypass was originally built to alleviate.

Lastly, the policy is meant to establish a statewide definition of what a bypass is and include planning, design, and access management procedures. At the time the *Transportation and Land Use Coordination Report* was published, definitions and procedures varied by WisDOT district.

The State of Oregon added bypass policy to its highway plan in 2003. This policy identifies the need for a bypass to be associated with issues related to growing congestion and safety problems. The policy identifies regional through travel as being best served by limited access facilities that allow higher speeds and infrequent stops.

Oregon bypass policy objectives are the following:

1. Maintain and enhance utility of the state highway investment
2. Assure land uses are consistent and compatible with Oregon statewide land use goals
3. Identify the appropriate function of bypasses in the transportation system
4. Guide long-term operation of bypasses through agreement on land use and transportation management actions

The Oregon Department of Transportation (ODOT) analysis on existing bypasses in Oregon showed that bypasses function well for regional and statewide traffic where land use plans are compatible with the through function of the bypasses and where access to the bypass has been tightly controlled. Therefore, ODOT feels that bypass planning requires local and state policy coordination involving land use, local street patterns, access control, design characteristics, and other items. Long-term local planning and zoning must support the function of the bypass, and ODOT requires that land development patterns in the vicinity of the bypass not feature street network patterns that will cause reliance on the bypass for local trips. In addition, connections to the bypass must be agreed on by ODOT and the local governments.

Similar to Wisconsin policy, Oregon policy states the need for access control to avoid re-creating conditions on the highway that the bypass was designed to alleviate. ODOT has complete control of access rights on any bypass constructed after May 1951 and is the only government body that can grant access to bypasses from abutting properties.

Because bypasses and communities differ by case, ODOT has developed a check list of considerations rather than absolute criteria that can be applied on a case-by-case basis. The first step in the policy is the identification of bypass need. This need is established through analysis of local and through trips projected over at least a 20-year period. The analysis includes volumes and impacts of freight truck traffic, average trips on the bypass based on build out of the comprehensive land use plan, and crash data history on nearby or impacted facilities. Once the need is established, ODOT and local governments make joint agreements with respect to major bypass facility elements. These elements include interchange management plans, access management plans, master plans and/or interchange overlay zones for the bypass facility and its interchanges and intersections, local street circulation, compatible land uses, and bypass termini protection.

Section 2 of the policy covers the general character and planning for a new bypass. Action 1H.2 of the policy covers general character and planning for a new bypass. General character includes designing the bypass for moderate to high speeds at freeway or expressway standards for regional and statewide traffic. Planning covers the development of management plans for new and existing interchanges and interchanges replacing existing intersections. The section also includes a provision for management plans for intersections with medium- to high-volume roads that include timelines for grade separation should traffic volumes or safety considerations create the need for separation. Management plan refinement should be developed for bypass termination points to protect the mobility function of the bypass and should be adopted in the local transportation system plan and facility plans by the Oregon Transportation Commission.

Section 3 covers existing bypasses by breaking down general characteristics by design elements such as access management and interchange/intersections. In addition, this section covers specifications for access management and connections (made consistent with standards outlined in the1999 Oregon Highway Plan), interchanges/intersections (use grade separation and interchanges where possible and appropriate), local traffic circulation (build overpasses/underpasses that do not connect to the bypass), and medians (on multi-lane existing bypasses, install non-traversable medians beginning at well-designed intersections).

The planning segment covers consideration for developing management plans that outline the following:

- New and existing interchanges
- Intersections with medium- to high-road volumes that include timelines or other triggers for grade separation if connections are currently at grade and traffic volumes or safety considerations warrant such separation
- Refinement plans or management plans, when appropriate, for bypass termini with affected local governments to protect the mobility function of the bypass; these plans should be adopted in the local transportation system plan and as facility plans by the Oregon Transportation Commission
- Participation in the development review when development is seen as potentially impacting the bypass facility

Section 4 covers the criteria regarding funding for bypass projects that must be met before the Oregon Transportation Commission will authorize financial support. These criteria include the protection of the regional and statewide mobility function of the new bypass through the comprehensive plan and the development of ordinances that provide for local street connectivity in the vicinity of the bypass facilities. The following is a list of the funding criteria in Section 4:

1. Have acknowledged transportation system plan unless exempt from transportation system planning requirements, in which case the local comprehensive plan must address these policy provisions
2. Protect the regional and statewide mobility function of the new bypass through an applicable comprehensive plan, transportation system plan, and implementing ordinances
3. Consider re-planning and re-zoning properties that could have an adverse affect on the facility; this may included reducing the list of permitted and conditional uses that substantially impact the intersections and interchanges of the bypass
4. Develop ordinances that provide for local street connectivity in the vicinity of the bypass facilities, including provisions for parallel streets and limits on interrupted street networks that may cause reliance on the bypass facility for local trips
5. Limit approaches to the bypass to public street connections consistent with the interchange management plan
6. If necessary, finance the overall bypass project and/or its connections through monetary and/or “in kind” efforts and contributions such as moving and rebuilding utilities, providing right of way for and relocation of local streets and street accesses, constructing elements of the local transportation system plans needed to support the project, relocating affected facilities, participating in transit components for the project, and participating in the project as a tolled project
7. Negotiate jurisdictional transfer of the bypassed highway

ODOT does not require transfer of jurisdiction of a bypassed highway if the bypassed highway will continue to function as a state highway because the highway will carry a significant number of vehicle trips that do not originate or terminate in the bypassed city or cities.

Lastly, the ODOT policy discusses considerations for reinvestment in the bypasses. Such reinvestment includes actions to maintain acceptable mobility on the facility, bicycle and pedestrian amenities, signing, and other urban design features.

4. SAFETY ANALYSIS

The safety analysis portion of this research utilized various sources of information for Iowa cities with bypasses, including the Iowa DOT Office of Project Planning, previous studies, and consultation with various Iowa DOT staff members. An initial list of potential study sites was compiled from locations indicated through these sources. Once an initial list was compiled, historical paper maps were used to obtain or verify bypass completion years.

From the list of sites, sites whose start and end points were discernible and whose completion dates were after 1982 (the earliest date for which site crash data could be obtained) were retained. Sites not meeting these criteria were discarded. 50 sites were retained, with one further site being discarded after data were gathered due to an identified data gathering error, resulting in a final set of 49 sites. These sites are listed in Table 4.1 below. As noted in the table, 8 of these 49 bypasses were constructed relatively early on (completion years 1985 or earlier) and were used as control sites.

Table 4.1 Study Sites

Sioux City	New London	Nashua
Le Mars	Danville	Le Grand
Seney	Donnellson	Marshalltown
Alton	Blue Grass	Dubuque
Sheldon	Cascade	Otley
Ashton	Monticello	Duncombe
Storm Lake	Langworthy	
Pleasantville	New Hampton	Knoxville*
Prairie City	Waverly Charles City	Iowa City*
Monroe	Mason City/Nora Springs/Rudd	Waterloo*
Pella	Fort Dodge	Mount Joy*
Oskaloosa	Marion	Nevada*
Eddyville	Springville	Colo*
Batavia	Fostoria	State Center*
Mount Pleasant	Denver	Ames*
Swedesburg	Hospers	
Olds	Plainfield	* control sites

Site characteristics were determined through a variety of means. Initially, exclusive use of geographic information system (GIS)-based methods was considered, relying on the mapping available through Iowa's Geographic Information Management System (GIMS). This sole use of GIS was not possible for sites with completion dates prior to 1998, the earliest year for which electronic, mapped GIMS records are available. Therefore, paper Iowa Transportation Maps dating back through the study period were consulted to obtain plausible project extents. Once determined, the study areas were selected within the GIS to encompass the crash data along the sites in preparation for the process of parsing the data by site. Descriptive statistics (two charts) for each city are included in the appendix. The charts are provided to graphically illustrate the change in crashes and VMT over time. Examples are shown in Figure 4.1.

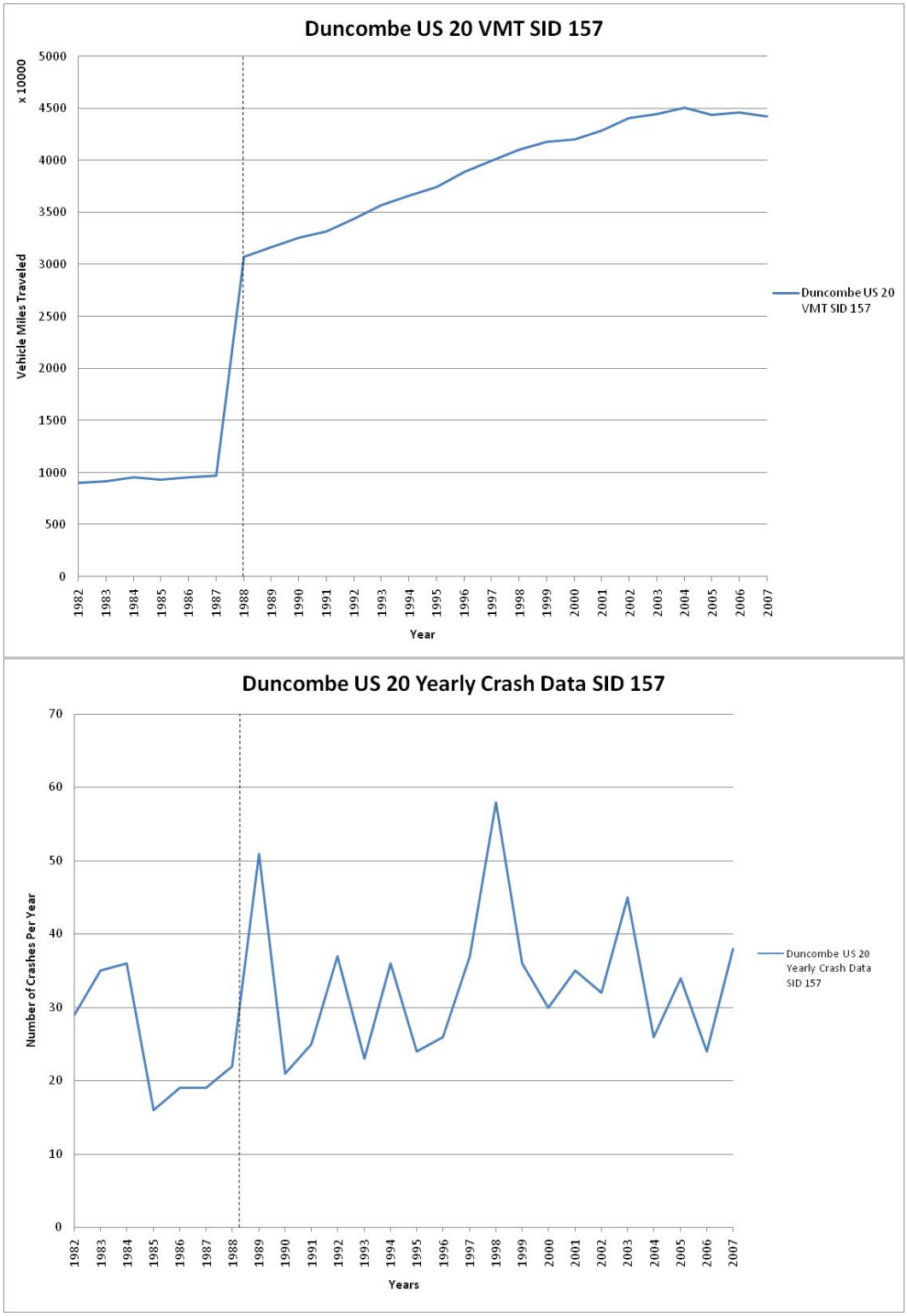

Figure 4.1 Duncombe VMT and Crashes over Time

SAS code written to summarize the data into the format desired for statistical operations was utilized. The final dataset included data for each site from 1982 through 2007 for most sites and 1984 to 2007 for a few sites for which the 1982 and 1983 data were not available. Each observation in the dataset represents one month of data, with the pertinent variables of site ID, crashes by month, fatal crashes by month, major injury crashes by month, Vehicle-Miles-Travelled (VMT) by month, crash rate by month included. See Table 4.2 below for data elements collected and considered in the analysis.

Table 4.2 Site Data

1. SID = site ID
2. County = county within which the site falls
3. Literal = city name
4. Type = type of facility as indicated by level of access from the local roads to the bypass - options are full, mixed, and at-grade
5. Route = routes impacted by each bypass
6. Length = length of the thru route in miles for the before situation and length of the thru route and bypass route for the after situation
7. Year = year for which the crash and road data are pertinent
8. CompYear = year which the bypass was existent for some portion of the year
9. Month = month for which the crash and road data are pertinent
10. Monum = month number
11. SiteAll = total frequency of crashes for the site during a particular month and year
12. StateAll = total frequency of crashes throughout the state for a particular year
13. AllRate = total crash rate for the site during a particular month and year
14. SiteFatal = frequency of fatal crashes for the site during a particular month and year
15. StateFatal = frequency of fatal crashes throughout the state for a particular year
16. FatalRate = fatal crash rate for the site during a particular month and year
17. SiteMajor = frequency of major crashes for the site during a particular month and year
18. StateMajor = frequency of major crashes throughout the state for a particular
19. MajorRate = major crash rate for the site during a particular month and year
20. SiteMinor = frequency of minor crashes for the site during a particular month and year
21. StateMinor = frequency of minor crashes throughout the state for a particular year
22. MinorRate = minor crash rate for the site during a particular month and year
23. MADT = monthly traffic during a particular month and year as determined by a combination of factors adjusting across years and adjusting to months
24. VMT (MVMT) = monthly vehicle-miles travelled during a particular month and year
25. VMTState = total VMT in the state for a particular year
26. MVMTState = millionvehicle-miles travelled in the state for a particular year
27. CIPOP1980, 1990, and 2000 = listed city populations for the respective city for years indicated
28. COPOP1990 and 2000 = listed county populations for the respective county for years indicated
29. Days = number of days in the respective month
30. Period = timeframe with “Before” indicating prior to the existence of the bypass and “After” indicating post the existence of the bypass

Three separate datasets were developed: one which combined the through and bypass road in the after situation, one which contains data related to just the through road, and one which contains data related to just the bypass road, which clearly only exists in the after situation. Statistical before and after analyses were then conducted for each site.

Results of statistical safety analysis indicate that, at least when crashes are separated by severity, bypasses with at-grade accesses appear to perform more poorly than either the bypasses with fully separated accesses or with a mix of at-grade and fully separated accesses. However, the benefit in terms of improved safety of bypasses with fully separated accesses relative to bypasses with a mixed type of accesses is not statistically conclusive.

5. SOCIAL AND ECONOMIC ANALYSIS

This chapter presents the results of the trade analysis, statistical analysis, and site visits for the four communities (and their control communities) in the study. Each section provides a summary of community and bypass characteristics to complement the trade analysis results.

5.1 New London

New London is a community of approximately 1,850 persons located in southeast Iowa 20 miles west of Burlington and 7 miles east of Mount Pleasant on U.S. Highway 34. The community was bypassed in 2000 with an expressway that features one interchange at about the mid-point of the bypass route and two at-grade intersections with the old highway route on the west and east sides of town. Annual average daily traffic (AADT) data gathered from the Iowa DOT shows AADT on old U.S. 34 was approximately 8,600 vehicles in the central business district (CBD). The next AADT study done was in 2002 and shows that the AADT on the old highway route in the CBD fell to 2,780. Local business and community leaders who were interviewed were happy with the reduction of traffic through the community because traffic on the old highway could be so heavy that a person or vehicle could not easily cross the road. The interview also revealed that a large portion of New London's population commutes outside the community for work. This is consistent with employment values from 2006 (Table 5.1) that show only 313 jobs available in the community.

Table 5.1 New London employment and business data (NAICS and SIC)

New London		
Year	**# Business establishments**	**Total employees**
1994	44	233
1995	45	272
1996	49	290
1997	53	354
1998	54	329
1999	56	354
2000	55	340
2001	50	315
2002	50	305
2003	49	274
2004	52	274
2005	49	285
2006	47	313

In comparison, the control community, Mediapolis, has much higher employment (Figure 5.2) and a smaller population than New London.

Table 5.2 Mediapolis employment and business data (NAICS and SIC)

	Mediapolis	
Year	**# Business establishments**	**Total employees**
1994	70	709
1995	67	804
1996	73	824
1997	71	781
1998	72	778
1999	68	912
2000	71	903
2001	74	931
2002	69	865
2003	68	655
2004	68	712
2005	72	999
2006	72	1115

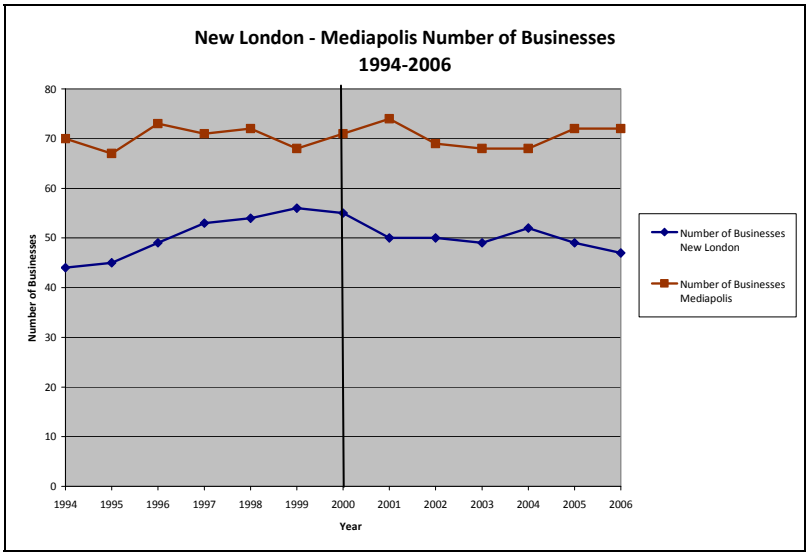

Figure 5.1 New London and Mediapolis business data (NAICS & SIC)

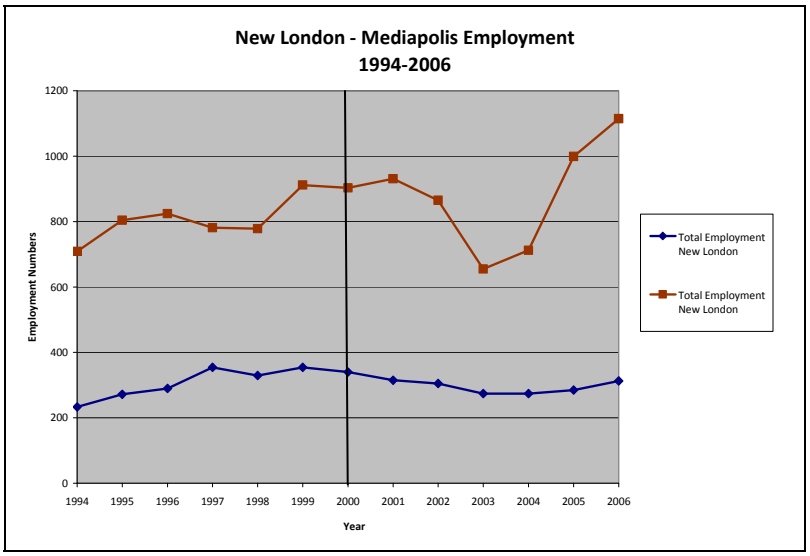

Figure 5.2 New London and Mediapolis employment data (NAICS and SIC)

Even though it may be possible that New London's trade leakage may be related to types of businesses and the number of jobs available in the community, the historical surplus and leakage analysis (Figure 5.3) shows that since 1990 New London has consistently experienced leakage. In the interview, one of the residents spoke about the loss of retail stores in New London in the 1970s and the continued loss through the 1980s during the farm crisis. The introduction of Wal-Mart to Mount Pleasant also contributed to the loss of retail options in New London.

The trade analysis of surplus and leakage from 1990 to 2007 (Figure 5.3) shows that New London is continuing a trend of trade leakage while Mediapolis has had a trade surplus nearly every year since 1995. After the opening of the U.S. 34 expressway, the community experienced increased trade leakage, but that could be related to the drop in employment numbers, shown in Table 5.1 and Table 5.2. The larger number of manufacturing, accommodation, and food businesses (Table 5.2) may be what makes Mediapolis's leakage less significant and may have led to the town's trade surplus in the 1990s. Jobs have rebounded in Mediapolis since 2003, and the community trade analysis is showing a return to a surplus.

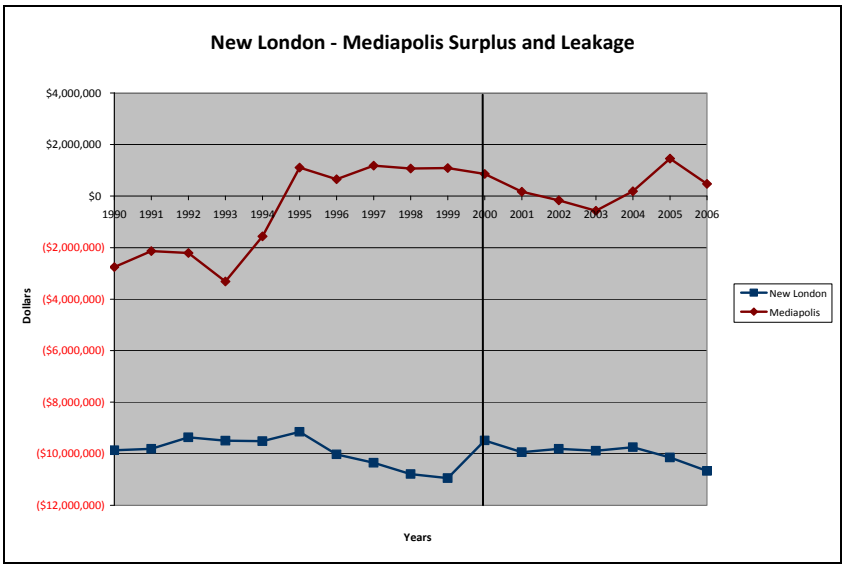

Figure 5.3 New London and Mediapolis trade surplus and leakage

Real and potential sales data show that New London is not capturing as much trade as it could based on its population and its per capita income. Figure 5.4 shows that New London's real sales are around $6,000,000, but potential sales could be greater than $16,000,000. Mediapolis, however, has real sales that are nearly at the potential sales level, meaning the residents are spending what they earn in the community. The paired samples t-test performed on real sales data for New London and Mediapolis shows that there is significant difference at the 99.9% confidence interval ($p < .001$) between the real sales of the two communities for all years and again for before and after the bypass opened. This finding supports the data shown in Figure 5.4 that indicate that New London real sales are much less than those in Mediapolis.

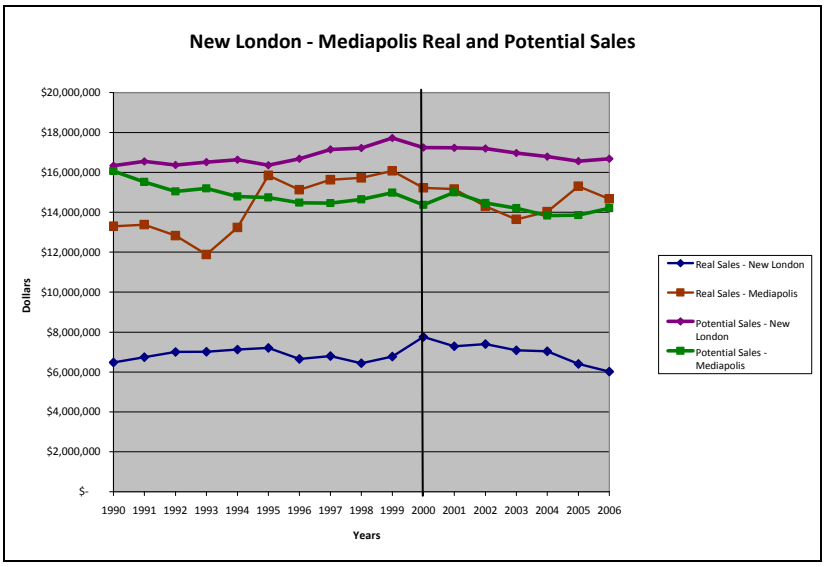

Figure 5.4 New London and Mediapolis real and potential sales data

Per capita income data are used to calculate potential sales and the surplus or leakage of a community. As Figure 0.5 shows, per capita income data for New London and Mediapolis are very similar, although both are less than the per capita income for the State of Iowa. Mediapolis's trade surplus could show that the community retains much more of its per capita income than New London does. The statistical analysis using the paired t-test shows that there is significant difference between the two communities at the 95% confidence interval ($p < .05$) before and after the bypass opened, as well as during the entire study period.

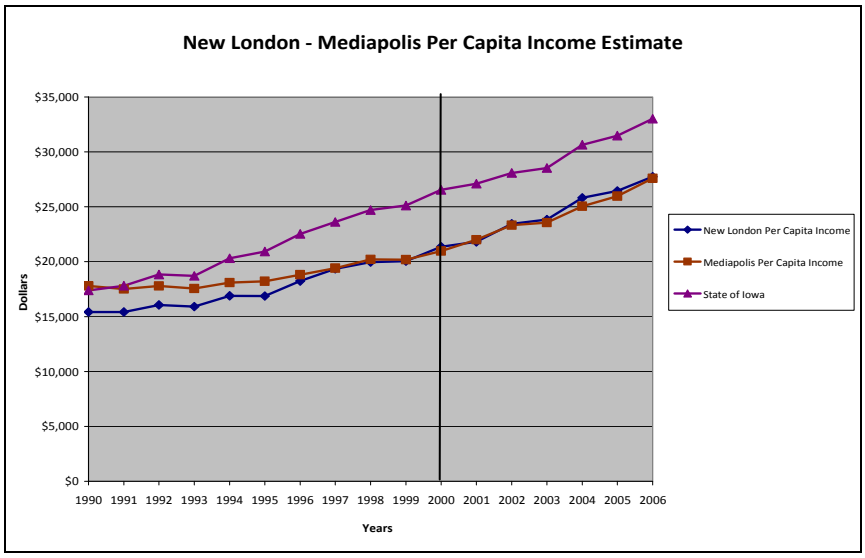

Figure 5.5 New London and Mediapolis per capita income

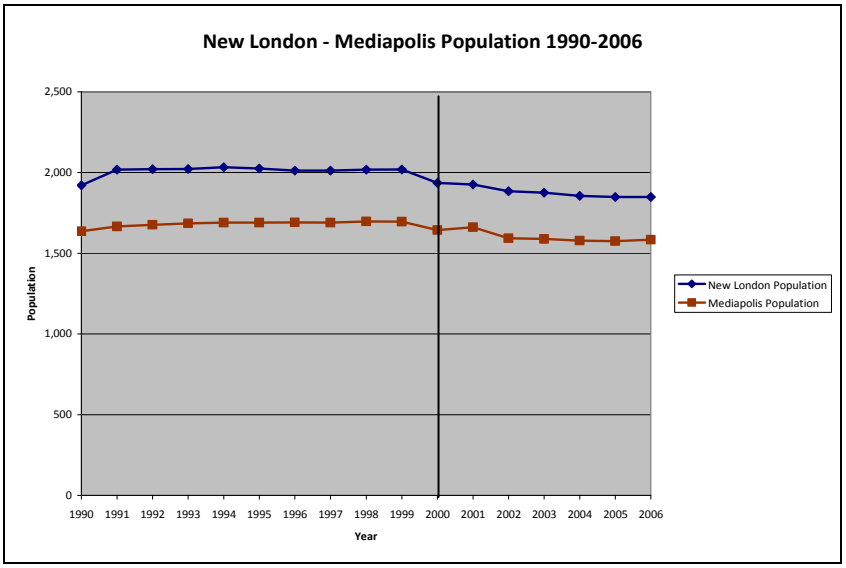

Figure 5.6 New London and Mediapolis population estimates (Iowa Data Center)

Population estimates from the Iowa Data Center for both communities show some loss during the study period, with a more pronounced loss the year before the bypass opened. Therefore, there are no visible effects, such as population loss or gain, associated with the bypass. This finding also shows that trade leakage or surplus for these communities are not caused by population changes. The paired t-test on population data supports the claim that there are significant differences in the two communities at a 99.9% confidence ($p < 0.001$) interval before and after the bypass opened and during the entire study period.

Sales per capita is the real sales divided by the population of the community; therefore, these data show that New London businesses do not generate many sales per number of people in the community, which results in greater leakage for the community. Results of the paired t-test show that for the entire study period and before and after the bypass opened there was significant difference between the two communities at a confidence level of 99.9% ($p < 0.001$).

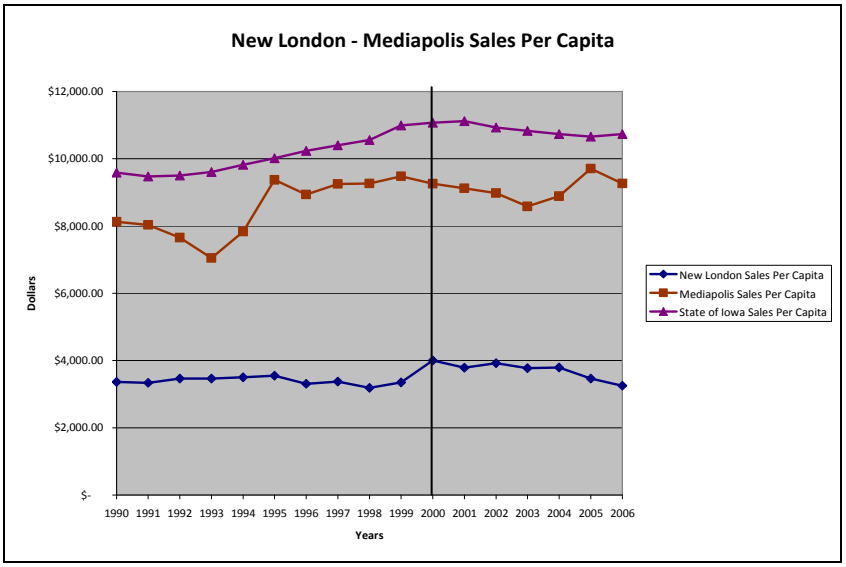

Figure 5.7 New London and Mediapolis—State of Iowa sales per capita

Commuting could also be a reason that the New London community consistently shows a leakage of potential sales dollars out of the community, as people may be spending their earnings in the community in which they work because of better shopping options or convenience. With an increase in trade leakage starting in 1999, possibly related to the highway bypass construction, the increasing trend continues through 2005. Increased incomes for New London residents could mean that more income money is being spent elsewhere, and a reduced population is a contributing factor. In combination with a large commuting population, leakage can be expected. Mediapolis has seen a fall in population as well, but trade leakage may be offset by per capita incomes and a greater number of jobs and businesses available in the community.

The interviews with residents, business owners, and town leaders revealed that New London residents find the town much more enjoyable due to the reduced amount of traffic going through town. Together, the group agrees that they would like to have the convenience of retail stores in their community; however, they do enjoy the improved quality of life and safety in the community that the bypass has provided.

A site visit to Mediapolis showed that a possible reason the city retains trade dollars is that the community is not near any other communities. In addition, U.S. Highway 61 goes through the western edge of the community instead of through the middle, and the centralized location of the CBD may cause residents to feel better about shopping in the community because of safety or mobility factors.

In conclusion, New London's significant trade leakage appears to be related to a declining population, a low number of businesses, and few employment opportunities within those businesses. The interviews provided insight on how many residents commute to other locations for work. However, without any quantitative evidence, it is hard to determine if commuting patterns have an effect on the economy. With the available data and trade analysis results, it appears that the bypass and expressway have had some negative impacts on the economy of New London. Statistical results show that per capita income in New London may have increased due to the bypass, but graphically the data show that New London's per capita income grew faster than Mediapolis' income between 1995 and 1998 and has followed the same growth rate from 1998 to 2006.

5.2 Olds

Olds is a small town of about 250 persons located nine miles north of Mount Pleasant along U.S. Highway 218/Iowa Highway 27 at the intersection with Iowa Highway 78. The community was bypassed by an expressway in 1999 as part of the Avenue of the Saints project and features one at-grade crossing for access into the town. Iowa Highway 78 still follows the old US 218 route through town and has an AADT of 730 vehicles. This is an enormous drop from the last AADT study that was conducted in 1990 (no counts conducted in 1994 or 1998) that showed AADT on U.S. 218/IA 27 at 6,600 vehicles going though the center of the community. The control city of Brighton saw an increase in AADT on IA 78 from 1,980 vehicles in 1998 to 3,560 vehicles in 2002. This could be attributed to the construction along U.S. 34 and/or U.S. 218 between 1998 and 2007.

The data for Olds and its control community of Brighton regarding the number of businesses in each community and the number of persons employed by the businesses for the years 1994–2006 were gathered from North American Industry Classification System (NAICS) and Standard Industrial Classification (SICs) on the census.gov website. As of 2006, neither community has any manufacturing or businesses in food or accommodations (Tables 5.3 and 5.1), with Olds having only one business that generates retail sales, compared to Brighton, which has four.

Table 5.3 Olds employment and business data (NAICS and SIC)

	Olds	
Year	**# Business establishments**	**Total employees**
1994	11	79
1995	11	80
1996	10	51
1997	7	58
1998	8	52
1999	5	63
2000	7	90
2001	6	88
2002	6	85
2003	6	78
2004	6	80
2005	7	74
2006	7	67

Table 5.4 Brighton employment and business data (NAICS and SIC)

	Brighton	
Year	**# Business establishments**	**Total employees**
1994	24	52
1995	25	72
1996	23	81
1997	23	71
1998	23	75
1999	30	78
2000	27	82
2001	25	94
2002	23	107
2003	23	85
2004	20	122
2005	19	122
2006	17	88

Figure 5.8 shows that Olds has been able to maintain a steady number of business establishments from 1994 to 2006. Brighton has seen a fall in the number of establishments; however, employment rose from 1997 to 2002 and then from 2003 to 2004. Olds did see a rise in the employment number from 1998 to 2000, but the town has experienced a downward trend since 2000.

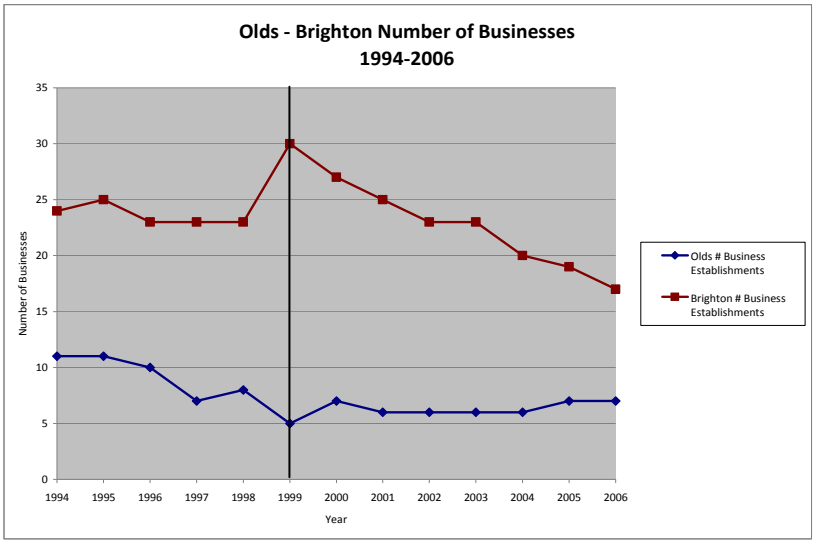

Figure 5.8 Olds and Brighton business data (NAICS and SIC)

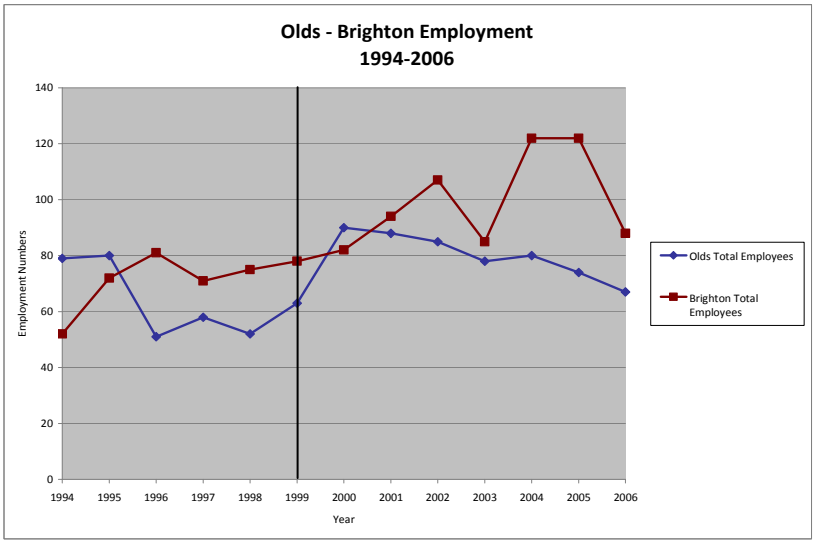

Figure 5.9 Olds and Brighton employment (NAICS and SIC)

Figure 5.10 shows that Olds had been able to capture its local trade dollars and essentially "break even" between 1990 and 1996. In 1997, trade leakage became apparent, with an increase in leakage through 2000 (one year after the bypass opened). The community returned to a surplus in 2002 but saw increased leakage in recent years. Brighton, on the other hand, has not shown any surpluses and experienced a pretty significant trade leakage. Brighton's large increase in trade leakage between 1999 and 2000 continued to increase into 2006, but at a slower rate.

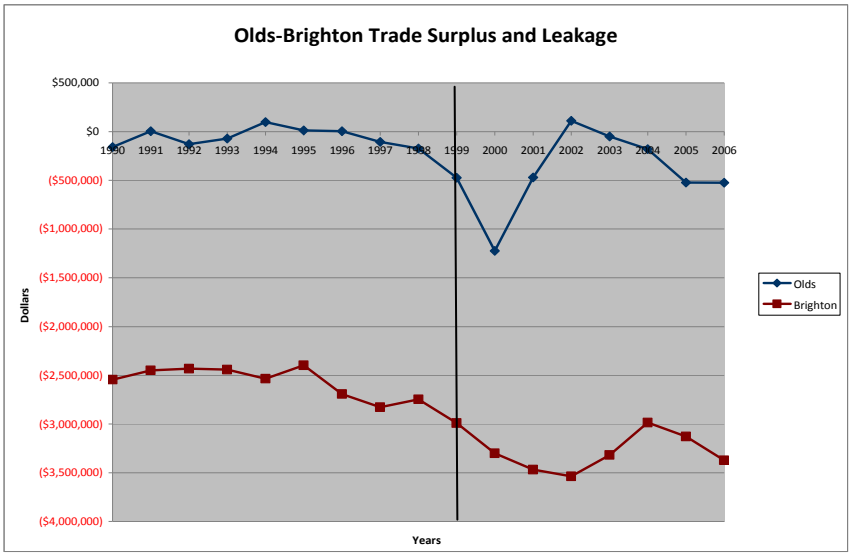

Figure 5.10 Olds and Brighton trade surplus and leakage

Real and potential sales data show that Brighton has a very large gap between potential and real sales (Figure 5.11), while Olds has had real sales comparable to its potential sales over most of the study period, except in 2000. It is evident that the trade leakage in 2000 follows the drop in real sales in 2000. Figure 5.11 shows that Brighton has estimated potential sales of just above $5,000,000, but real sales are just above $2,000,000. The differences in real sales have been statistically significant over the study period. However, this difference has become less significant after the opening of the bypass. Specifically, the paired t-test shows significant difference at the 99.9% ($p < .001$) confidence interval for the overall period and before the bypass opened, while there is significant difference at the 95% ($p < .05$) confidence interval after the bypass opened.

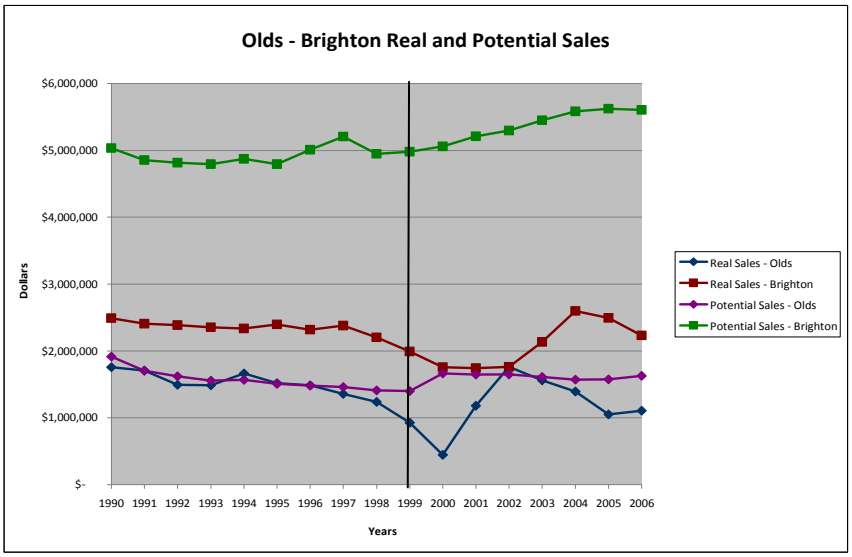

Figure 5.11 Olds and Brighton real and potential sales

Figure 5.12 shows that per capita income for both communities leveled out in the years leading to the bypass opening, but has had an upward trend through the end of the study period. In calculating the estimated per capita incomes between 1990 and 1999, the income growth for the community was actually negative compared to the growth of the county per capita income. Paired t-tests show that the per capita incomes are very similar over the entire study period.

However, Figure 5.12 shows that the per capita incomes were similar between 1996 and 1999, but before 1996 Olds per capita income exceeded that of Brighton, and after 1999 Brighton's per capita income exceeded that of Olds. This is reflected in the paired t-test, with differences being more significant after the bypass was built. Specifically, the paired t-test shows that for the overall period there is no significant difference ($p = .489$) between Olds and Brighton; however, before the bypass opened and after the bypass opened, the results show significant difference at the 95% confidence interval ($p < .05$).

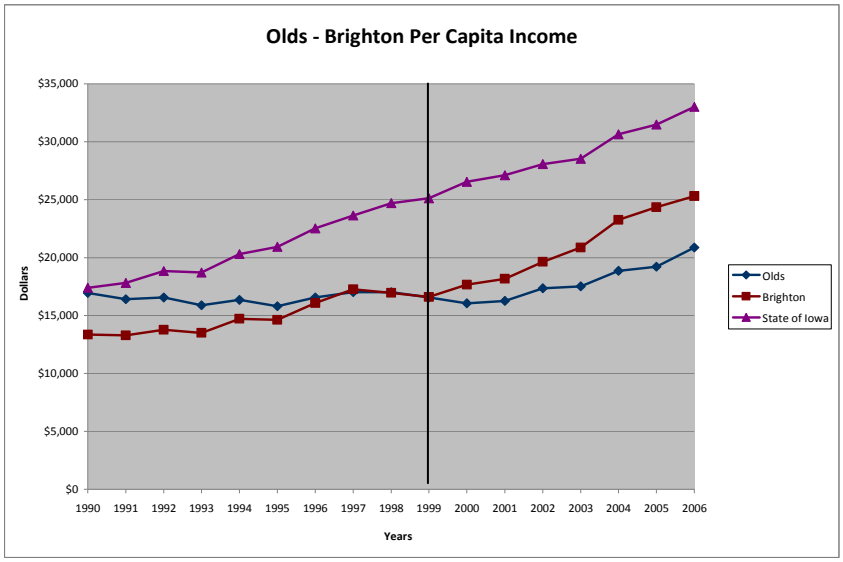

Figure 5.12 Olds and Brighton per capita income

The population estimates from the Iowa Data Center show that both communities have maintained steady population (Figure 5.13), with Olds showing some growth the year after the bypass. Results of the statistical test of the populations of the communities show that there are significant differences between the communities at a 99.9% confidence interval ($p < .001$) for the overall study period and before and after the bypass opened.

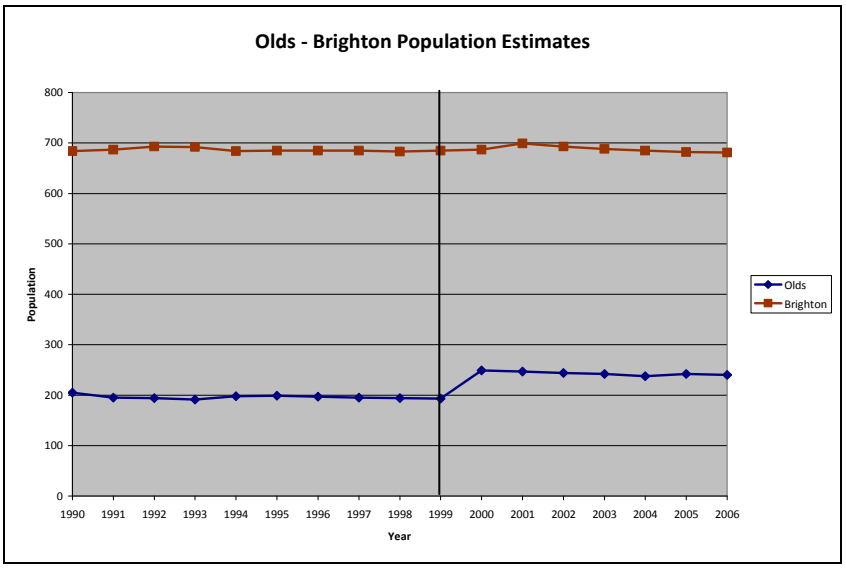

Figure 5.13 Olds and Brighton population estimates (Iowa Data Center)

The sales per capita data show declining real sales for Olds between 1997 and 2000, while Brighton has maintained a steady sales per capita trend, with some increased spending in 2004. The paired t-test shows that there is a significant difference in sales per capita between the two communities, with a more significant difference prior to the bypass opening in 1999. The statistical analysis shows that for the overall period and for the period before the bypass opened, there was a significant difference at 99.9% ($p < .001$) confidence interval. The period after the bypass opened saw significant difference at the 95% confidence interval ($p < .05$).

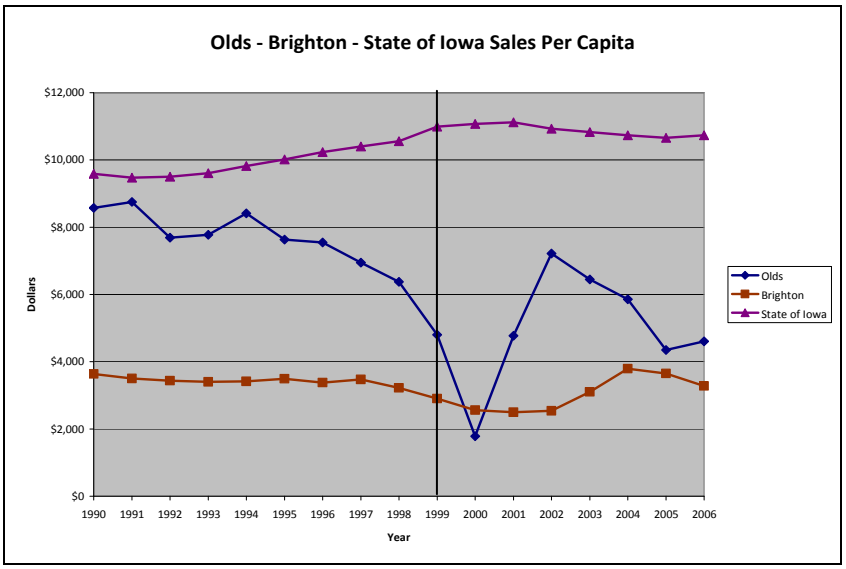

Figure 5.14 Olds and Brighton–State of Iowa Sales Per Capita

Graphically, the trade surplus and leakage data appear to show that the bypass had caused a trade leakage in Olds for the years leading up to and after the bypass opened. With few changes in the overall period in the number of businesses and employment, per capita income, and a small increase in population, the reason for increased leakage from 1996 to 2000 cannot be identified through trade analysis.

Because of the town's small population, it was difficult to find a large number of residents to interview to discuss how the bypass has affected Olds. Instead, a one-on-one interview was conducted with the city clerk, who has been a resident since the 1960s. The city clerk agreed that the central business district has not changed in years as far as the number of businesses. The town had historically been a local center for banking and agriculture-related businesses. After the bypass, the gas station that was in town went out of business; however, a new station was built along the expressway. The local eatery had closed a couple of years before the expressway was completed, but the city clerk did not attribute that so much to the bypass as he did to the restaurant's management. The city clerk also pointed out that there is talk of the arrival of some light industrial development near Olds.

As with other bypassed communities, the city clerk felt that the biggest change has not been economic, but increased quality of life due to the reduced amount of traffic coming through town. Although IA 78 and the grain elevator do still bring trucks through town, the town is much quieter with the majority of traffic routed east of town.

5.3 Denver

The community of Denver, Iowa, is located in northeast Iowa, 10 miles north of Waterloo, and is home to about 1,600 residents. This community was bypassed by a U.S. 63 expressway project from Waterloo to Denver that was completed in 1996 and ended at the north end of Denver. The expressway was bypassed around the west side of the town and features one interchange near the center of town and at-grade crossings on each end of town. For comparison purposes, trade data gathered about Denver were also gathered for the community of Tripoli, which is located on Iowa Highway 93 about 14 miles northeast of Denver.

A site visit to Denver revealed that the bypass is in close proximity to the community's business district. The mayor of Denver partially attributes the city's strong economy to the proximity of the CBD to the highway bypass, which makes it easy for travelers who are on the bypass to stop into town quickly for purchases such as gas or food. The Iowa Highways Page website shows that the expressway between Waterloo and Denver was opened in 1991 (Hancock 2008), which may have led to increased traffic to the community and perhaps attracted business from a larger area. Average annual daily traffic in the Denver CBD on U.S. 63 dropped from 8,600 in 1993 to 3,730 in 1997, while the community of Tripoli experienced a small drop in its AADT numbers between 1993 and 1997.

Employment and business data show that Denver has a good base of jobs in the community with 535 jobs in a community of 1,600 persons. The NAICS and SIC data, shown in Table 5.5, show that, although the total number of business establishments has decreased from 2004 to 2006, the community still has over 70 businesses.

Table 5.5 Denver employment and business data (NAICS and SIC)

	Denver	
Year	**# Business establishments**	**Total employees**
1994	73	477
1995	80	499
1996	77	538
1997	79	543
1998	73	511
1999	76	503
2000	78	503
2001	77	509
2002	81	502
2003	71	513
2004	77	559
2005	73	491
2006	72	535

Table 5.6 Tripoli employment and business data (NAICS and SIC)

	Tripoli	
Year	**# Business establishments**	**Total employees**
1994	45	237
1995	46	244
1996	45	248
1997	45	246
1998	46	262
1999	44	225
2000	46	230
2001	37	226
2002	35	208
2003	35	199
2004	34	181
2005	36	185
2006	32	194

The comparison of the two communities by number of business establishments and total number of persons employed in each community (Figures 5.15 and 5.16) shows small fluctuations after the bypass was constructed in 1994, with Tripoli showing a steady loss of both businesses and employment.

Unfortunately, data pertaining to years prior to bypass/expressway construction were not available from any of the study's data sources (State of Iowa, NAICS, SIC, or the Iowa Data Center).

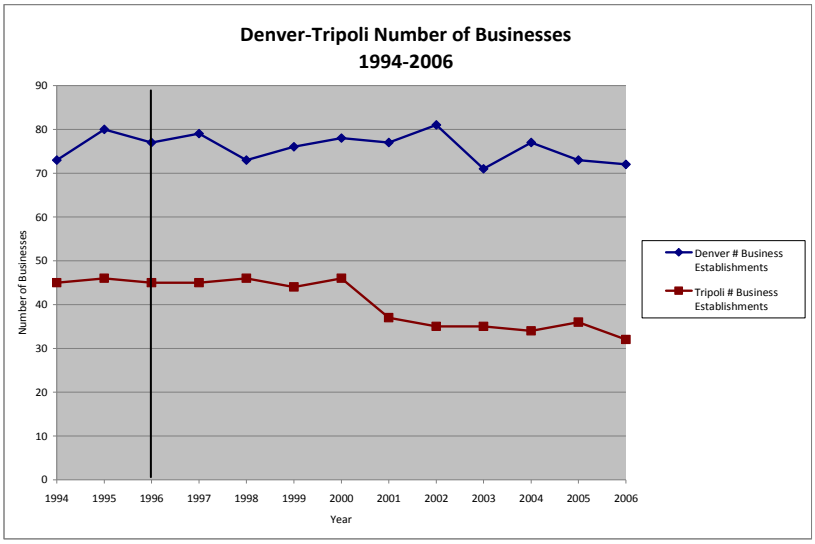

Figure 5.15 Denver and Tripoli number of businesses (NAICS and SIC)

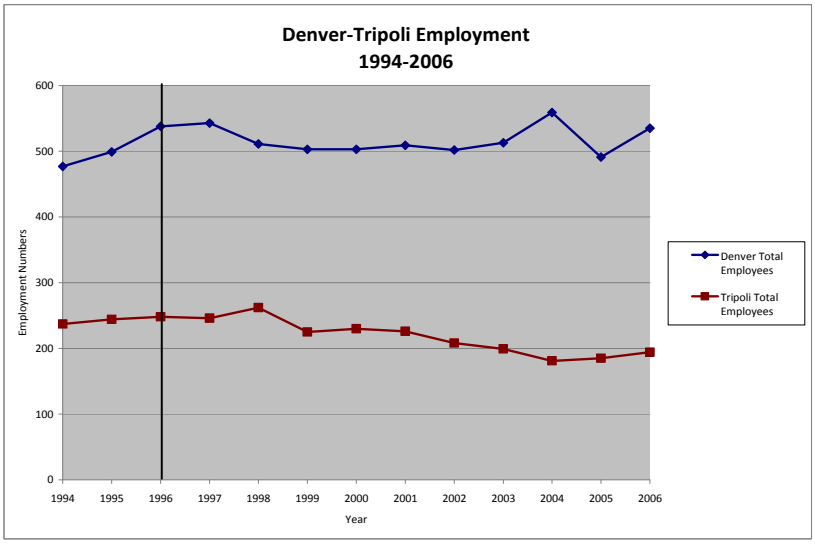

Figure 5.16 Denver and Tripoli employment numbers (NAICS and SIC)

Commuting data were available from the Iowa Data Center for 1990 and 2000 (Figure 5.17) showing that commuting increased between 1990 and 2000 in both communities. Residents commuting to other communities to work may contribute to trade leakage in Denver and Tripoli.

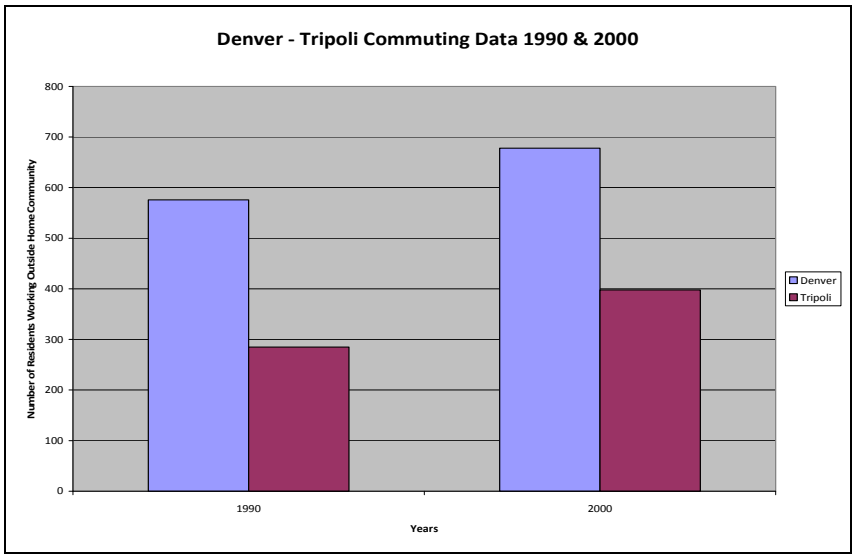

Figure 5.17 Denver and Tripoli commuting 1990 vs. 2000

The results of the surplus and leakage analysis for Denver and Tripoli are shown in Figure 5.18. The graph shows that, before the opening of the bypass and expressway in 1994, Denver was capturing more of its potential sales dollars. However, after 2000 the trend reversed and Denver experienced more sales leaving the community.

In comparison, the surplus and leakage data for Tripoli has been more unstable, showing increased leakage of dollars out of the community in 1993, a surplus for one year in 1994, and then back to a trend where the community was capturing more trade but still not meeting its potential sales.

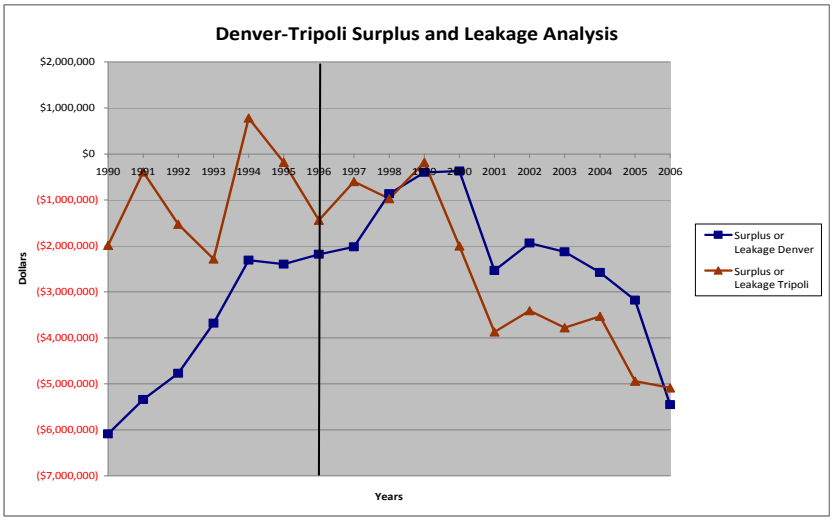

Figure 5.18 Denver and Tripoli trade surplus and leakage

The surplus and leakage is calculated from community real sales and potential sales. Figure 5.19 shows the real sales and potential sales for the communities of Denver and Tripoli to support the surplus and leakage analysis. Both communities show increasing potential sales from around 2000 through 2006, but falling real sales. Real sales analysis using the paired t-test shows that at the 99.9% confidence interval there is significant difference ($p < .001$) in real sales between the two communities for the overall study period and after the bypass opened. Before the bypass opened, there was significant difference at a 95 % confidence interval ($p < .05$)

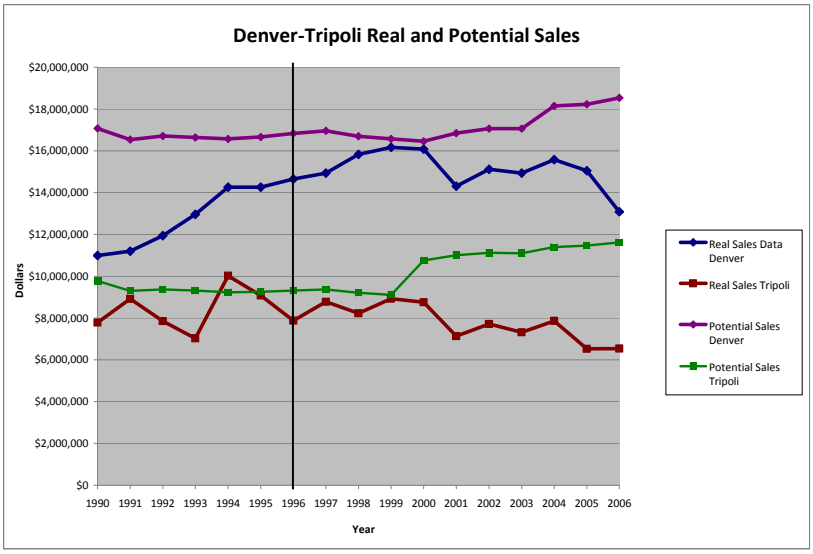

Figure 5.19 Denver and Tripoli real and potential sales

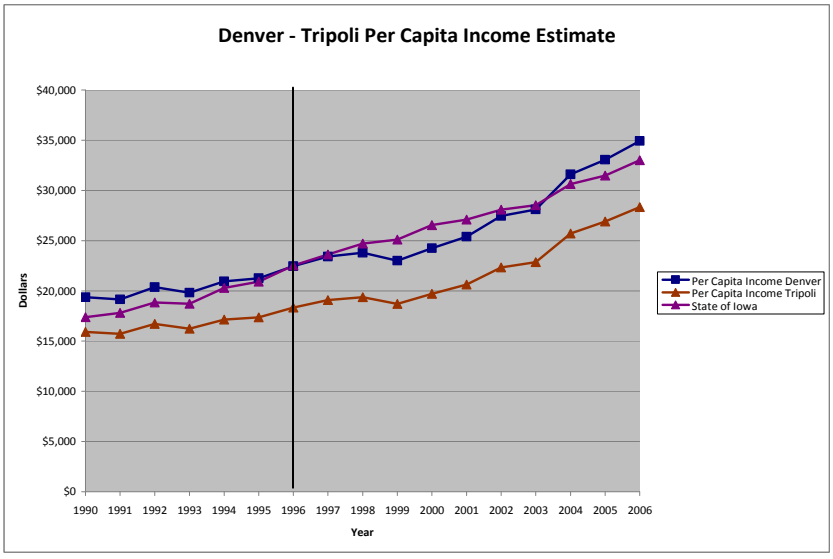

Figure 5.20 Denver and Tripoli per capita income

Per capita incomes for both communities (Figure 5.20) have shown consistent growth over the study period. In addition, the trends are much more consistent with the state of Iowa as a whole. The statistical analysis results show that there are significant differences between the communities for the entire study period and before and after the bypass opened at a 99.9% confidence interval ($p < 0.001$).

The population of Denver was stable (around 1,600) during the analysis period, while Tripoli experienced some population growth in the same period. Paired t-test results show the population is significantly different ($p < .001$) before the bypass, after the bypass, and overall at 99.9% confidence.

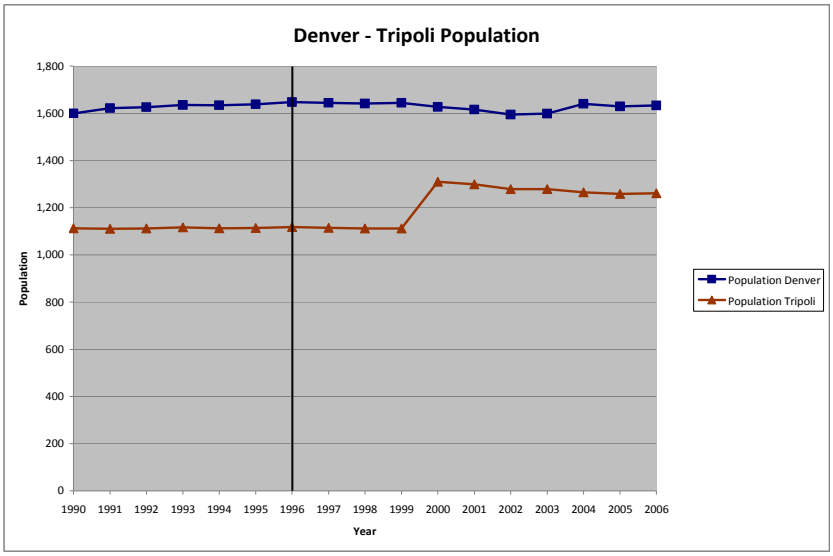

Figure 5.21 Denver and Tripoli population estimates (Iowa Data Center)

The two communities are showing decreased sales per capita in recent years, with Tripoli showing a greater decline. This information shows that increased spending per person on a statewide average and less spending in these communities is creating the greatest amount of leakage of trade in the two communities. The statistical analysis of the sales per capita results shows a significant difference ($p < .001$) at a 99.9% confidence interval after the bypass opened and for the study period, but the communities were not significantly different before the bypass.

The site visit to Denver and Tripoli took place in 2007 and included a group interview of community and business leaders in Denver. From the interview, it was found that during bypass construction some shops did close; however, no one believed the closings to be a result of the bypass. Speculation about the opening of a Hy-Vee grocery store along U.S. 63 on the north side of Waterloo concerned the group because of the potential loss of business to Denver's grocery store.

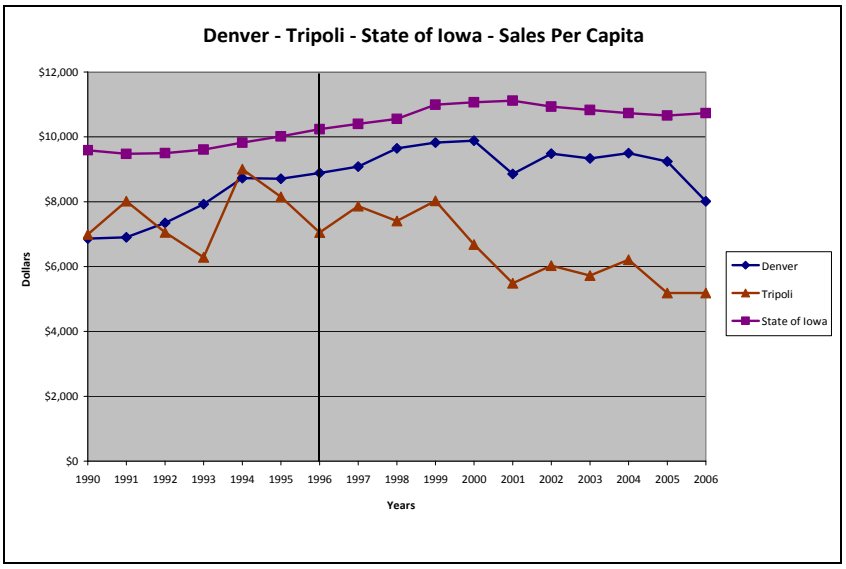

Figure 5.22 Denver and Tripoli–State of Iowa sales per capita

Denver stands out from the other communities in this report because it has a land use and comprehensive plan (which includes the bypass) to provide guidance on the city's growth and development decisions. The mayor feels strongly that the comprehensive plan has contributed to successes in the community and is important for accommodating future growth. The mayor also believes that the location of the bypass very close to the community has helped attract business to the CBD. Overall, the interview group believes that the Land Use and Comprehensive Plan, and a solid base of volunteers involved in community projects have combined to positively shape their community. They also feel that the quality of life has increased substantially due to the bypass diverting highway traffic from the main street.

From the information gathered from the group and the data analysis, it is possible that the bypass and expressway have impacted the economy of Denver. However, those interviewed feel that the impacts have been positive, while the analysis shows that the community is losing trade revenue. Because of the convenience of the U.S. 63 expressway and proximity to Waterloo and Cedar Falls, residents may indeed be spending their money in the larger cities because of retail options.

The trade analysis shows that trade leakage in Denver increased after the bypass opened. In addition, the statistical results show an increase in the t-ratio of the paired t-test for real sales and sales per capita from before and after the bypass completion, meaning that the difference between the two communities became more significant after the bypass. However, per capita income and population show a t-ratio that was lower before the bypass compared to after the bypass, though the difference was still significant.

5.4 Blue Grass

Blue Grass, Iowa, is a community of about 1,300 people that is located west of Davenport along U.S. Highway 61 and that was bypassed by an expressway in 2001. The bypass features two interchanges at each end of the community and is part of the U.S. 61 expressway between Davenport and Muscatine. Blue Grass and its control community of Buffalo are located closer to a large city than any of the other communities in this research, which may have a bearing on the results. AADT in Blue Grass decreased from 9,500 in 1998 to 2,330 in 2002. The traffic on U.S. 61 between Blue Grass and Davenport increased from 10,600 AADT in 2002 to 13,400 AADT in 2006. Interestingly, the AADT of IA 22 in the CBD of Buffalo fell from 6,200 in 1998 to 4,640 in 2002. This may suggest that commuters who once used IA 22 to reach Davenport began using the U.S. 61 expressway after construction of the bypass.

The NAICS and SIC data for the communities (Tables 5.7 and 5.8) show that there are some businesses in Blue Grass and Buffalo, including manufacturing plants.

Table 5.7 Blue Grass employment and business data (NAICS and SIC)

	Blue Grass	
Year	**# Business establishments**	**Total employees**
1994	69	404
1995	70	436
1996	77	511
1997	78	592
1998	80	523
1999	81	529
2000	85	535
2001	74	524
2002	75	478
2003	71	505
2004	78	518
2005	80	521
2006	76	546

Table 5.8 Buffalo employment and business data (NAICS and SIC)

	Buffalo	
Year	**# Business establishments**	**Total employees**
1994	24	342
1995	21	351
1996	21	396
1997	25	378
1998	27	425
1999	27	474
2000	29	512
2001	30	452
2002	21	265
2003	21	266
2004	23	318
2005	29	369
2006	28	344

Figure 5.23 shows that the number of businesses was stable for both communities from 1994 to 2006. However, Figure 5.24 shows that after the bypass was completed total employment in Blue Grass fluctuated but stayed above 500, while Buffalo saw a sharp decrease but has gained employment in recent years.

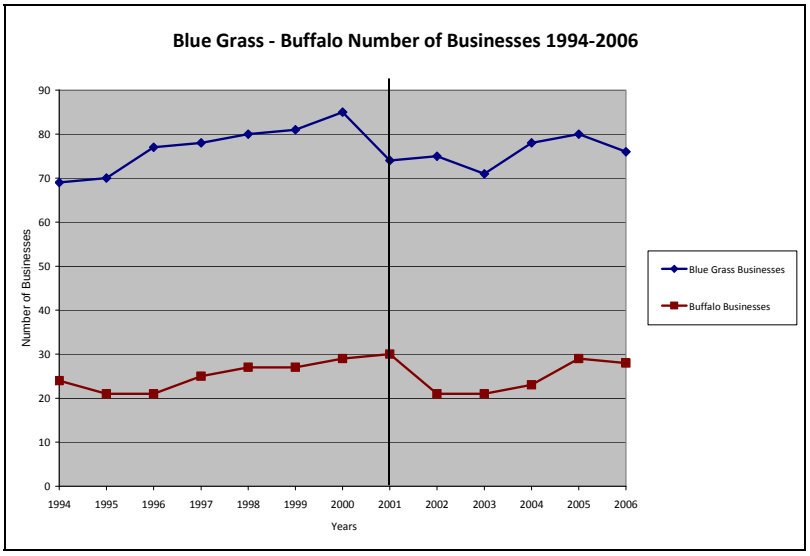

Figure 5.23 Blue Grass and Buffalo number of businesses (NAICS and SIC)

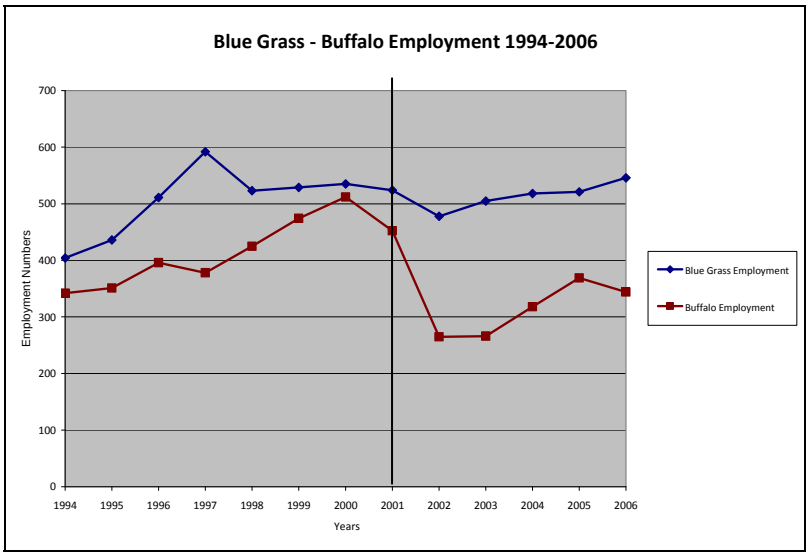

Figure 5.24 Blue Grass and Buffalo employment (NAICS and SIC)

The surplus and leakage analysis for these two communities shows that Buffalo has had surplus trade for many of the years in this study period, while Blue Grass experienced leakages for all years. Both communities show trade leakage for 2001, the year the bypass opened.

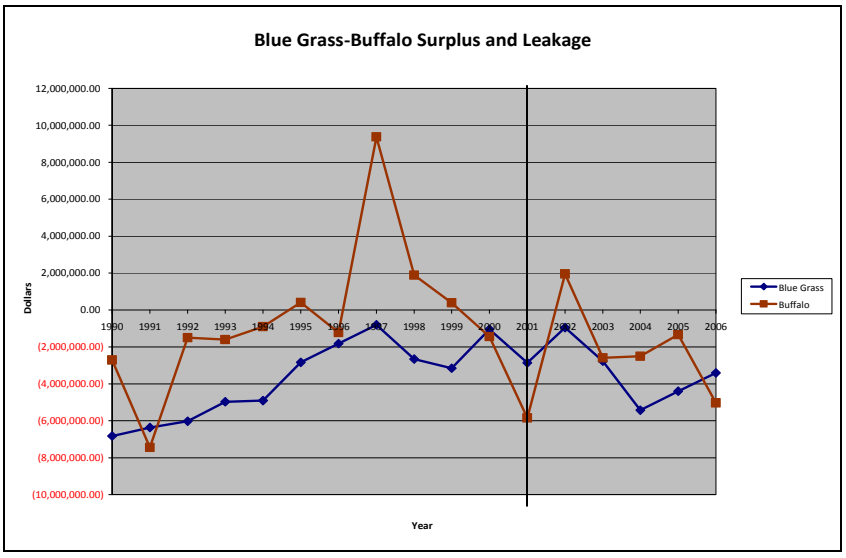

Figure 5.25 Blue Grass and Buffalo trade surplus and leakage

Figure 5.26 shows that over the study period Blue Grass real sales have never met their estimated potential sales. Real sales in Buffalo, in this same period, have met or exceeded potential sales for some years while not meeting potential sales in other years. Statistical analysis shows that the differences in real sales between Blue Grass and Buffalo were not significant at the 90% confidence interval ($p > .1$) before the bypass, after the bypass, and during the overall period. To understand these trends, per capita income, population, and state sales per capita must again be further investigated.

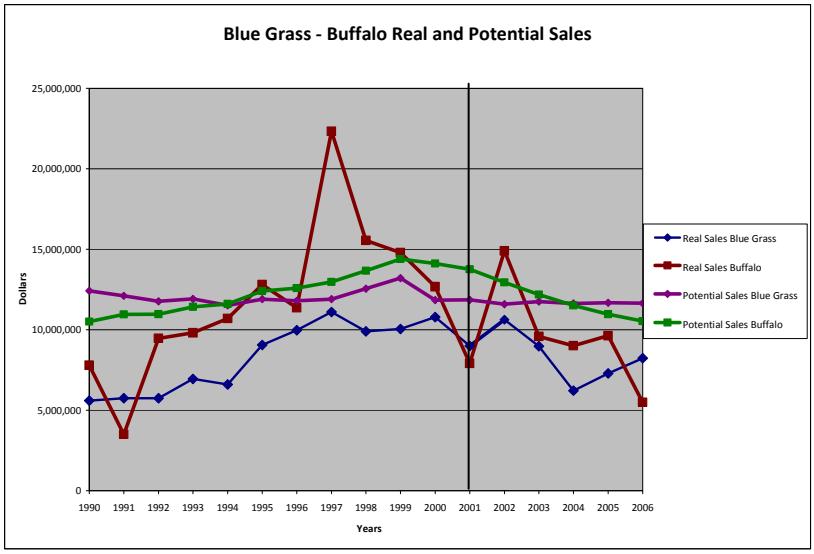

Figure 5.26 Blue Grass and Buffalo real and potential sales

Per capita income data displayed in Figure 5.27 show that income growth in both communities appears to have kept pace with the State of Iowa over the study period. For the overall period and the period before the bypass, paired t-tests results showed significant differences at a 95% confidence interval ($p < .05$). After the bypass was completed, the paired t-test resulted in no significant difference at a 90% confidence interval ($p > .1$) between the two communities.

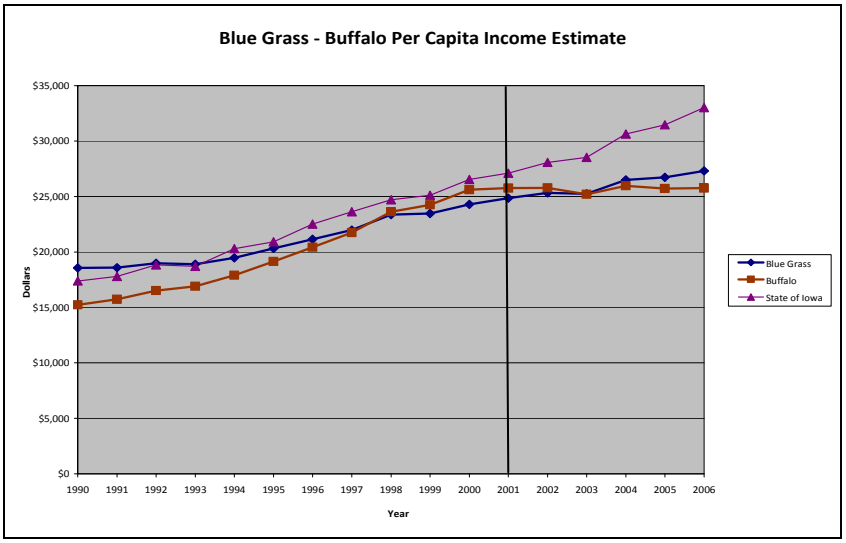

Figure 5.27 Blue Grass and Buffalo per capita income

The population of Blue Grass has dropped between 1999 and 2001, which corresponds to low employment numbers in the NAICS & SIC data, but employment was rebounding from 2002 to2006. Buffalo has seen a gradual decline in population since 1998, and it is not known why this occurred.

The paired t-test also shows that there was a significant difference in population for the two communities before the bypass and for the overall study period at a 99.9% confidence interval ($p < .001$). After the bypass, the population difference was not significant ($p = .2913$).

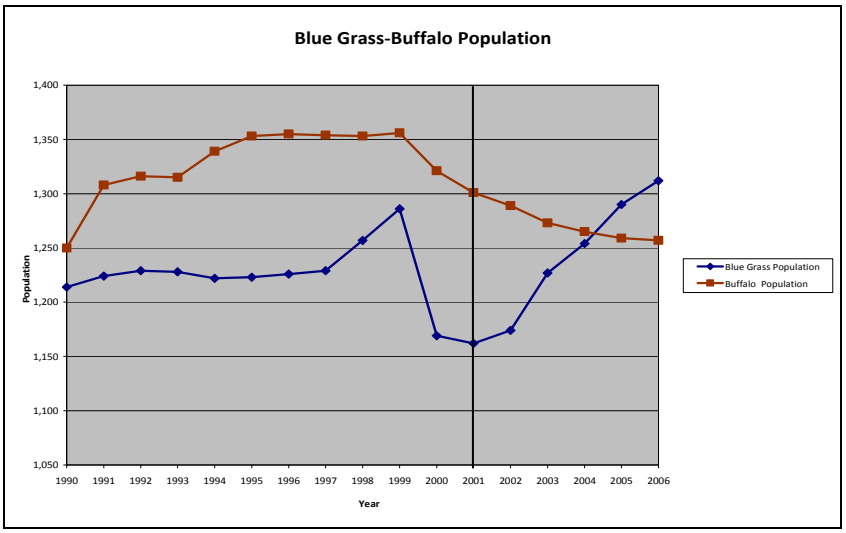

Figure 5.28 Blue Grass and Buffalo population estimates (Iowa Data Center)

Sales per capita (Figure 5.29) show that the spending in the communities is not stable. While per person spending in Iowa overall shows a gradual increase and levels off over the period, Blue Grass shows an increase in spending with some stabilization in the late 1990s, only to show less spending in the early 2000s. Buffalo's data do not provide a good idea of per capita spending, as the data varies over all the years. Sales per capita t-test results show significant differences at the 95% confidence interval ($p < .05$) for the overall study period and before the bypass, but no significant difference after the bypass.

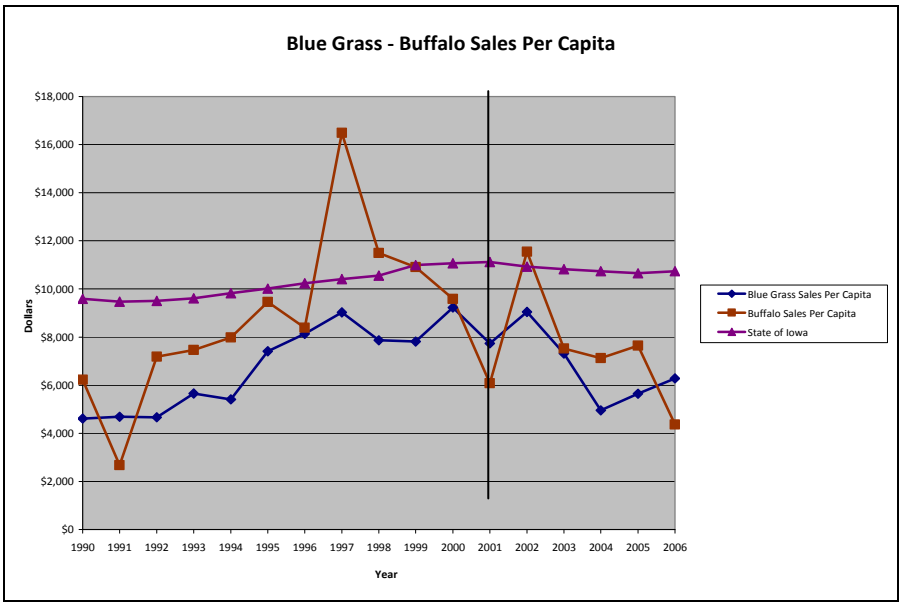

Figure 5.29 Blue Grass and Buffalo—State of Iowa sales per capita

Site visits to both towns provided very little additional information. Buffalo has a few river barge terminals along the Mississippi River that may employ several people for their operations. A publication known as *Quad-Cities Online* did interview the mayor of Blue Grass after the completion of the bypass. In this article, the mayor states, "I don't think it hurt the town at all," and "The businesses are still here, and now hopefully there are going to be some additions and there's also going to be another housing area as a result of the bypass." Town leaders feel that the residents have the best in both a close-knit community and easy access to the Quad Cities (Harris 2007).

Overall, this analysis does not show evidence that the bypass has had a positive or negative effect on the economies of either community. Even with increasing per capita income and population, the Blue Grass analysis still results in a trade leakage. The proximity of both communities to the Quad Cities as well as sales per capita that are lower than the state overall may be the reason for the sales leakages.

5.5 Circumstances where Bypasses are Likely and Unlikely to Have Significant Impacts on Communities and Local Economies

Transportation investments with the highest returns appear to be those that can produce "network" effects. Network effects raise the potential of the system as a whole, in contrast to local improvements. Increases in network effects benefit everyone linked to the network. However, network effect can be eclipsed by the site-specific local benefits of new projects when alternative policies are weighed (ITE 1999). Actual growth and development are a result of a complex set of factors that are important to new industry. Elements contributing to these factors include existing population and employment, land use plans, forecasts of employment and population, and trip generation rates (Goldstein 2001).

6. BYPASS POLICY AND DECISIONS

6.1 Framework

A framework for decision making regarding highway bypass construction can be completed on a case-by-case basis using the basic elements of transportation planning outlined in *Transportation and Highway Engineering* (Garber and Hoel 2002). The elements of the transportation planning process include the following:

1. **Situation definition**—describe all activities required to understand the situation that gave rise to the perceived need, including the following:
   a. Factors that created the present situation are identified
   b. Scope of system to be studied is delineated
   c. Present system is analyzed and characteristics described
   d. Information about the surrounding area is included
   e. The people and their travel habits are studied
   f. Previous reports and studies that may be relevant to present situation are reviewed and summarized
   g. Scope of study and domain of the system to be investigated are delineated

2. **Problem definition**—describe the problem in terms of the objectives to be accomplished by the project and translate those objectives into criteria that can be quantified, while keeping the following in mind:
   a. Objectives are statements of purpose (e.g., to reduce traffic congestion)
   b. Criteria are the measures of effectiveness that can be used to measure how effective a proposed transportation project will be in meeting the stated objectives (e.g., "to reduce traffic congestion" may use "travel time" as the measure of effectiveness)
   c. Characteristics of an acceptable system should be identified, and specific limitations and requirements should be noted
   d. Pertinent standards and restrictions that the proposed transportation project must conform to should be understood

3. **Search for solutions**—consider a variety of ideas, designs, locations, and system configurations that may provide a solution to the problem, keeping the following in mind:
   a. Brainstorm
   b. Option proposals for later testing and evaluation
   c. Ensure that any group or organization can participate (determine feasibility of projects)
   d. Consider the following options:
      - Different types of transportation technology or vehicles
      - Various system or network arrangements
      - Different methods of operation
      - Preliminary feasibility studies (helps narrow the range of choices)
      - Some data gathering, field testing, and cost estimating (to determine practicality and financial feasibility of alternatives being proposed)

4. **Analysis of performance**—estimate how each of the proposed alternatives would perform under present and future conditions by examining the following:
    a. Determination of investment cost of building the transportation project
    b. Annual costs for maintenance and operations
    c. Mathematical models used to estimate travel demand
    d. Number of persons or vehicles that will use the system, determined with results expressed in vehicles or persons/hour (will serve as basis for project design)
    e. Trip length, travel by time of day, and vehicle occupancy
    f. Environmental effects, such as noise and air pollution levels and acres of land required
    g. Non-user impact calculations in situations where the transportation project could have significant impacts on the community or as required by law

5. **Evaluation of alternatives**—determine how well each alternative will achieve the objectives of the project as defined by the criteria, while keeping in mind:
    a. Performance data produced in the analysis phase are used to compute benefits and costs that will result if the project is selected.
    b. Where results cannot be reduced to a single monetary value, a weighted ranking for each alternative may be produced and compared to other proposed projects.
    c. Benefit-cost ratio—use with effects that can be described in monetary terms
    d. Other economic tests

6. **Choice of projects**—select a project after considering all factors involved:
    a. Simple project—a single criterion such as cost may be used to choose the project with the lowest costs
    b. Complex project—more factors must be considered, and selection must be made based on how the results are perceived by those involved in decision making:
        - Project involves a community—may have to have additional hearings
        - Bond issue or referendum may be required
        - Perhaps none of the alternatives meet the criteria or standards and additional investigations will be necessary
        - Must be careful to avoid bias, or promising alternatives may be eliminated or inferior projects may be presented

7. **Specification and construction**—once a project has been selected, the design phase begins, in which each of the components of the facility is specified:
    a. Physical location, geometric dimensions, and structural configuration
    b. Design plans created for contractors to estimate cost of building

6.2 Alternatives Evaluation

Alternatives to bypasses should be evaluated if possible in the planning stages. Some basic steps in evaluating alternatives, according to Garber and Hoel (2002), include the following:

- Determine objectives for the evaluation - furnish appropriate information about outcome of each alternative so selection can be made.
- Identify stakeholders (business owners, community leaders, residents, other interested groups)
- Select and measure evaluation criteria (capital costs, maintenance costs, facility operating costs, travel time costs, vehicle operating costs, accident costs)
- Identify measures of effectiveness (e.g., travel time costs savings)
- Develop evaluation procedures and decision making

Evaluation can be based on economic criteria such as vehicle operating costs, travel time costs, and/or accident costs using methods such as present worth, net present worth, or benefit cost ratio. Evaluations also can be a fact finding process in order to gain the perspectives of interest groups, as well as from the perspective of each alternative and the process as a whole and then summarize the results of previous activities.

Garber and Hoel (2002) point out two more approaches, trade off and balance sheet. Lockwood and Wagner say that in any evaluation there are several important conditions that must be met if the difference among alternative projects is to be adequately considered. These conditions are that all alternatives should be evaluated in a framework of common objectives. Measures of effectiveness should be derived from the objectives covering all impact areas. The incidence and timing of impacts on groups and areas should be identified for all impact categories. Standards or accepted impact significance thresholds for measures of effectiveness should be indicated where accepted or required by law. All measures of effectiveness should be treated at an equal level of detail and an appropriate scale. Uncertainties or probabilities or both should be expressed for each impact category. Sensitivity analysis should be conducted to describe variations in results for alternatives when the values of key parameters are changed.

Balance sheet or trade off approaches satisfy these criteria and display the impacts of plan alternatives to various groups based on the viewpoint that individuals or groups that review the data will first introduce their own set of values and weights, and then reach a judgment based on the merits of each alternative using all the data in a disaggregated fashion. Each impact category or goal may have more than one measure of effectiveness. To determine the cost effectiveness of each impact category, it is useful to compare proposals to the do-nothing alternative.

6.3 Framework Data Requirements

In order for a bypass policy to be successful, the following information about the bypass would be helpful in decision making:

1. Speed (each alternative)
2. Distance (miles of each alternative)
3. Travel time (min)
4. Accident factor
5. Construction costs
6. Residences displaced
7. Traffic levels
    a. Present
    b. Future (20 years)
8. Air quality
9. Noise
10. Tax loss
11. Trees removed
12. Runoff
13. Population forecast (Bypass community and the region)
14. Traffic forecast (Are traffic volumes expected to increase in the long-range future?)
15. Economic growth forecast
    a. Bypass community, region, and state
    b. Expected number of jobs that a bypass could potentially create
    c. Planned development (with or without bypass)(bypass community and region)
16. Trip generation (Trip assignments/purposes)
17. Existing land use plans
18. State and local policy coordination
19. Existing transportation infrastructure (inventory)
    a. Are there existing routes past the community that could be utilized and expanded to cut down on land acquisition costs?
20. Environmental (National Environmental Policy Act)
21. Agriculture and other industries (Expected effects of farm land acquired for bypass construction)
22. Access control (Anticipated need so that proper amounts of land are purchased for interchanges if the land should become necessary for future traffic)

7. CONCLUSIONS AND RECOMMENDATIONS

This research used data on real sales, per capita income, and population to estimate trade surplus or leakage in bypassed communities. The trade analysis procedure requires the calculation of the potential sales in a community and sales per capita, which can then be utilized to calculate an estimated trade surplus or leakage for the community. The ability of a community to generate sales is based on its population, per capita income, the ability to capture economies of scale, and the ability to reduce transportation costs and energy costs related to transportation. The data presented here show these bypassed communities losing trade even though per capita incomes are on the rise and populations are either steady or increasing. People are earning more money and residing in these study communities, but are not spending their income in the community because of another community's ability to capture economies of scale.

From this research, it has been found that it is not just a consideration whether a bypass may encourage people to shop in other communities, but whether the bypass is part of an expressway that connects to other communities. Each of the communities studied here is located on a bypass that is part of an expressway facility that connects to a larger community. As a comparison, each control community is located on a two-lane highway facility with the highway crossing through the boundaries of the community at or near the CBD.

Recommendations for future research include the following:

- Location study on the proximity of a small community to a larger community and a bypass/expressway
- Whether the effects of bypass design and characteristics have an impact on economics (e.g., whether the bypass is two-lane or four-lane; number of access points)
- The commuting and shopping habits of bypass community residents
- Quality of life impacts as a result of highway bypasses

In conclusion, the use of trade area analysis does not provide proof that a bypass can positively or negatively impact the economy of a rural community. However, this analysis does show that these communities are not generating potential sales based on their population and per capita income. The trade area analysis shows that, even though the population of a community may be stable for several years and per capita income is increasing, sales leakage still occurs. So the question becomes - Why are these communities unable to generate sales or capture trade from other areas? A survey of the commuting and shopping habits of bypass community residents would help to answer this question by giving researchers information on where bypass community residents are spending their money.

From the literature reviews, site visits, and the data, it is apparent that a bypass can positively affect a community. Some conditions that would need to exist to improve the community include the installation of signage along the bypass directing travelers to businesses and services in the community, community or regional plans that include the bypass in future land development scenarios, and businesses adjusting their business plans to attract bypass users. In addition, how proactive a community is in adapting to the bypass determines the kinds of effects felt in the community.

For instance, Denver was in the process of replacing and expanding its water system at the time of the site visit in anticipation of housing development on the south side of the community. It is apparent that conditions that may lead to a bypass having negative impacts on a community would include lack of space for development anywhere in the community, no master plan, and no marketing efforts to attempt to capture trade from travelers on the bypass. Again, how proactive a community decides to be at attempting to develop benefits from a bypass has an impact on how the community is affected by the bypass.

The trade area analysis can serve as a starting point for further research, as this method can provide information about a community's trade characteristics from which future research questions can be developed. This study has been completed in the hopes that it can aid in finding an answer to why some rural Iowa communities seem to struggle economically and how a bypass may affect that. The attraction of manufacturing or other jobs to a community can change its trade capture ability, but communities need to find ways to keep sales dollars in their communities.

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APPENDIX: GRAPHS OF VMT AND YEARLY CRASHES FOR STUDY CITIES

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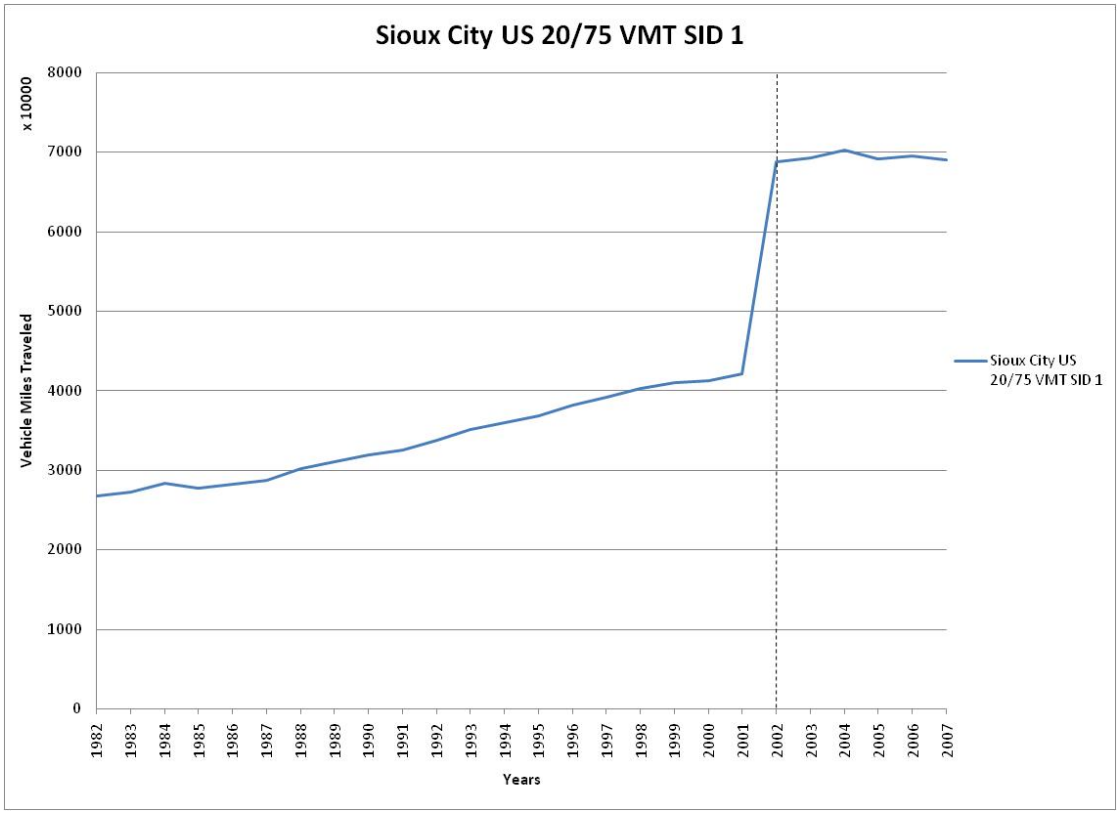

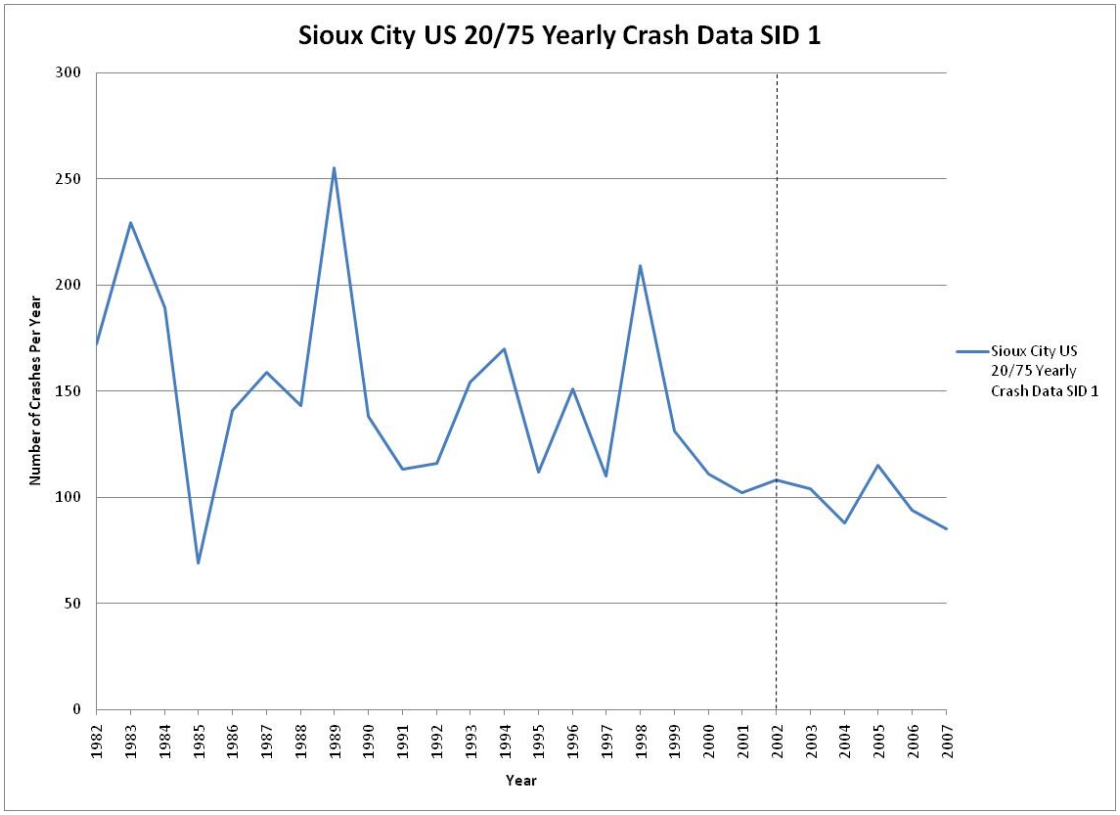

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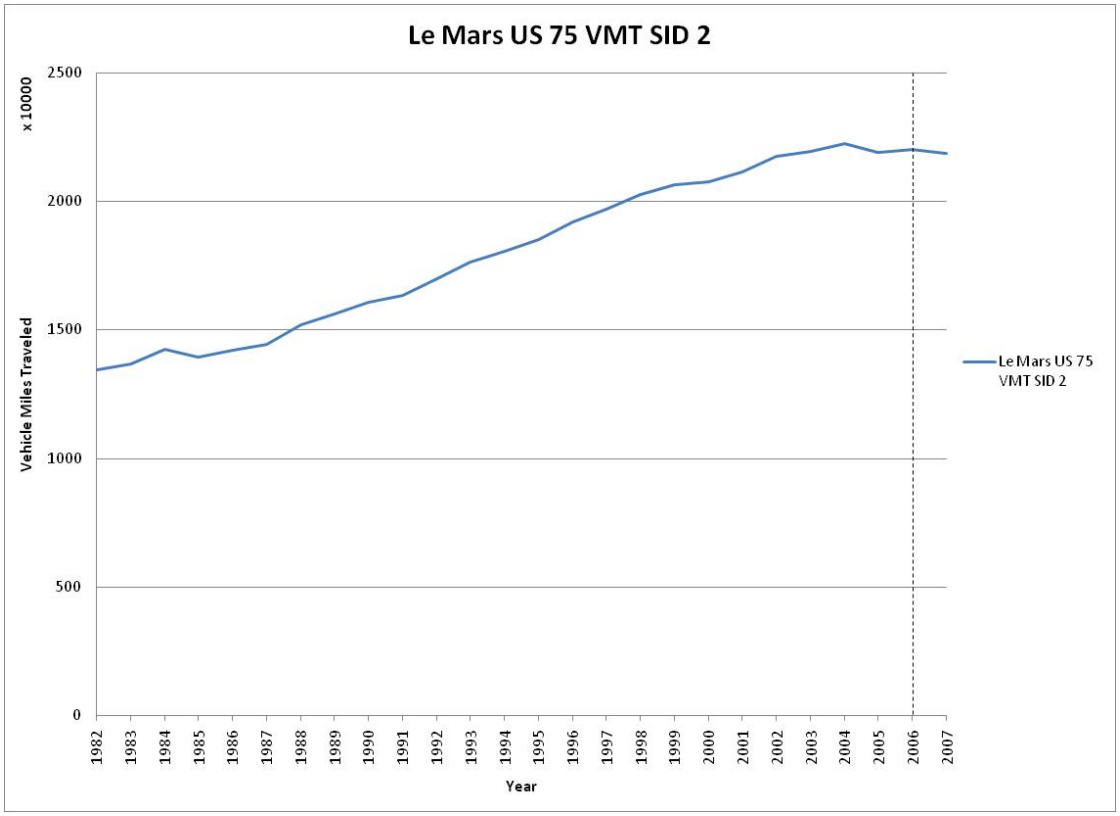
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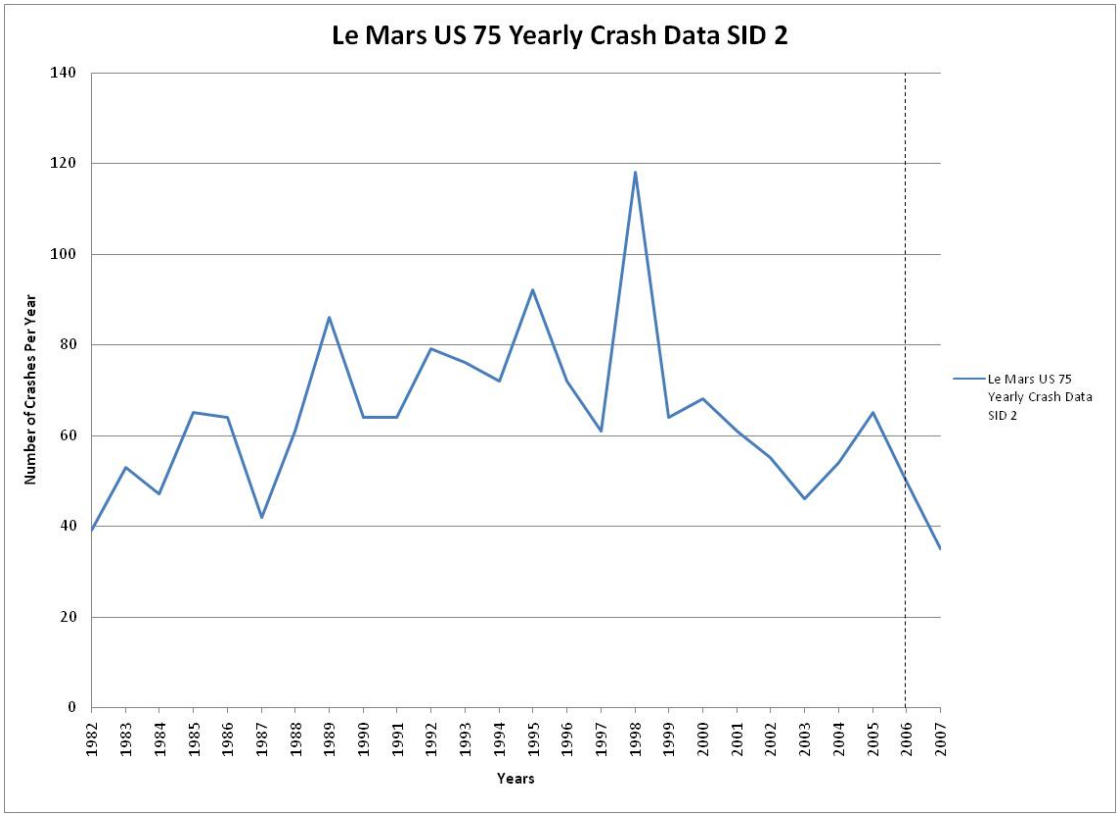
Le Mars US 75 VMT SID 2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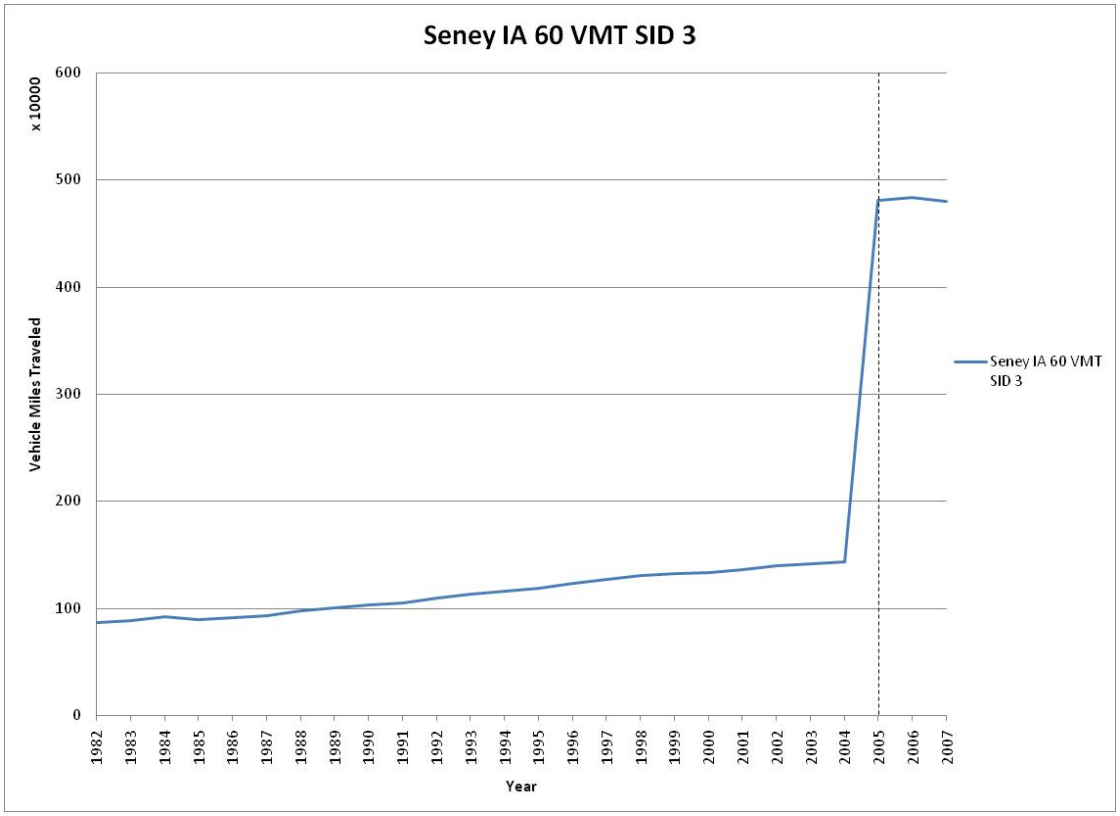
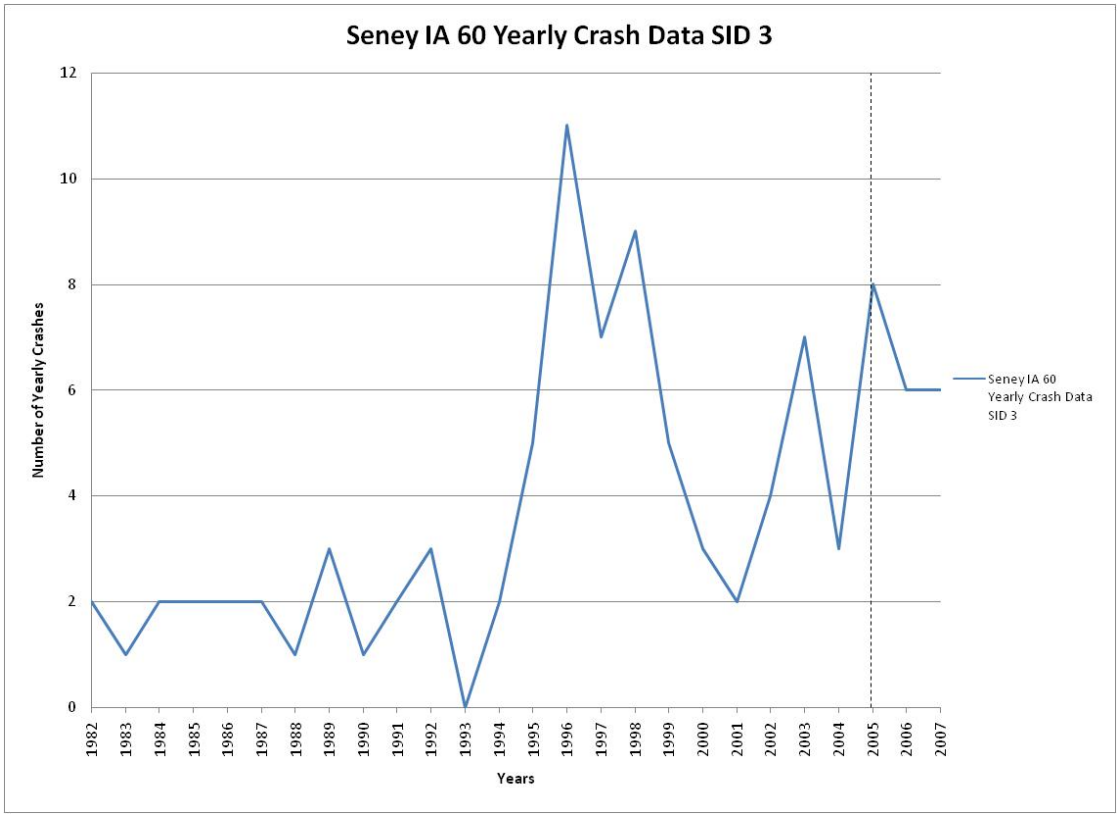
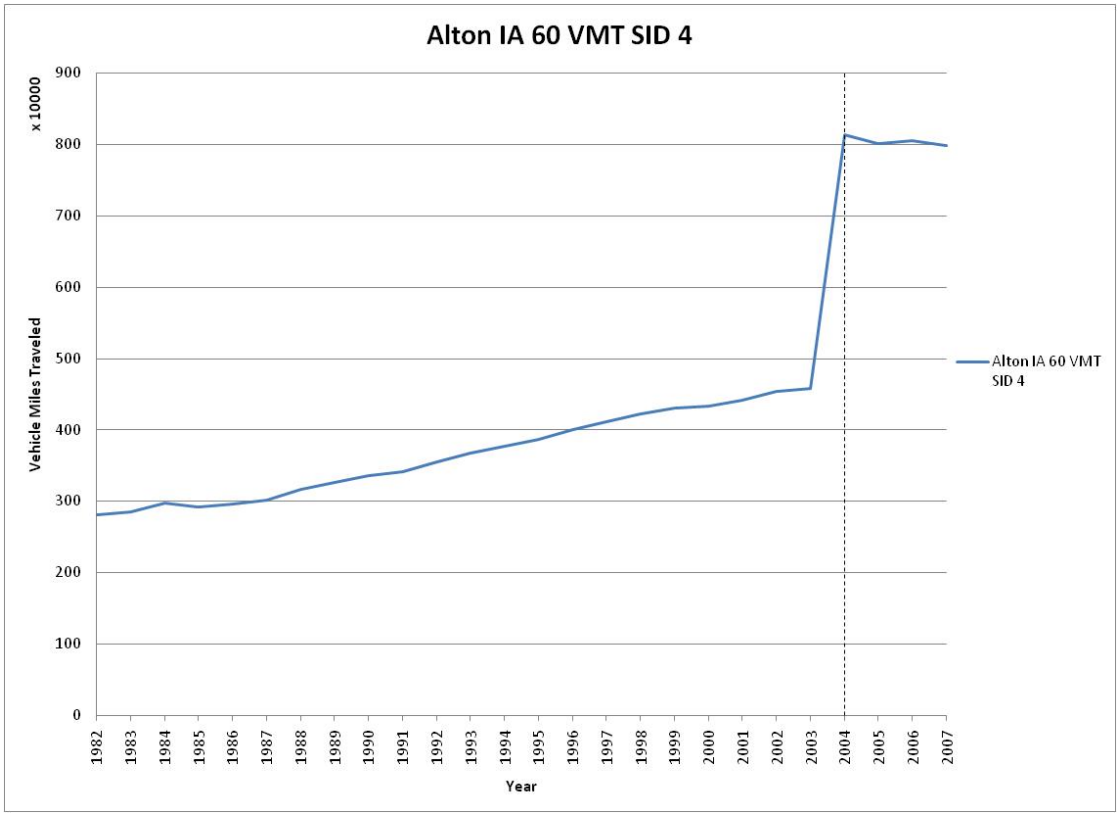
20
0
Number of Crashes Per Year
1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Years
Le Mars US 75 Yearly Crash Data SID 2

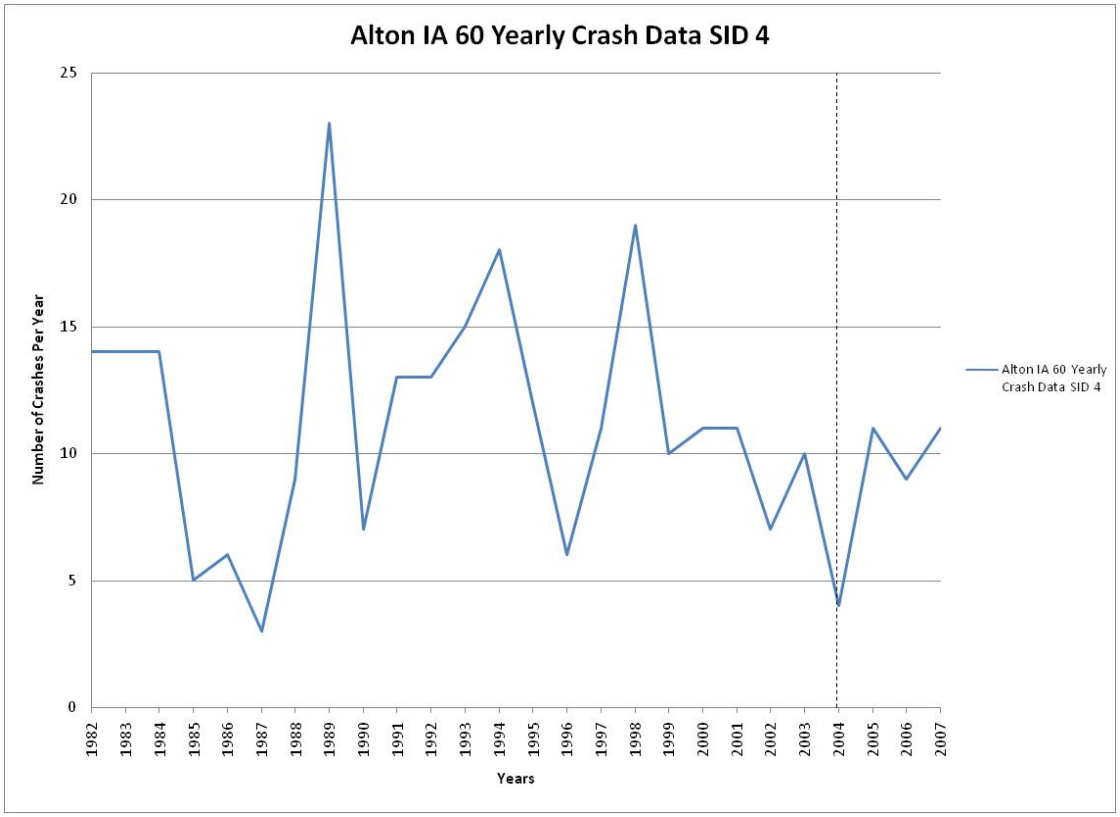
SID 3 - Seney


Seney IA 60 VMT SID 3
x 10000
Vehicle Miles Traveled
600
500
400
300
200
100
0
1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Year
Seney IA 60 VMT SID 3

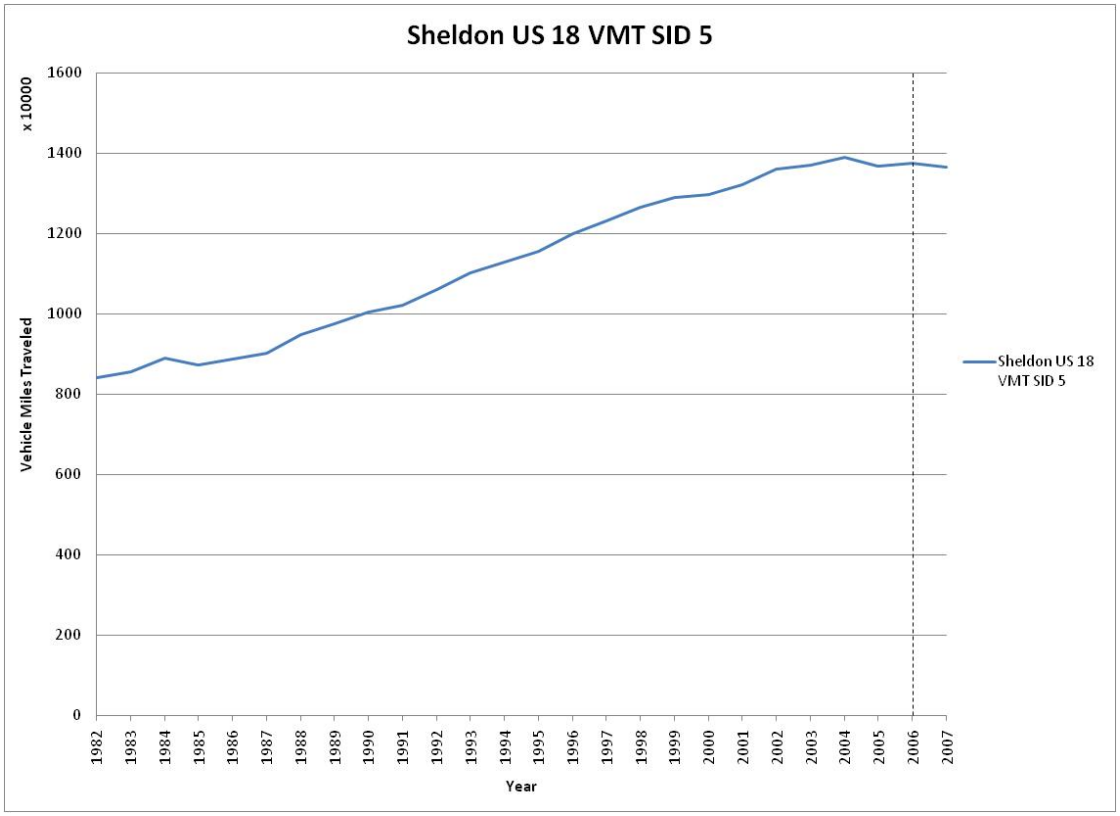

Seney IA 60 Yearly Crash Data SID 3
Number of Yearly Crashes
12
10
8
6
4
2
0
1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Years
Seney IA 60 Yearly Crash Data SID 3

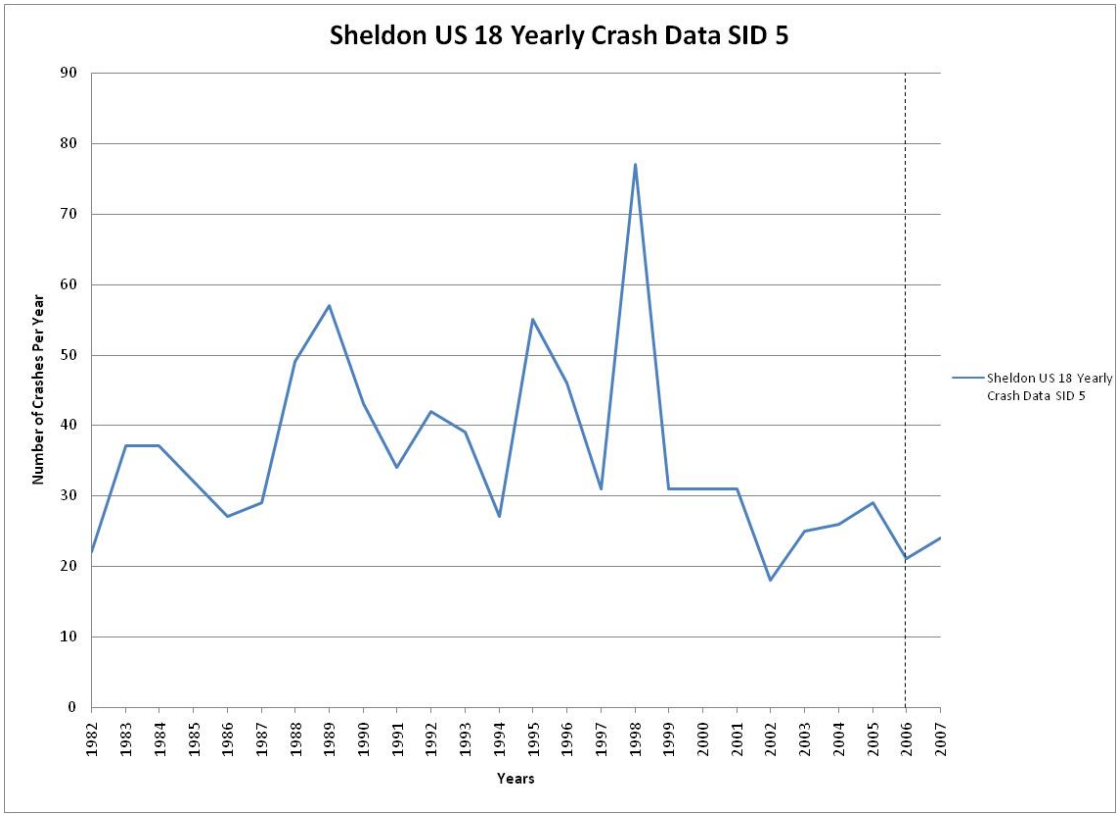
SID 4 - Alton


Alton IA 60 VMT SID 4
x 10000
Vehicle Miles Traveled
900
800
700
600
500
400
300
200
100
0
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year
Alton IA 60 VMT SID 4

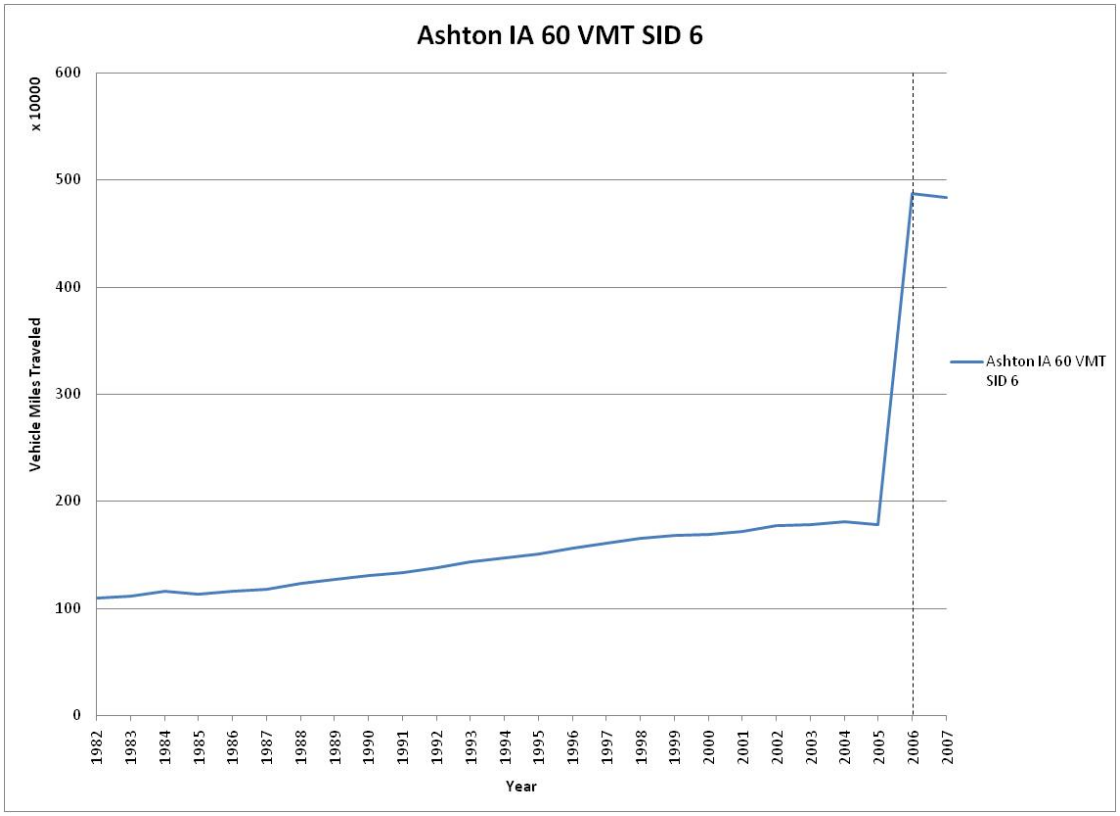

Alton IA 60 Yearly Crash Data SID 4
Number of Crashes Per Year
25
20
15
10
5
0
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Years
Alton IA 60 Yearly Crash Data SID 4

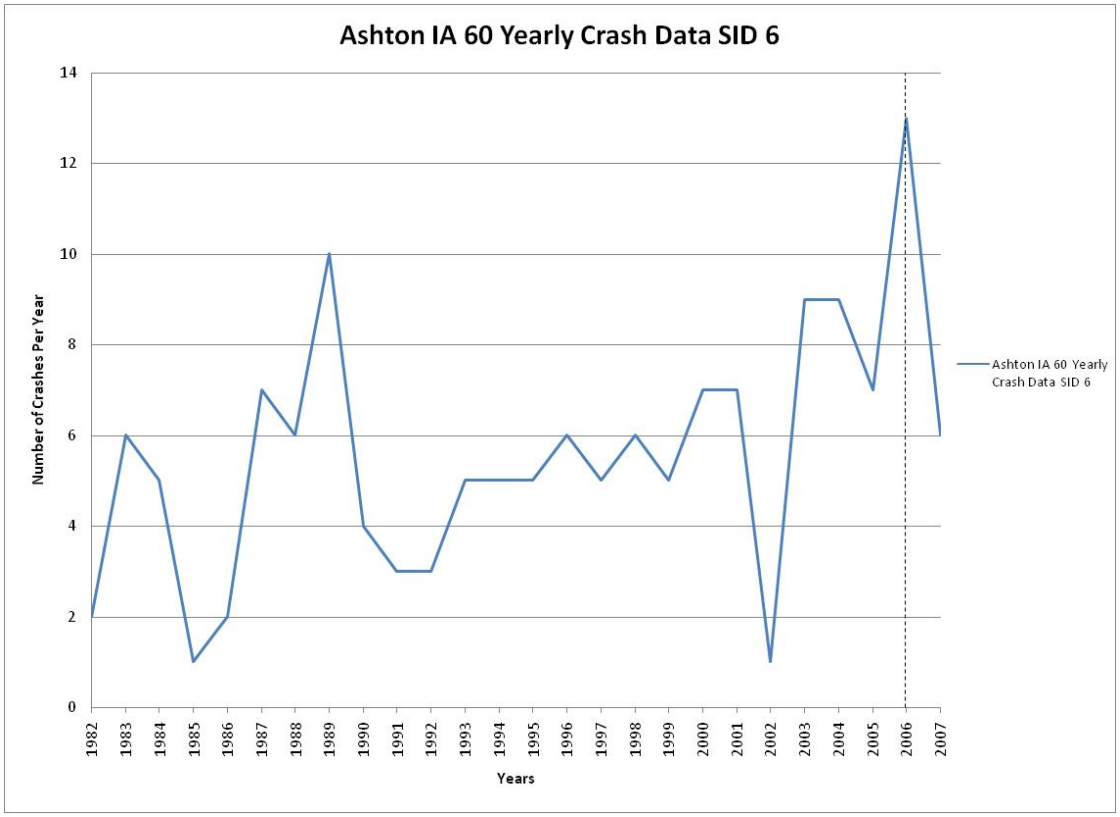
SID 5 - Sheldon



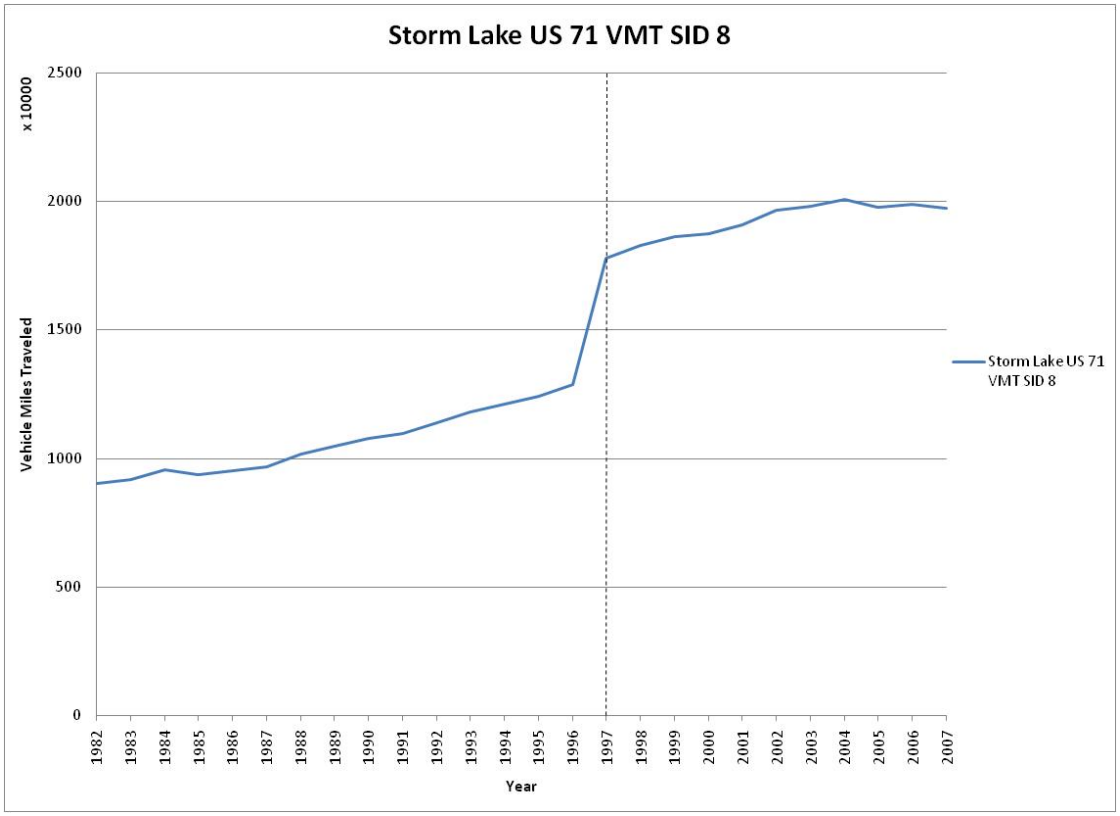


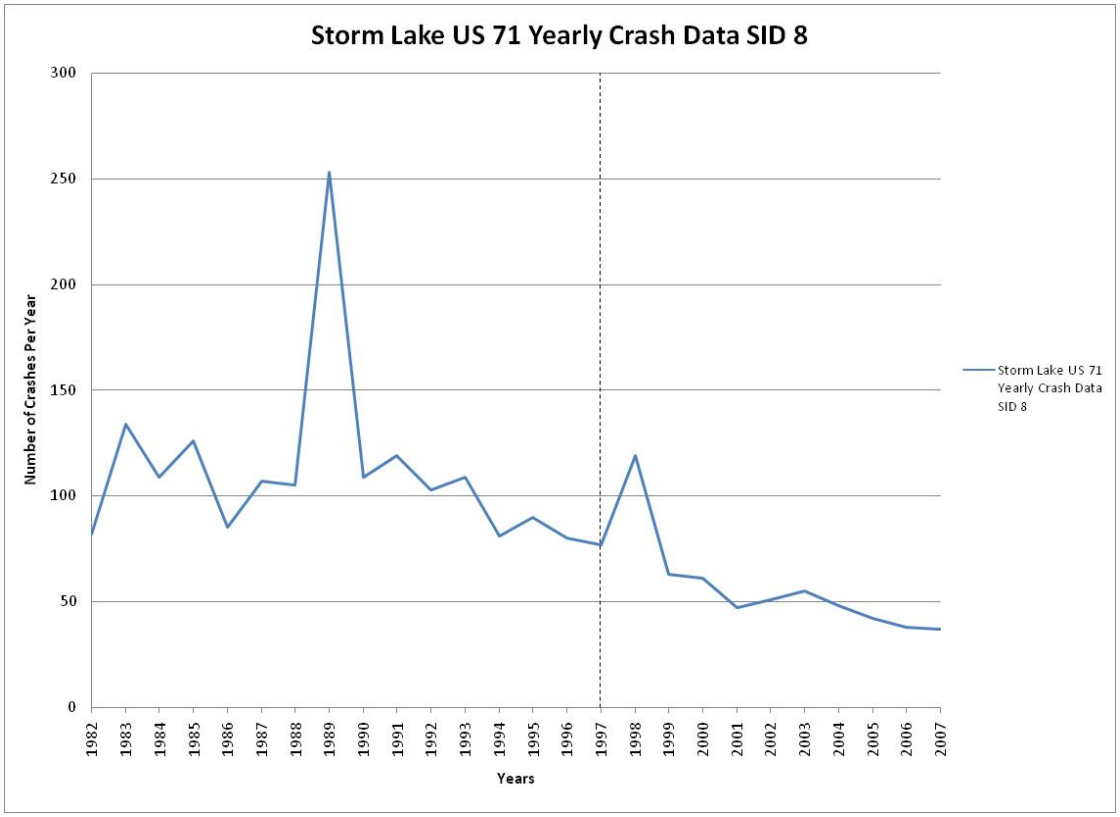
SID 6 - Ashton


Ashton IA 60 VMT SID 6
x 10000
Vehicle Miles Traveled
600
500
400
300
200
100
0
1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Year
Ashton IA 60 VMT SID 6

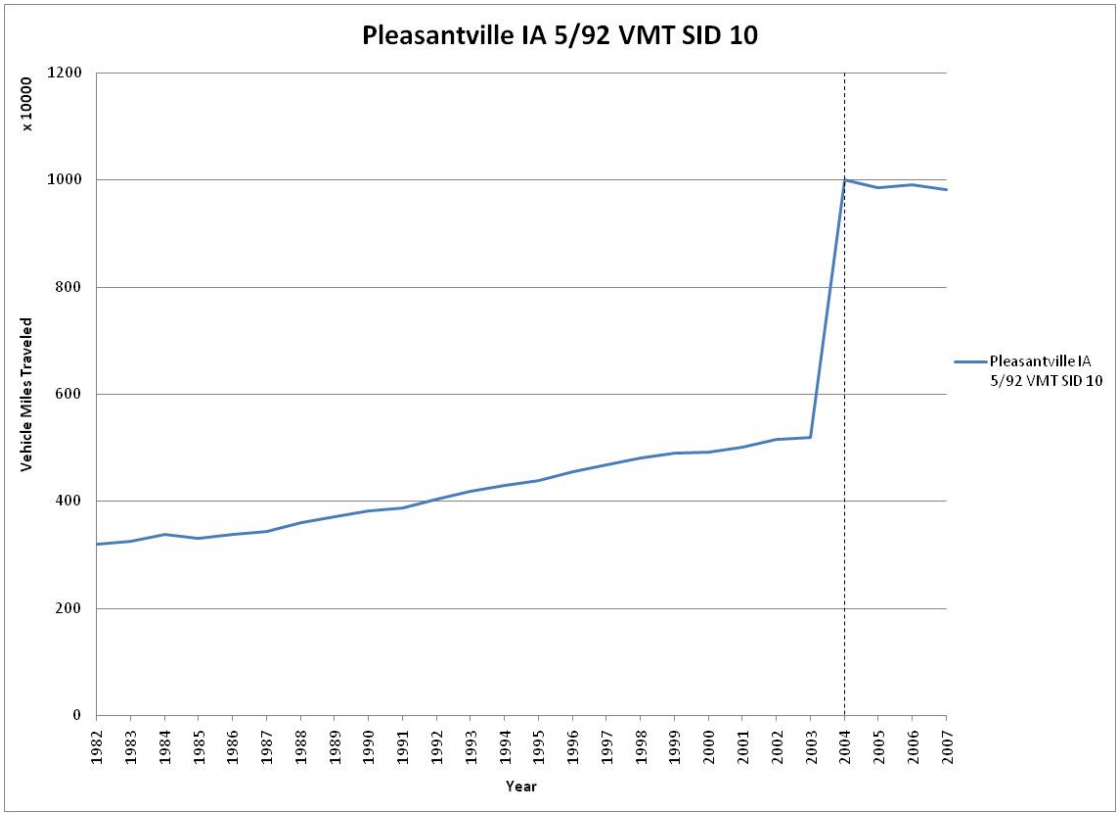

Ashton IA 60 Yearly Crash Data SID 6
Number of Crashes Per Year
14
12
10
8
6
4
2
0
1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Years
Ashton IA 60 Yearly Crash Data SID 6

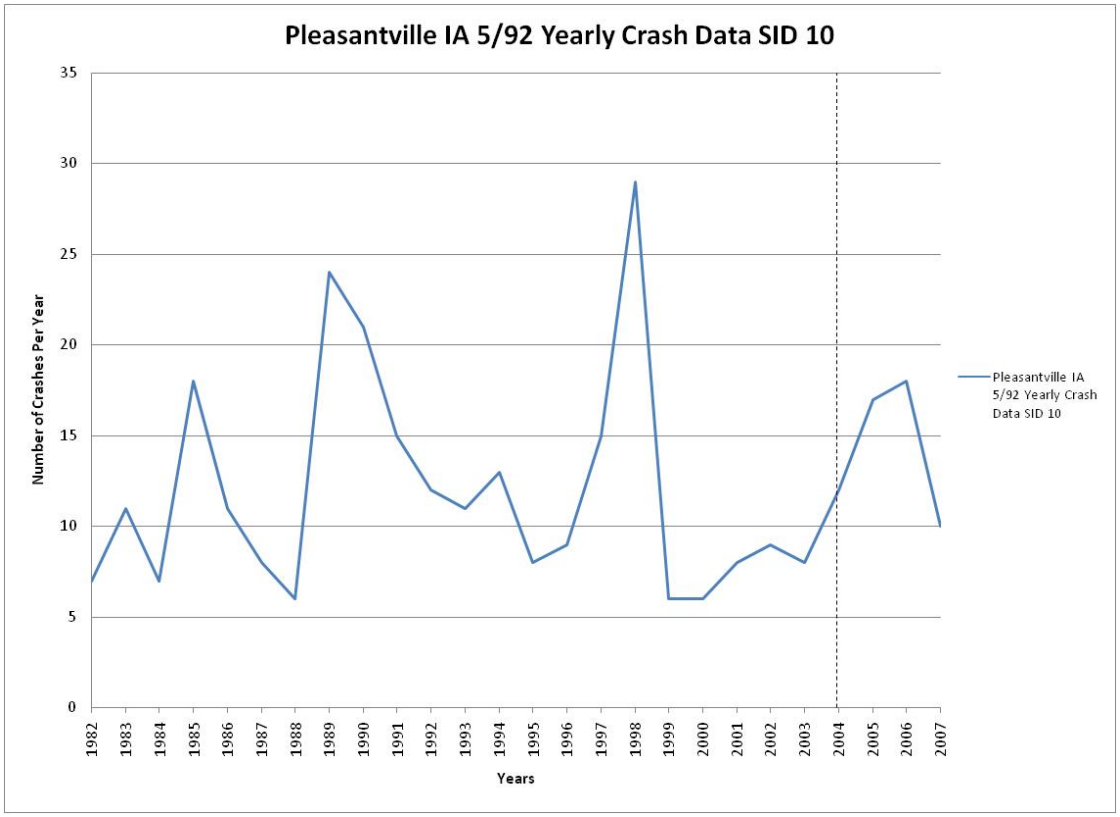
SID 8 - Storm Lake



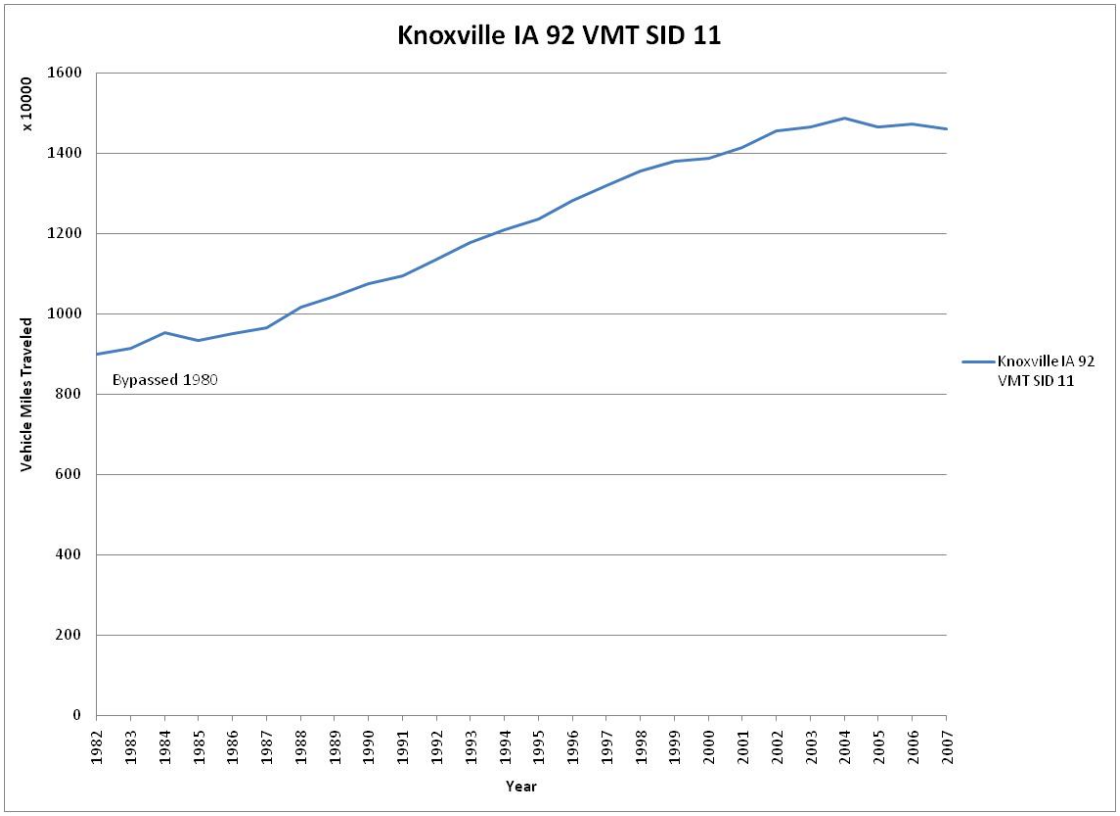


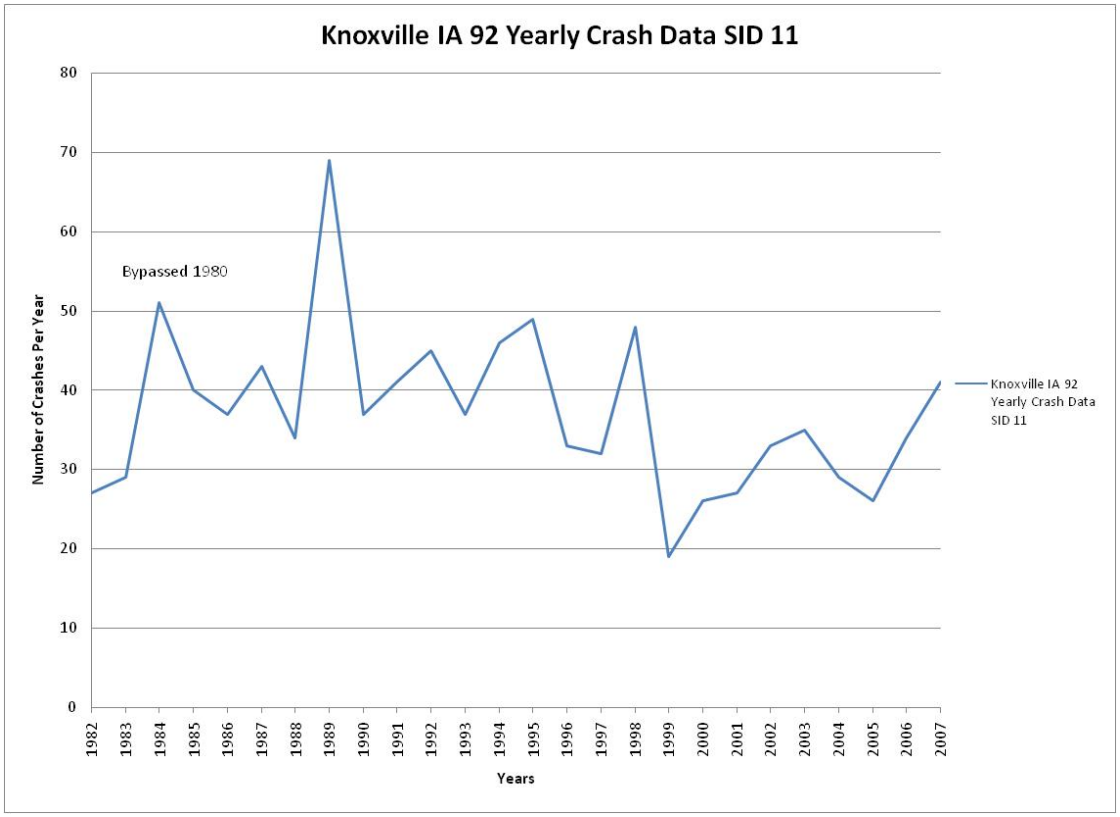
SID 10 - Pleasantville



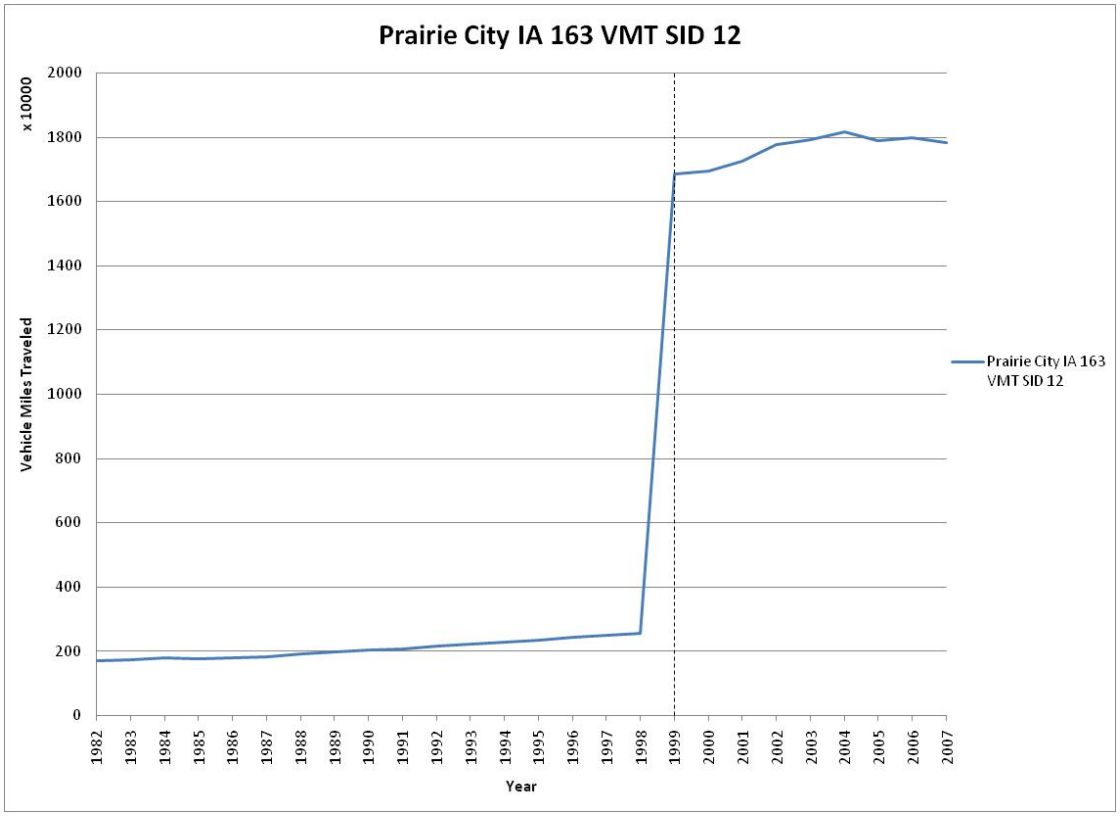


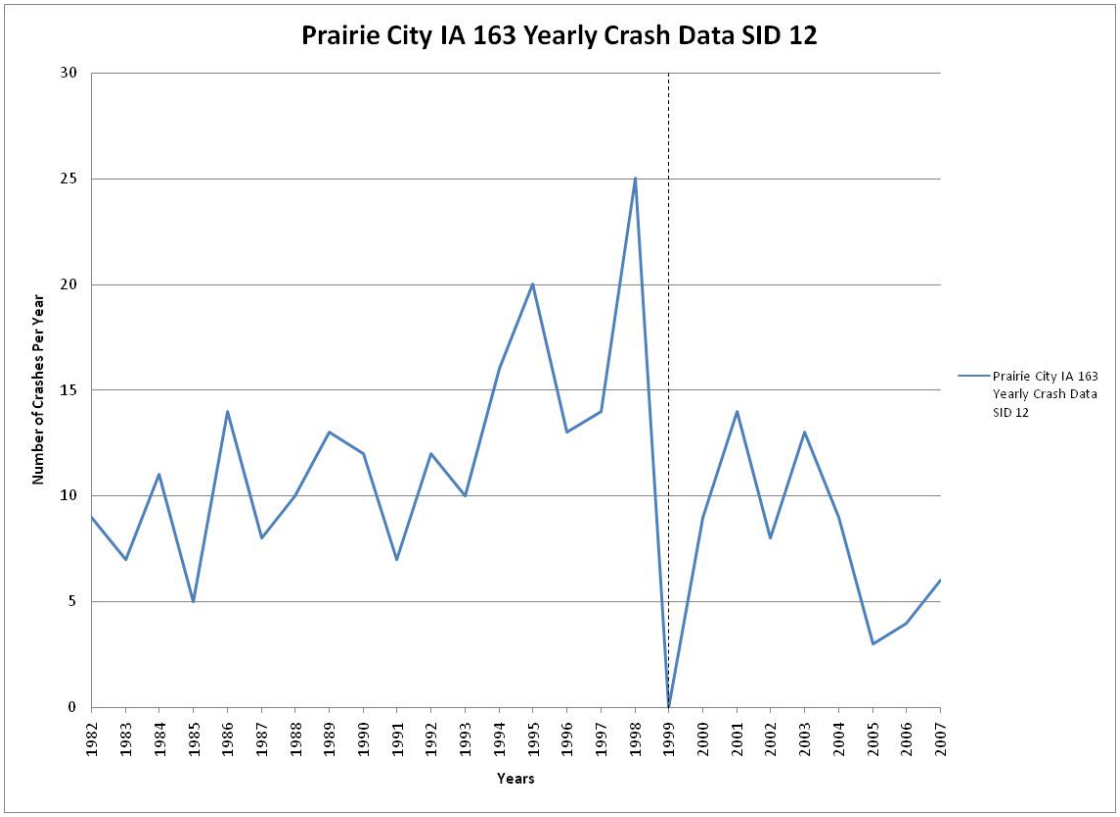
SID 11 - Knoxville



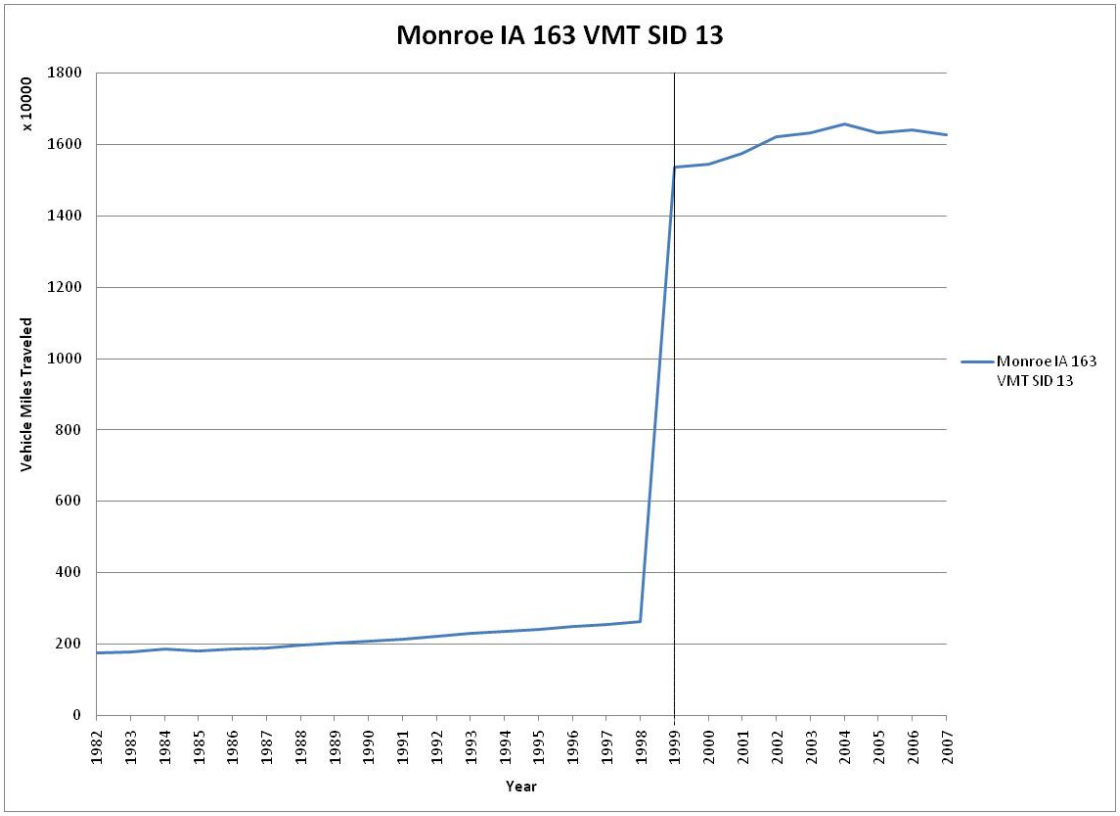


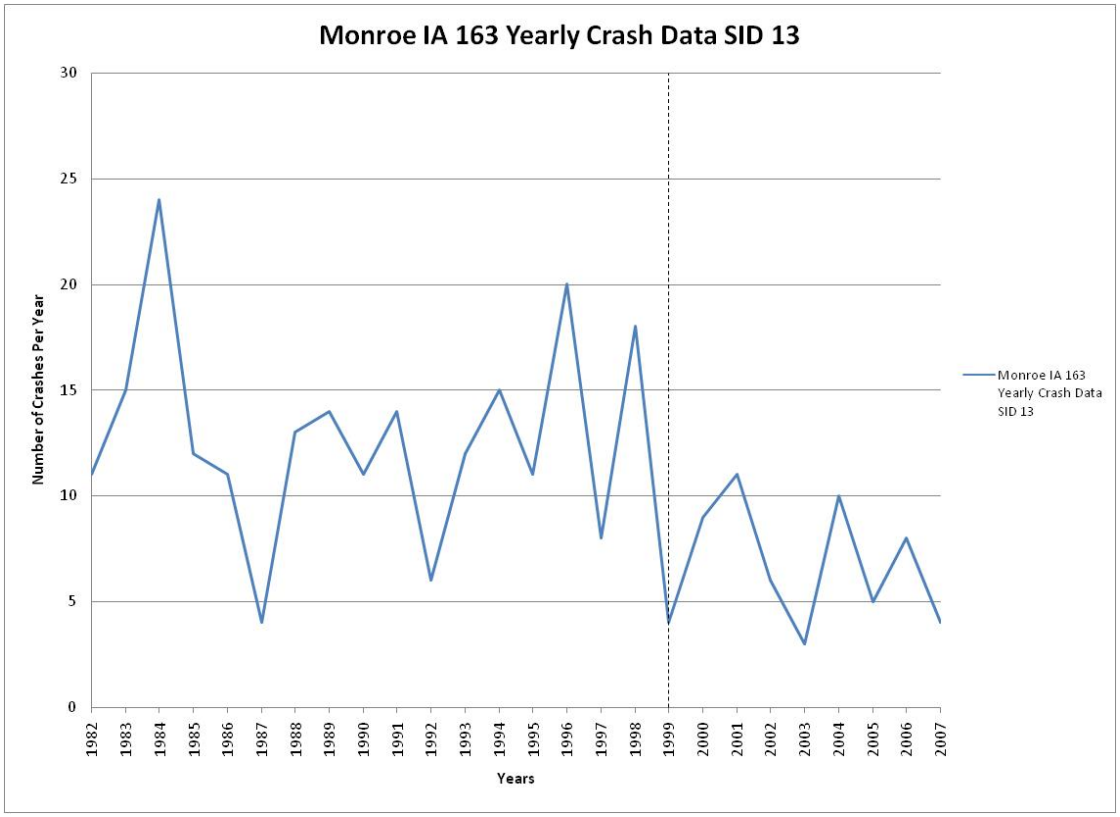
SID 12 - Prairie City



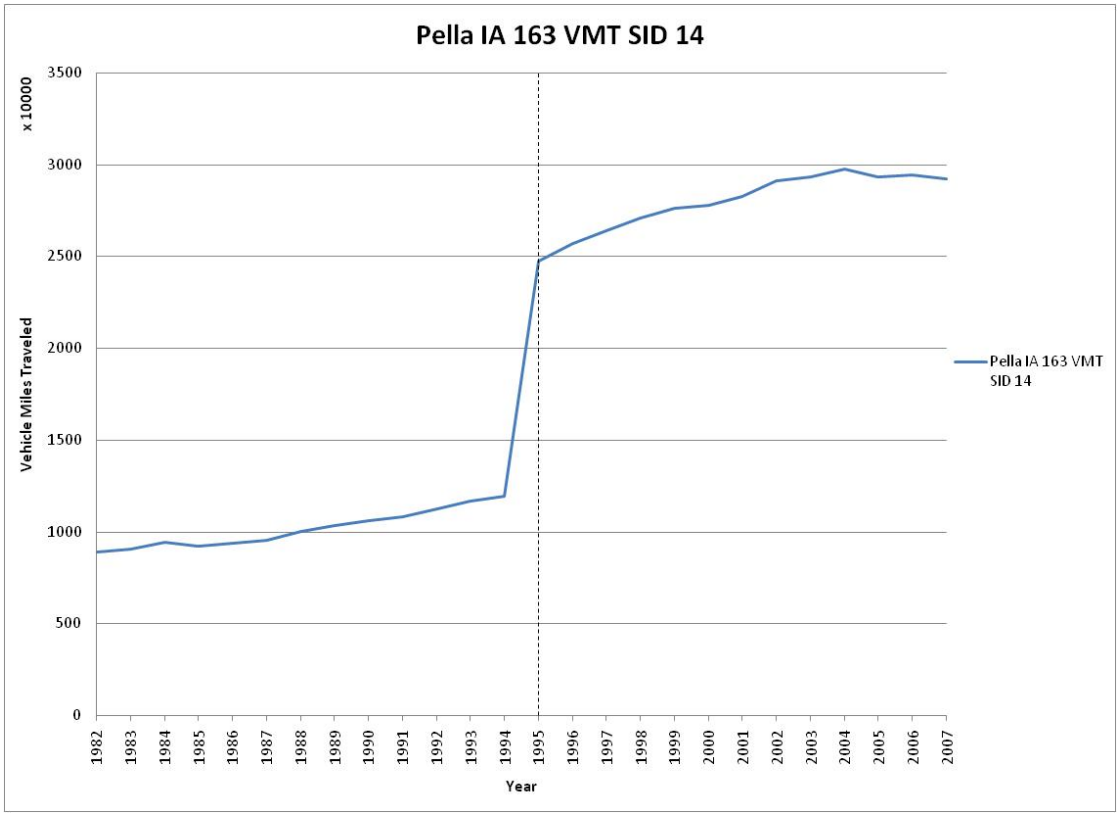


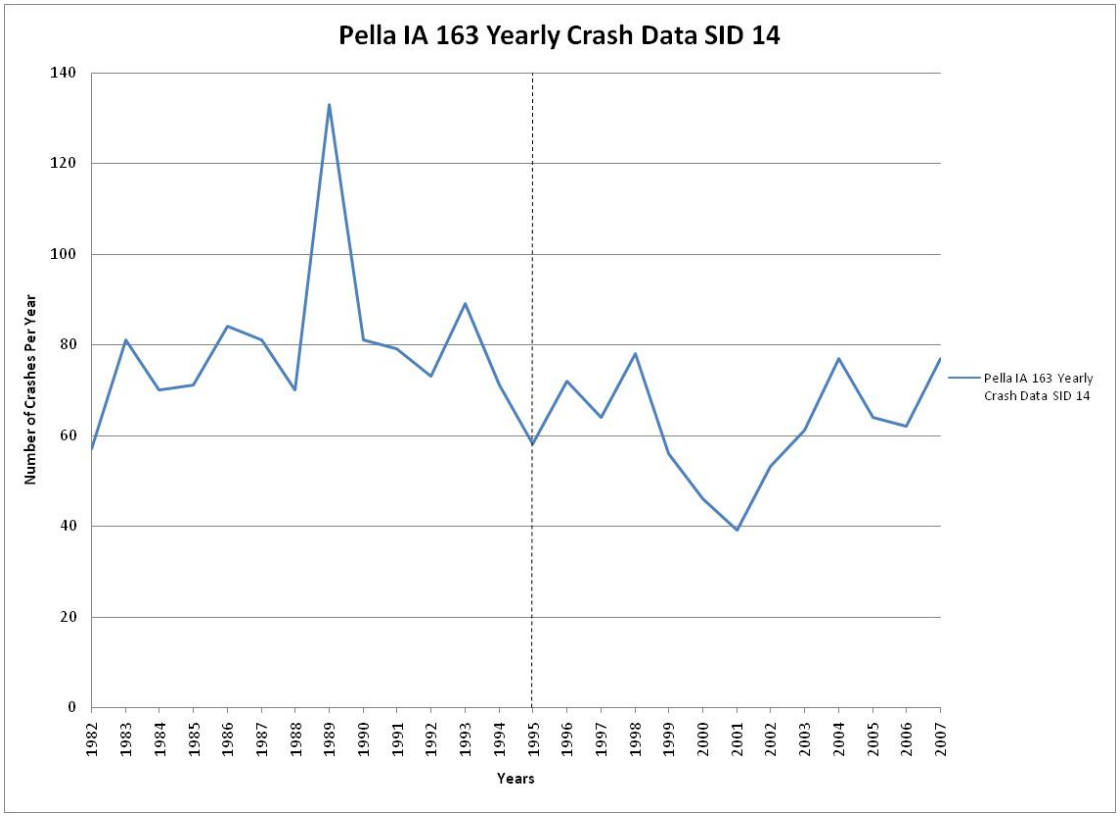
SID 13 - Monroe



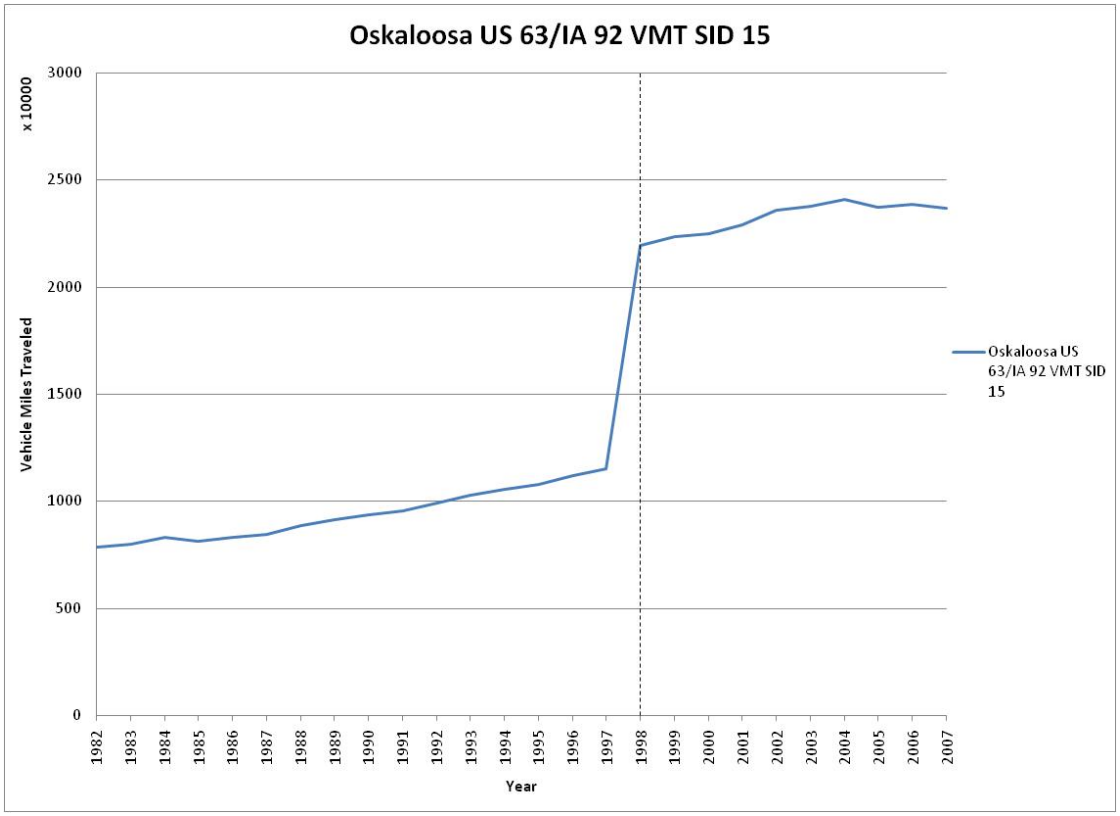


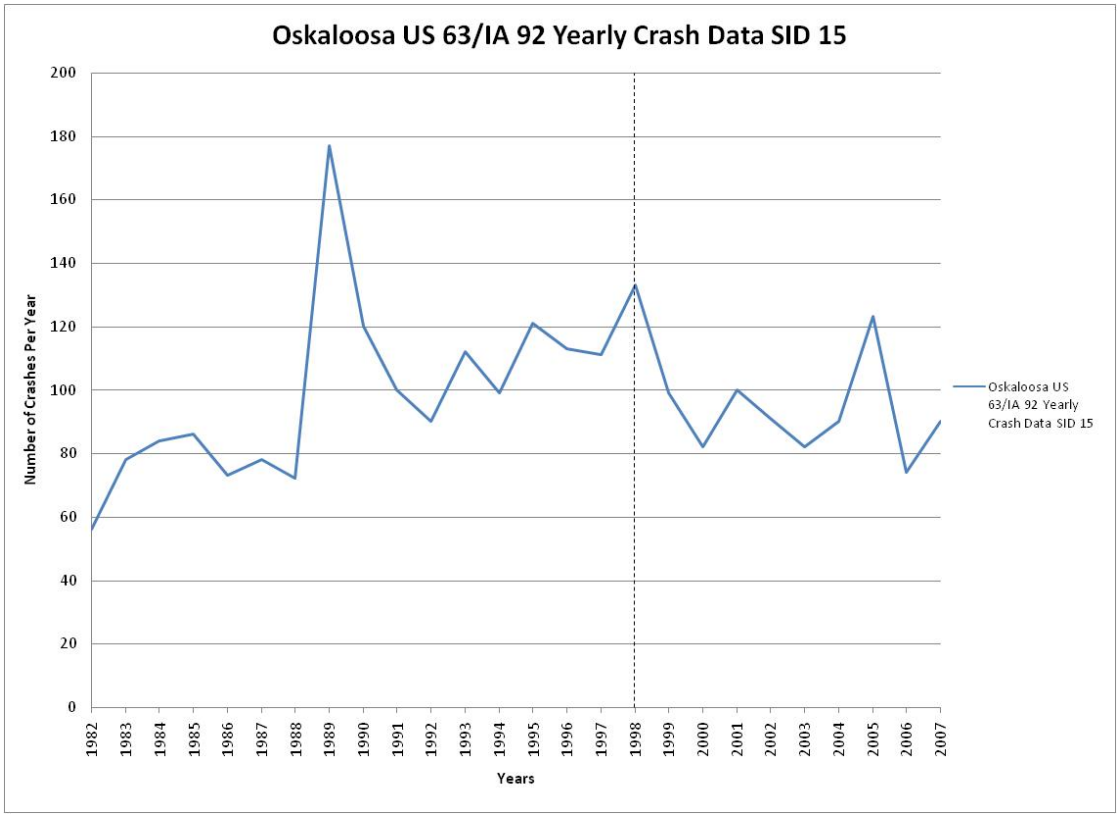
SID 14 - Pella


Pella IA 163 VMT SID 14
x 10000
3500
3000
2500
2000
1500
1000
500
0
Vehicle Miles Traveled
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year
Pella IA 163 VMT SID 14

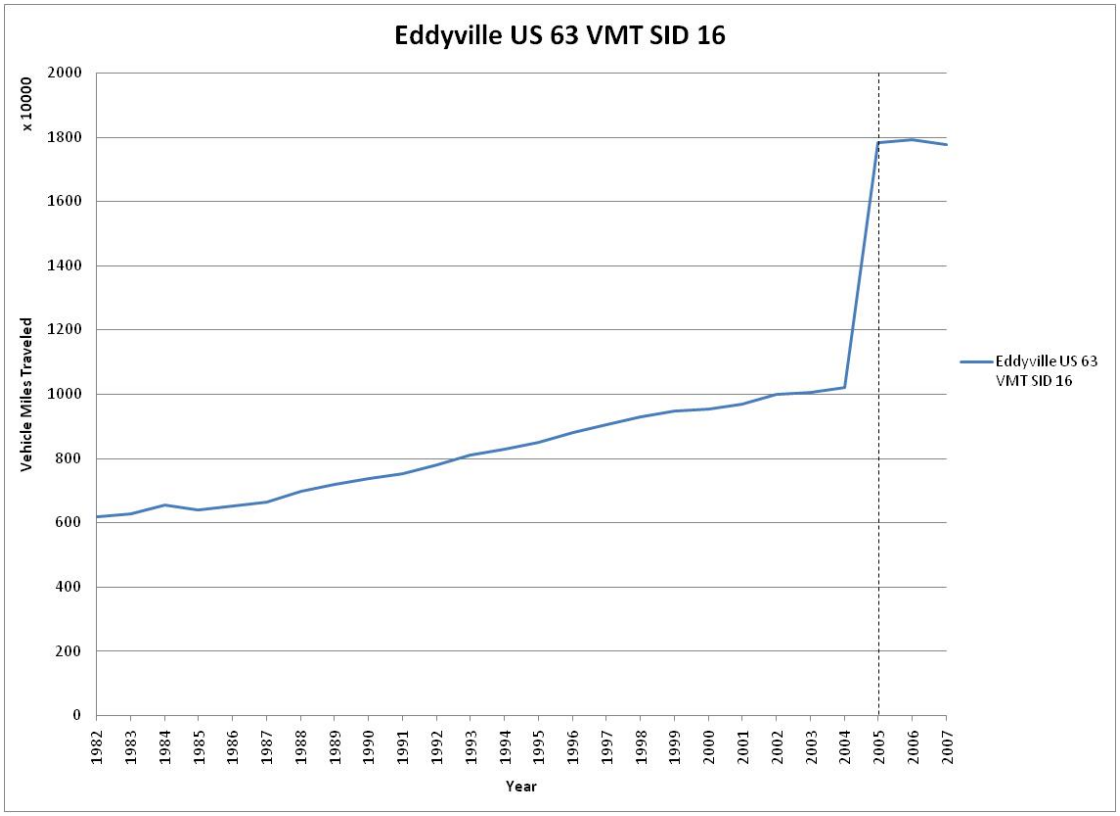

Pella IA 163 Yearly Crash Data SID 14
140
120
100
80
60
40
20
0
Number of Crashes Per Year
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Years
Pella IA 163 Yearly Crash Data SID 14

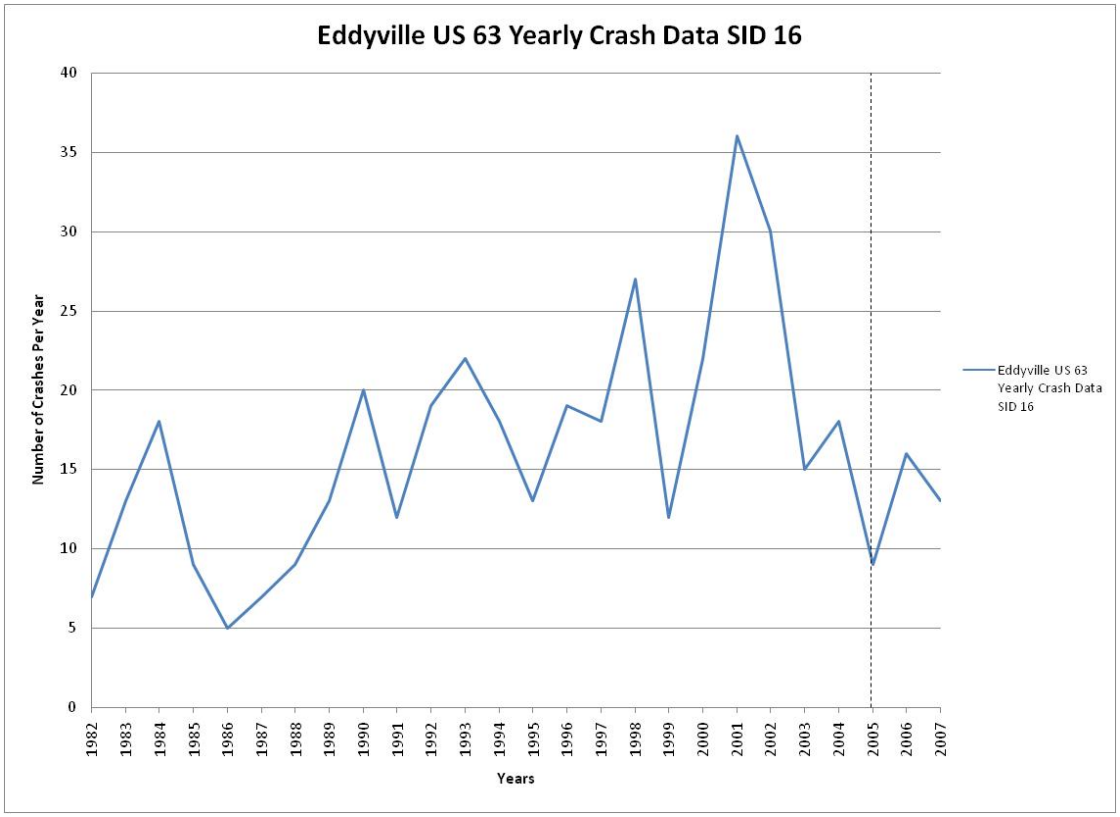
SID 15 - Oskaloosa



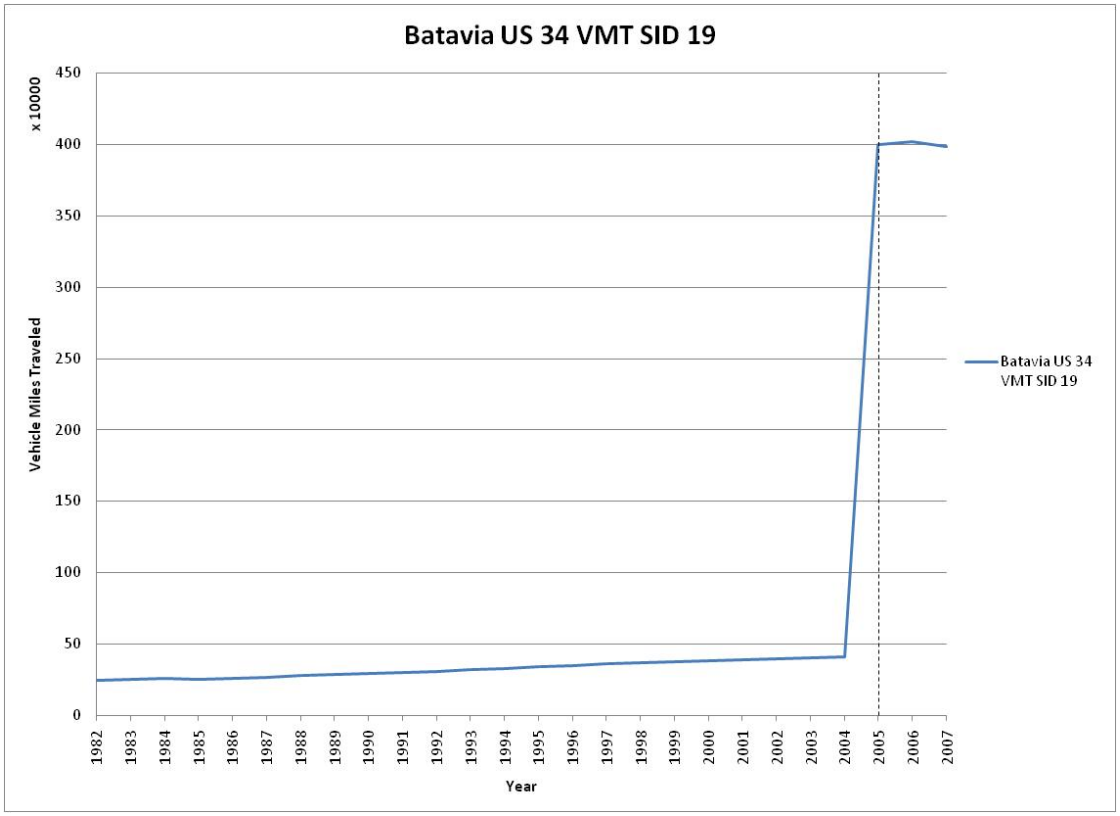


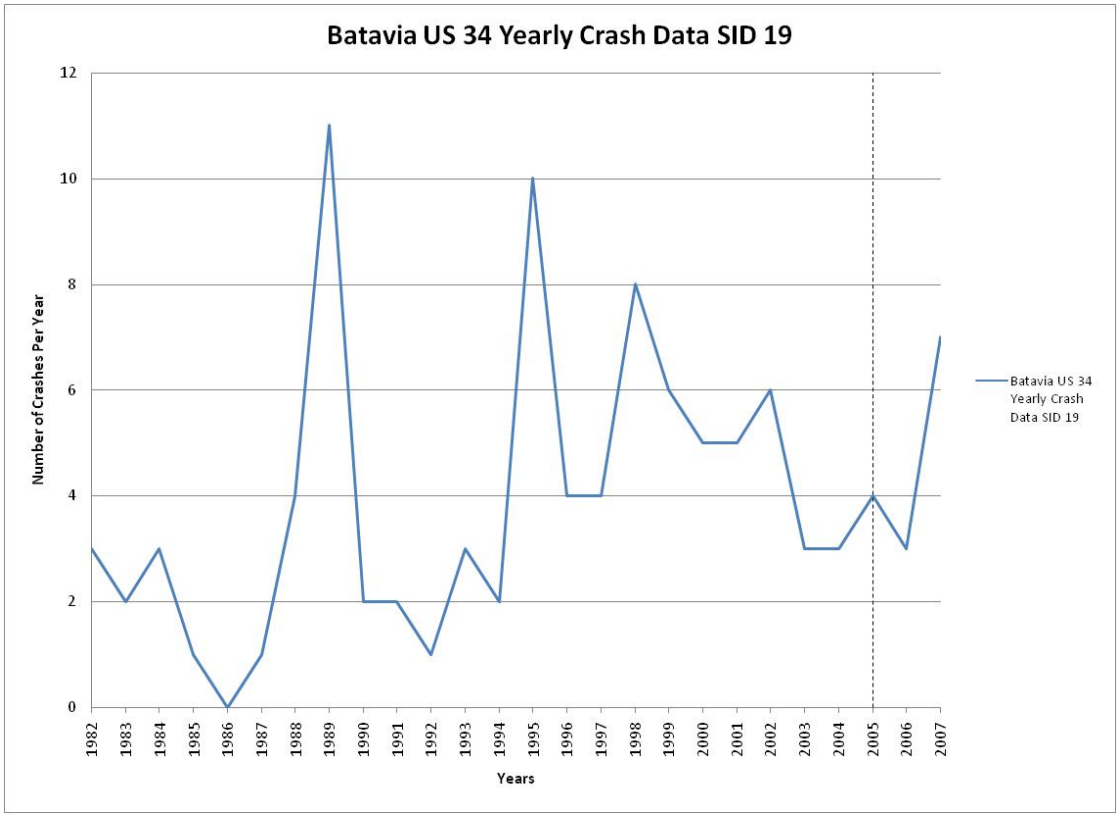
SID 16 - Eddyville



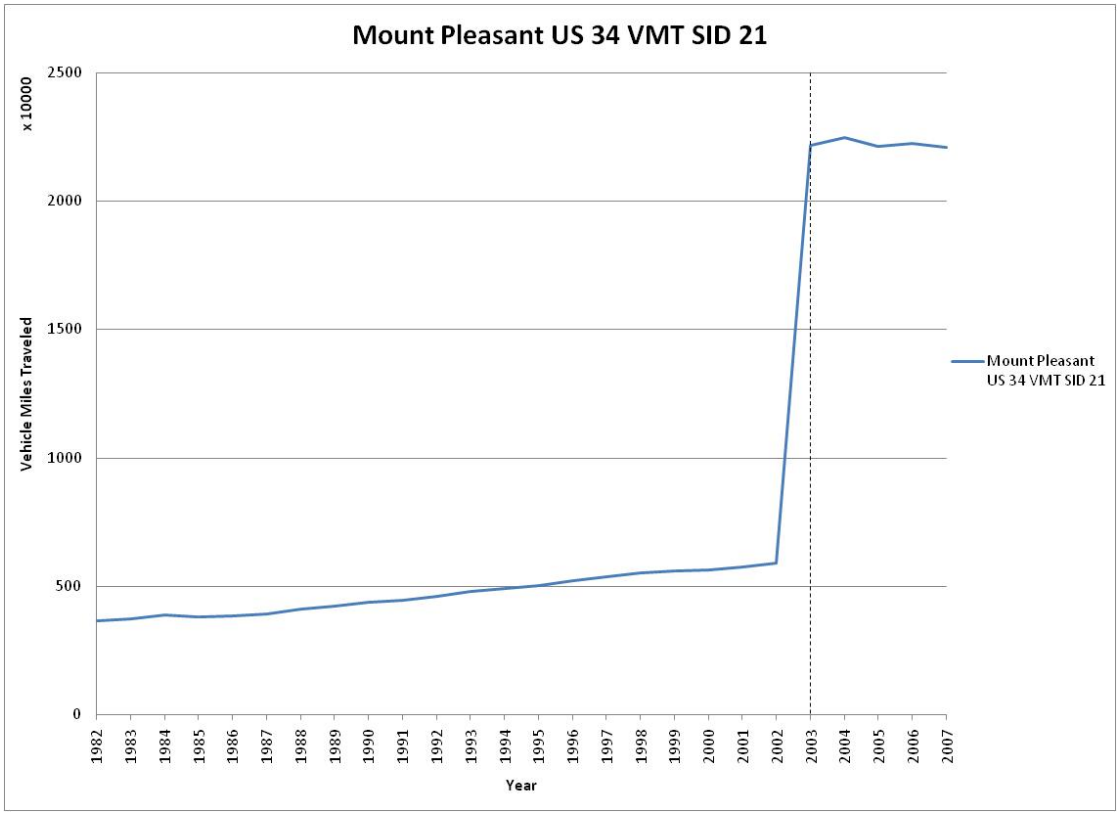


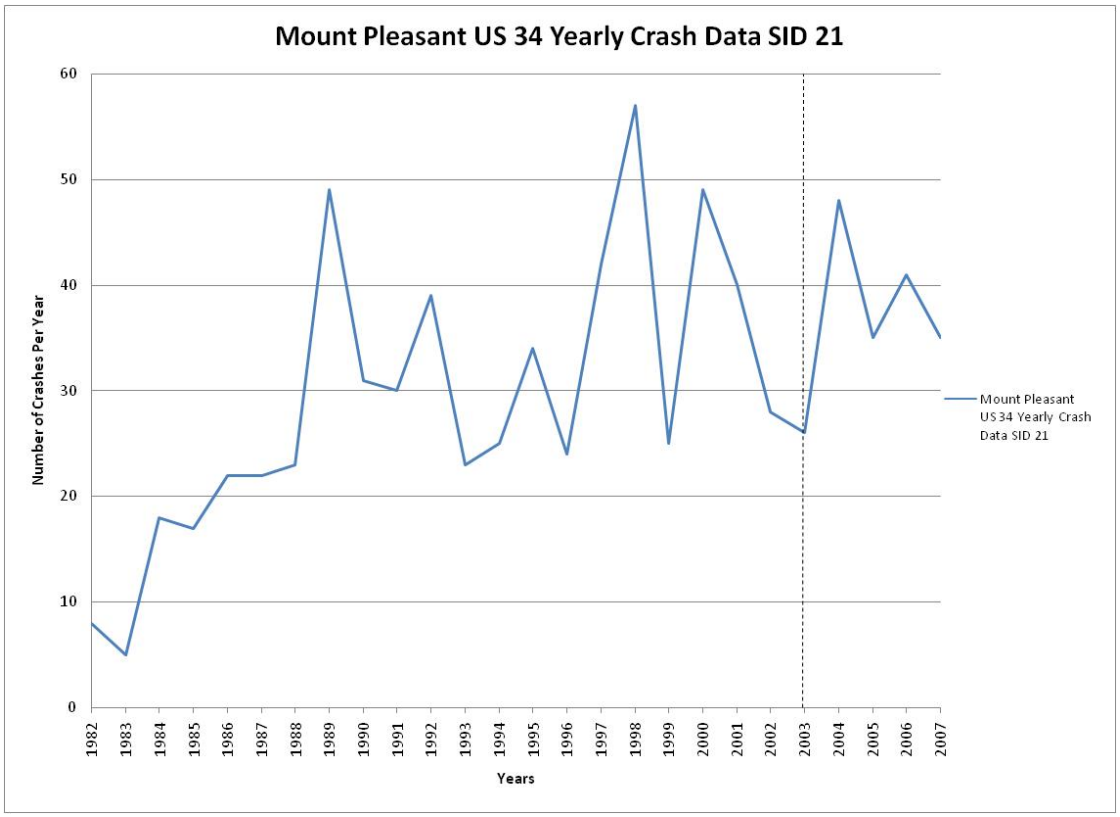
SID 19 - Batavia



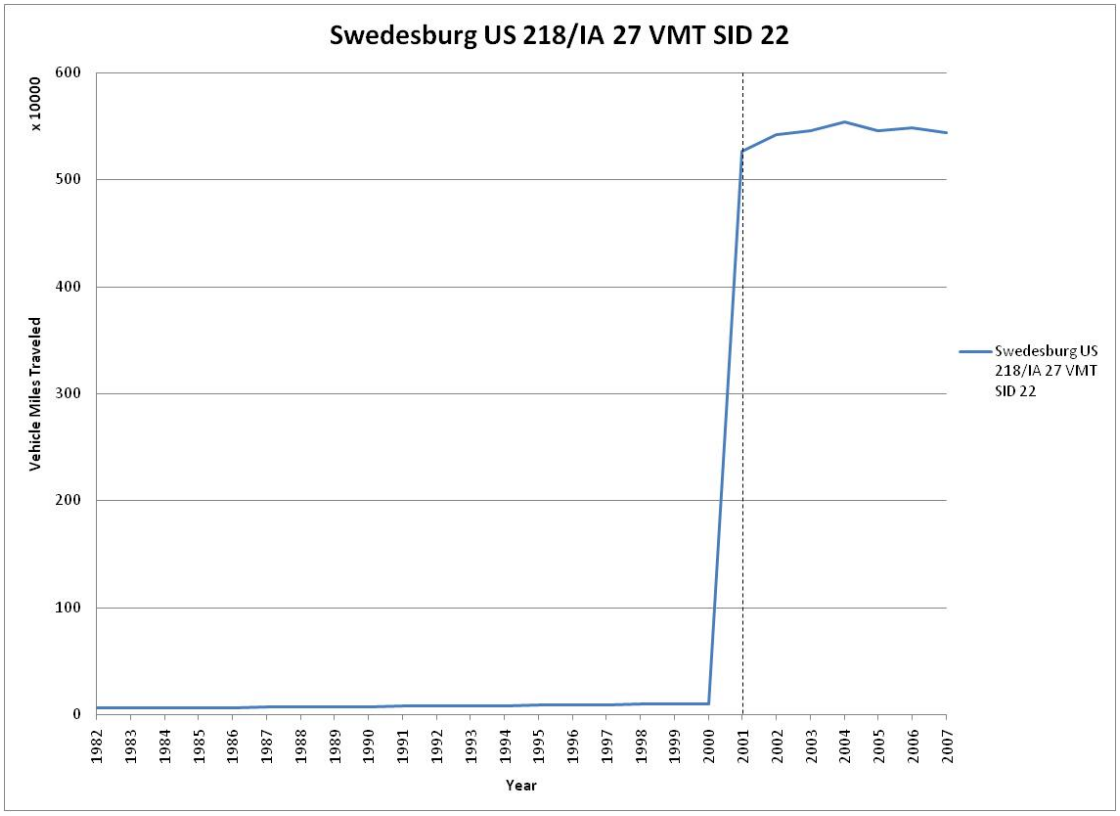


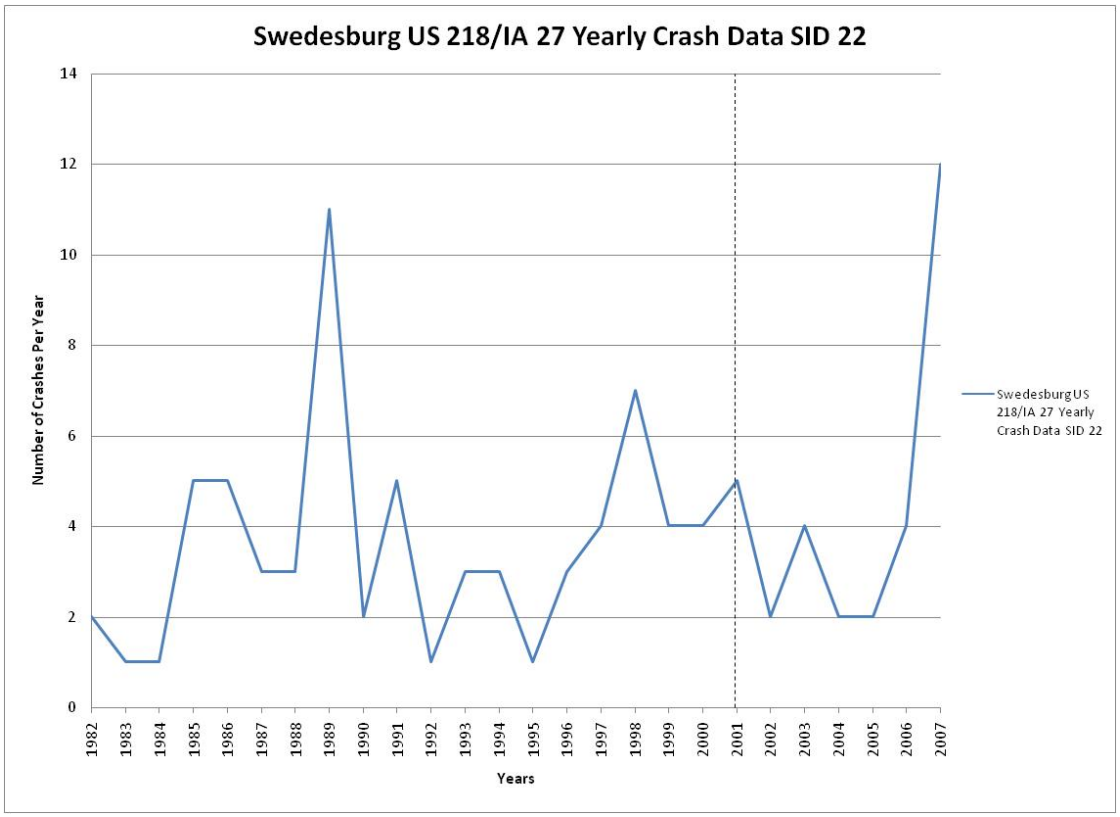
SID 21 - Mount Pleasant



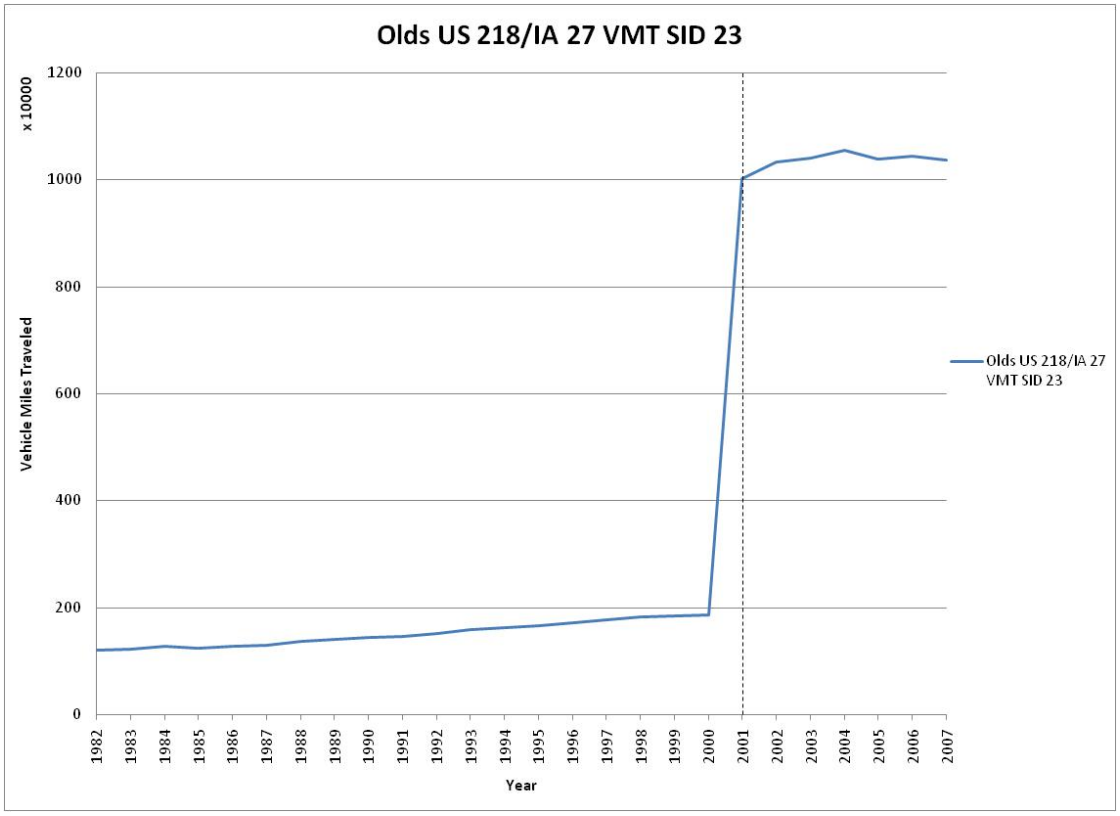


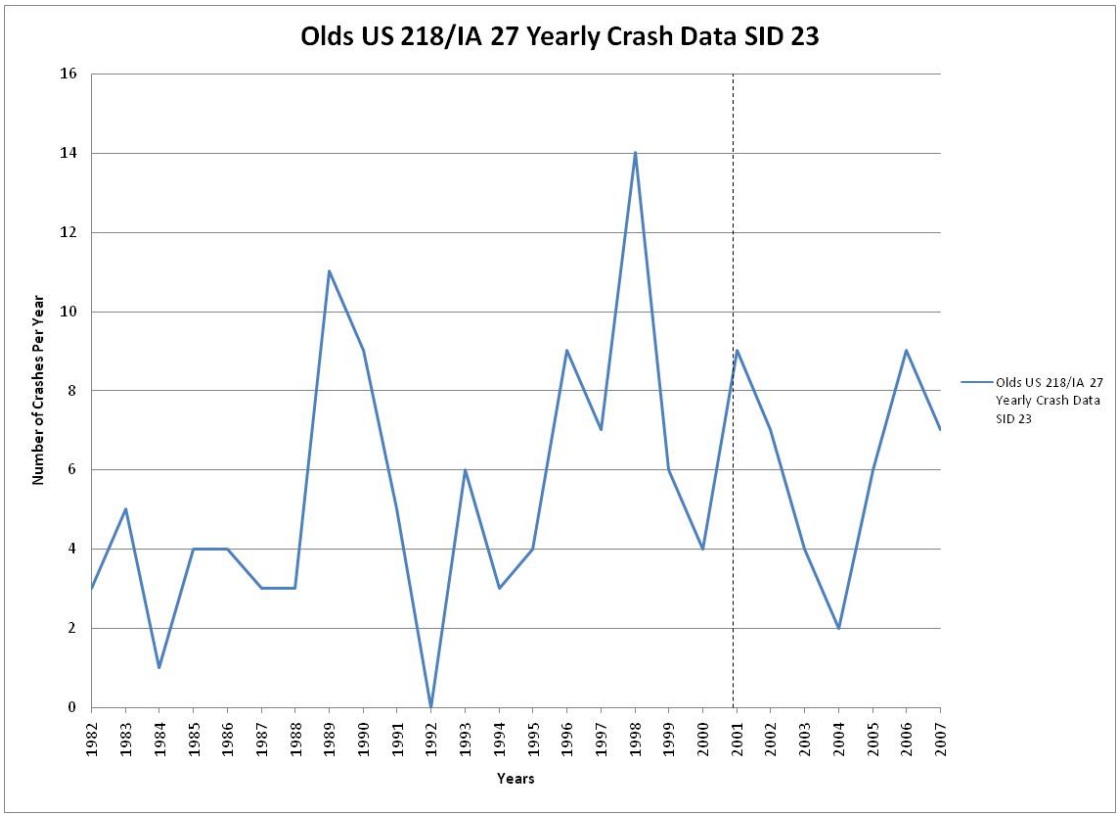
SID 22 - Swedesburg



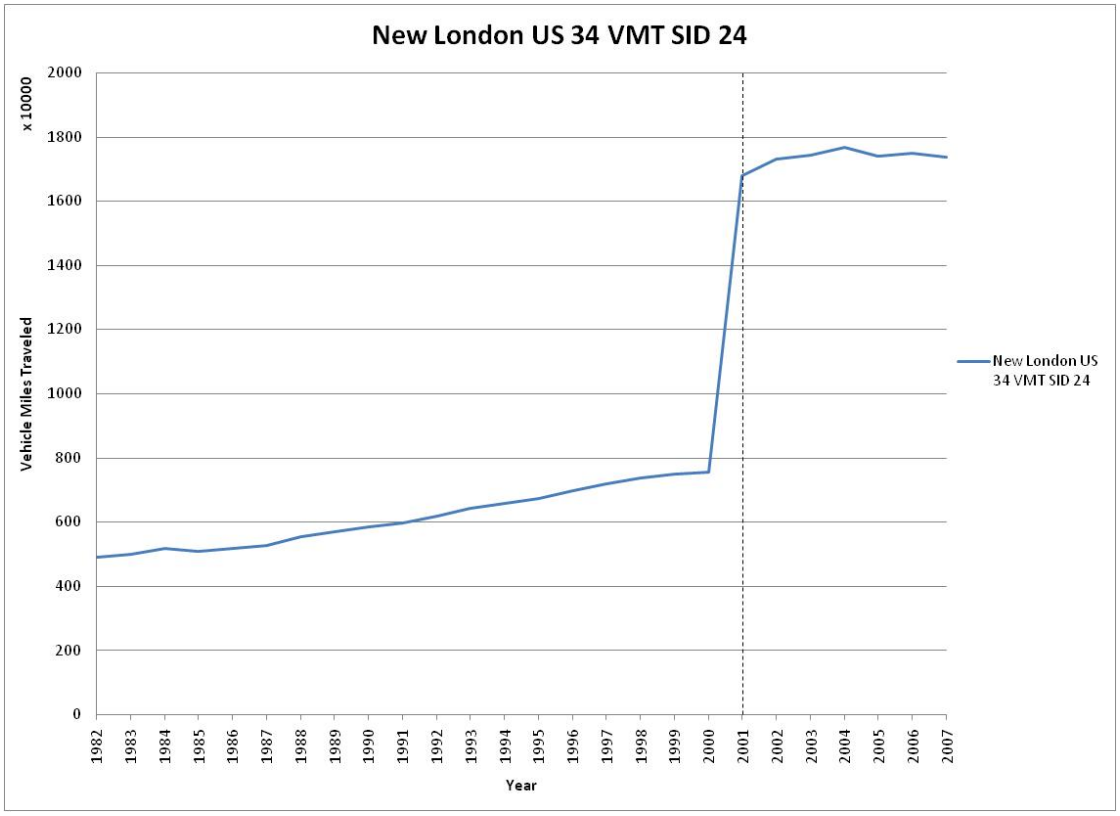


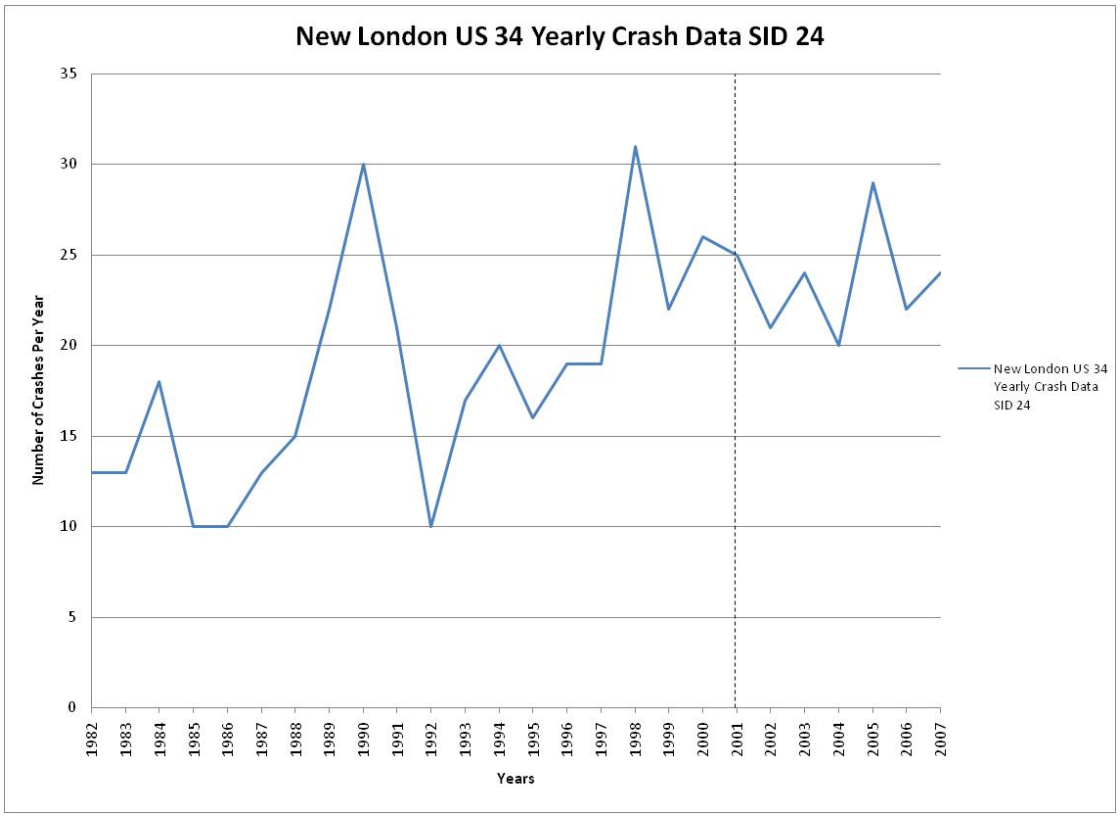
SID 23 - Olds


Olds US 218/IA 27 VMT SID 23
x 10000
Vehicle Miles Traveled
1200
1000
800
600
400
200
0
1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Year
Olds US 218/IA 27 VMT SID 23

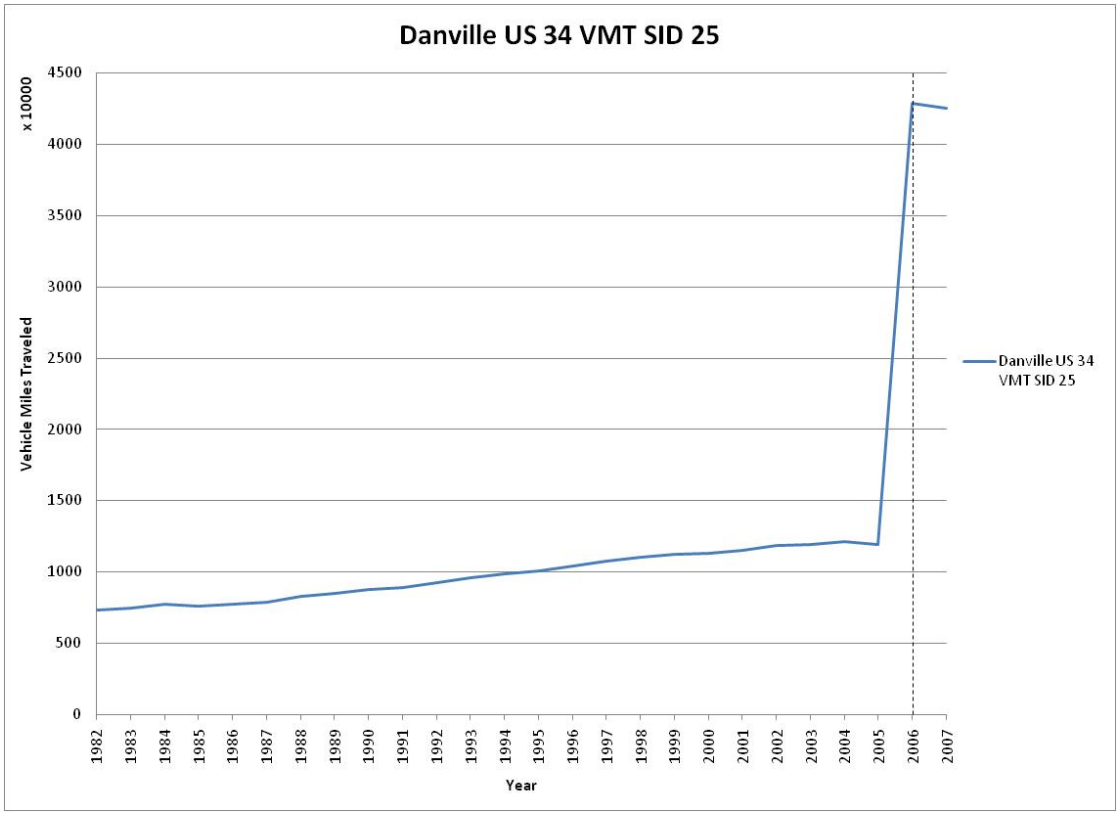

Olds US 218/IA 27 Yearly Crash Data SID 23
Number of Crashes Per Year
16
14
12
10
8
6
4
2
0
1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Years
Olds US 218/IA 27 Yearly Crash Data SID 23

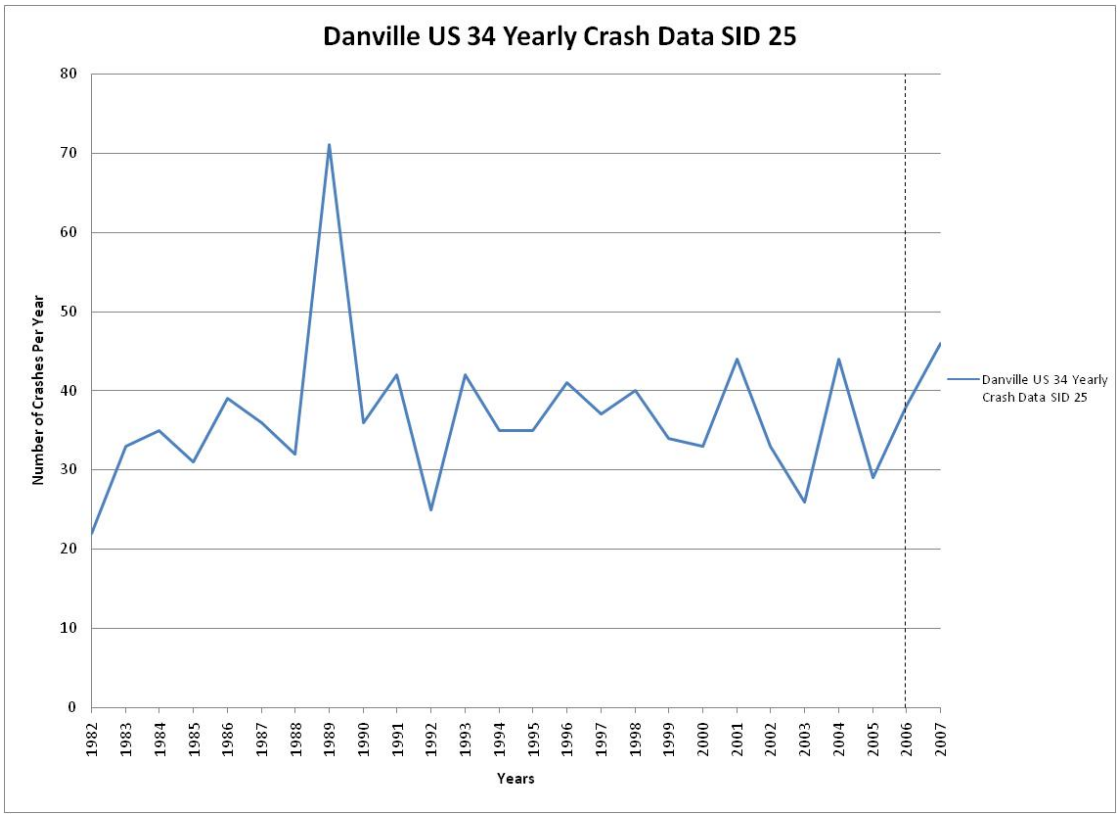
SID 24 - New London



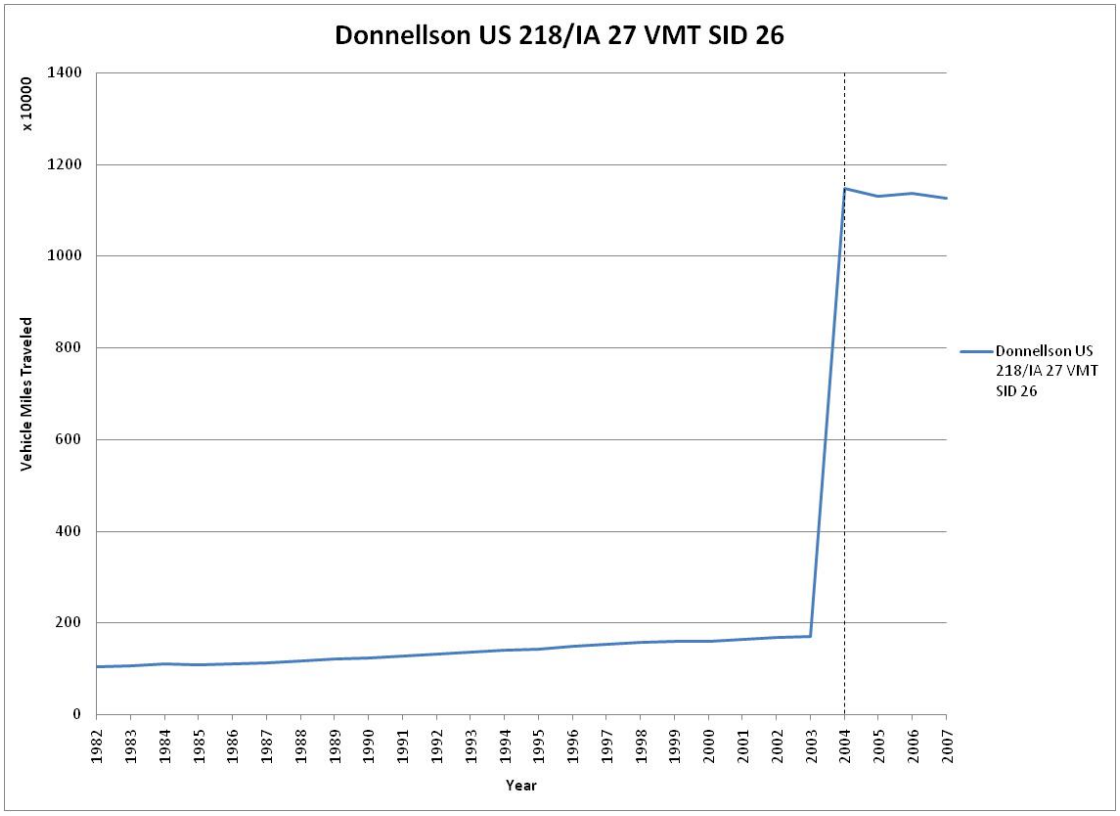


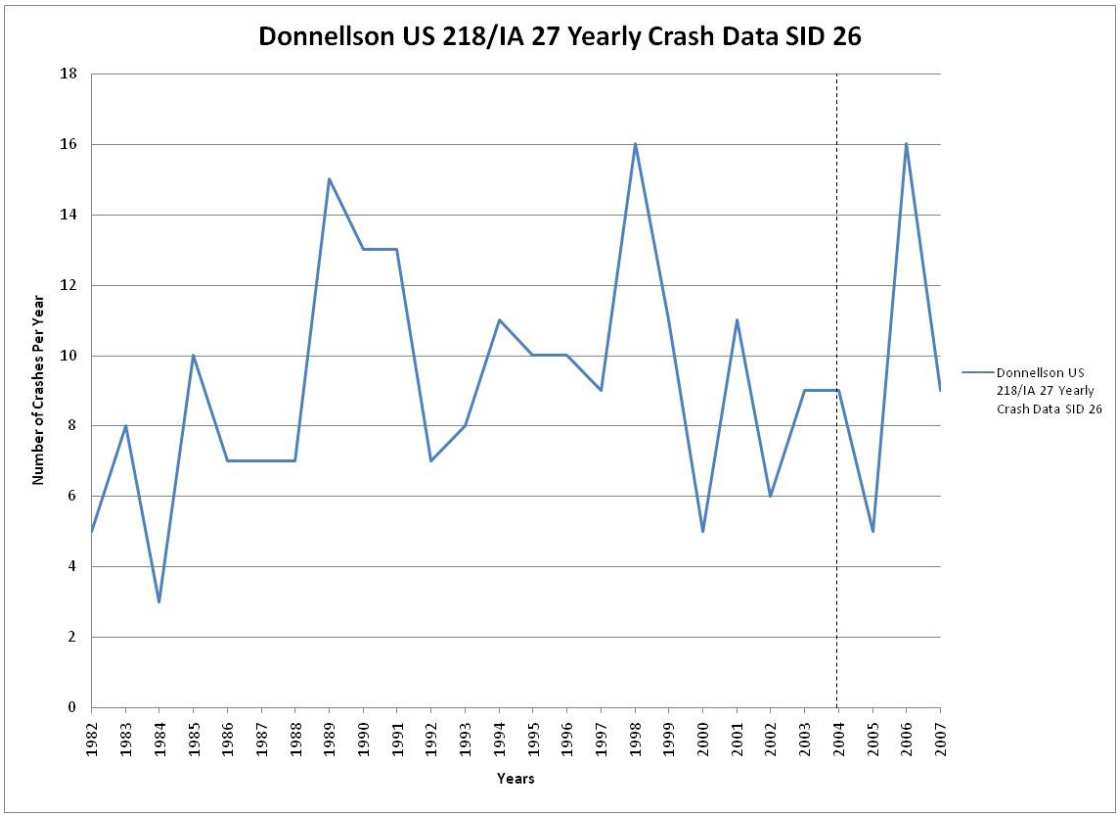
SID 25 - Danville



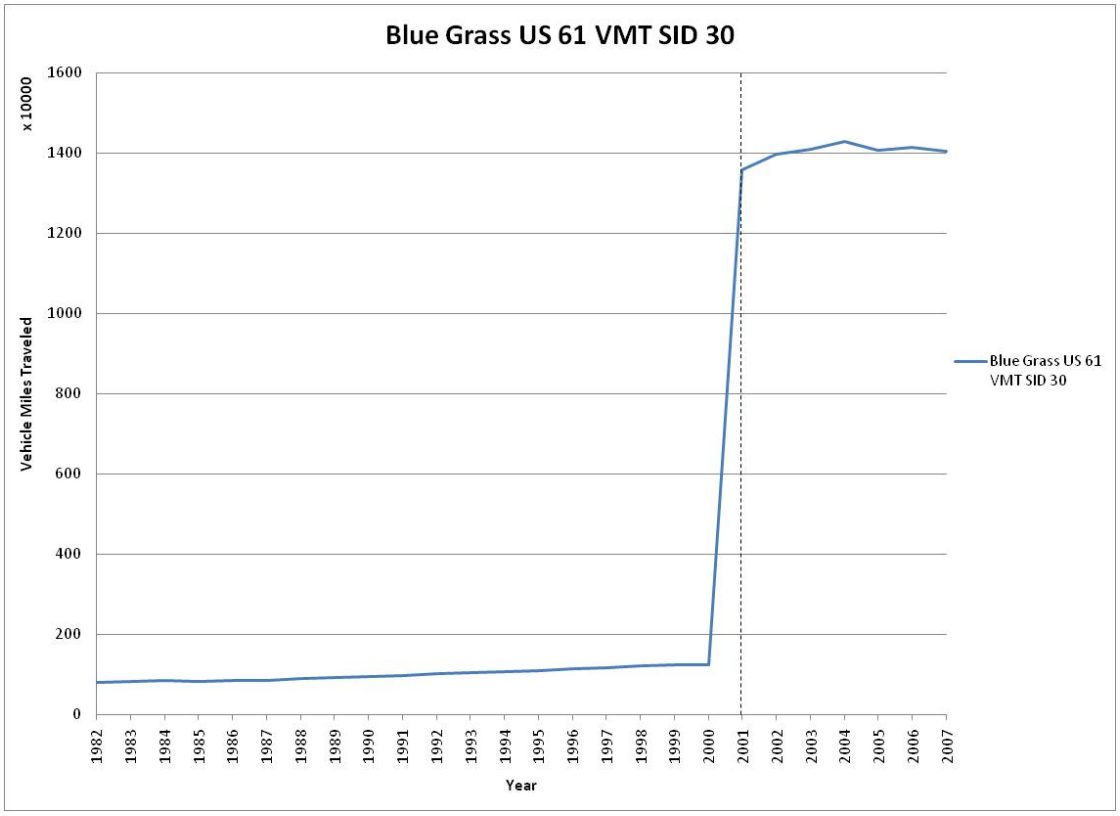


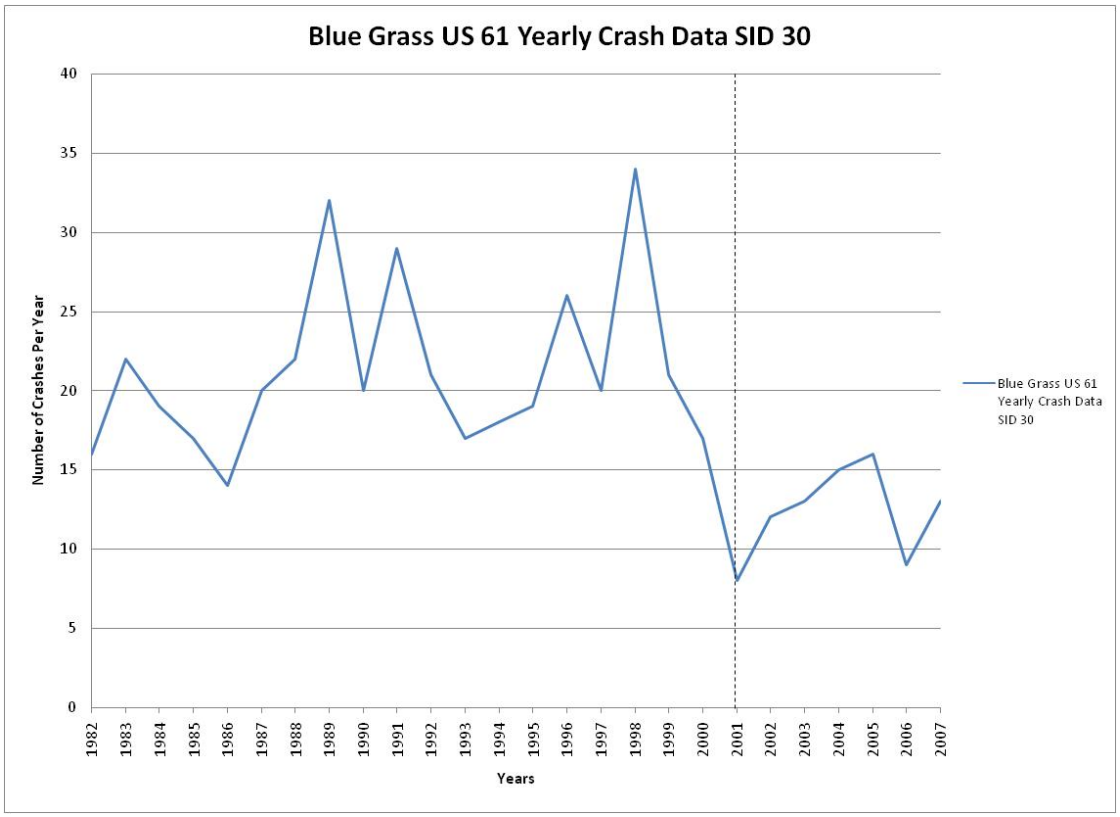
SID 26 - Donnellson



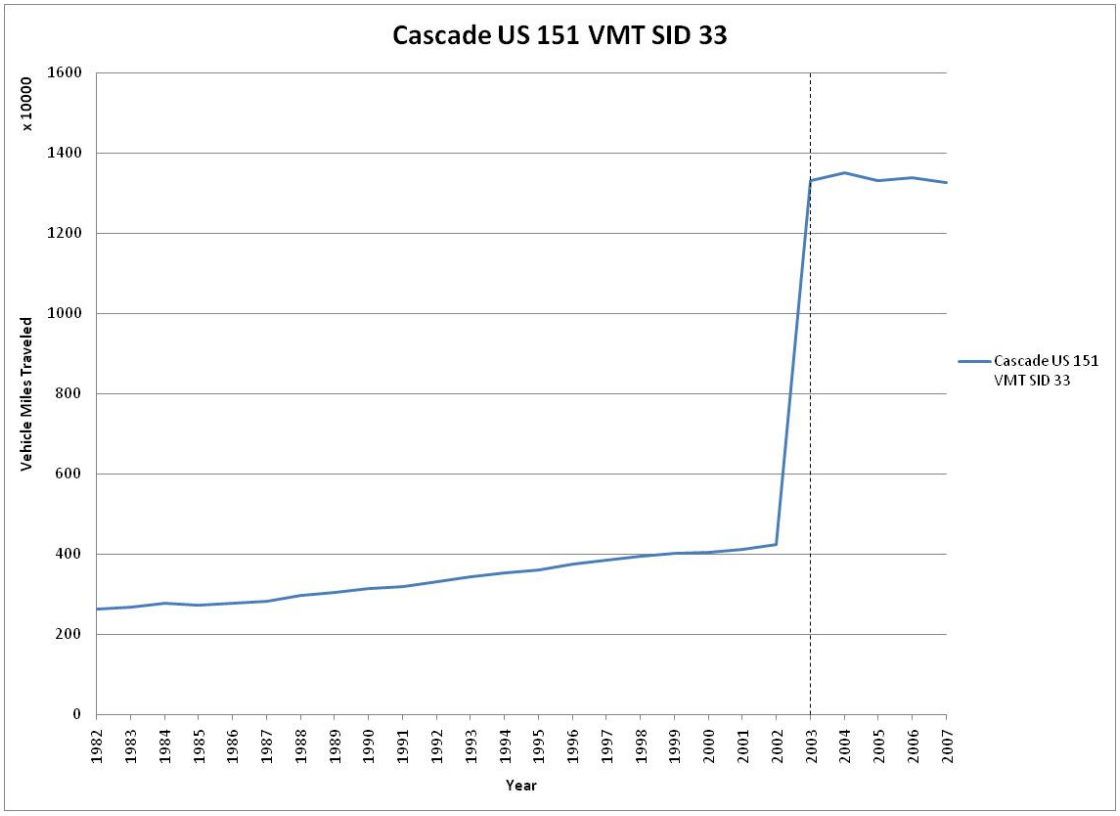


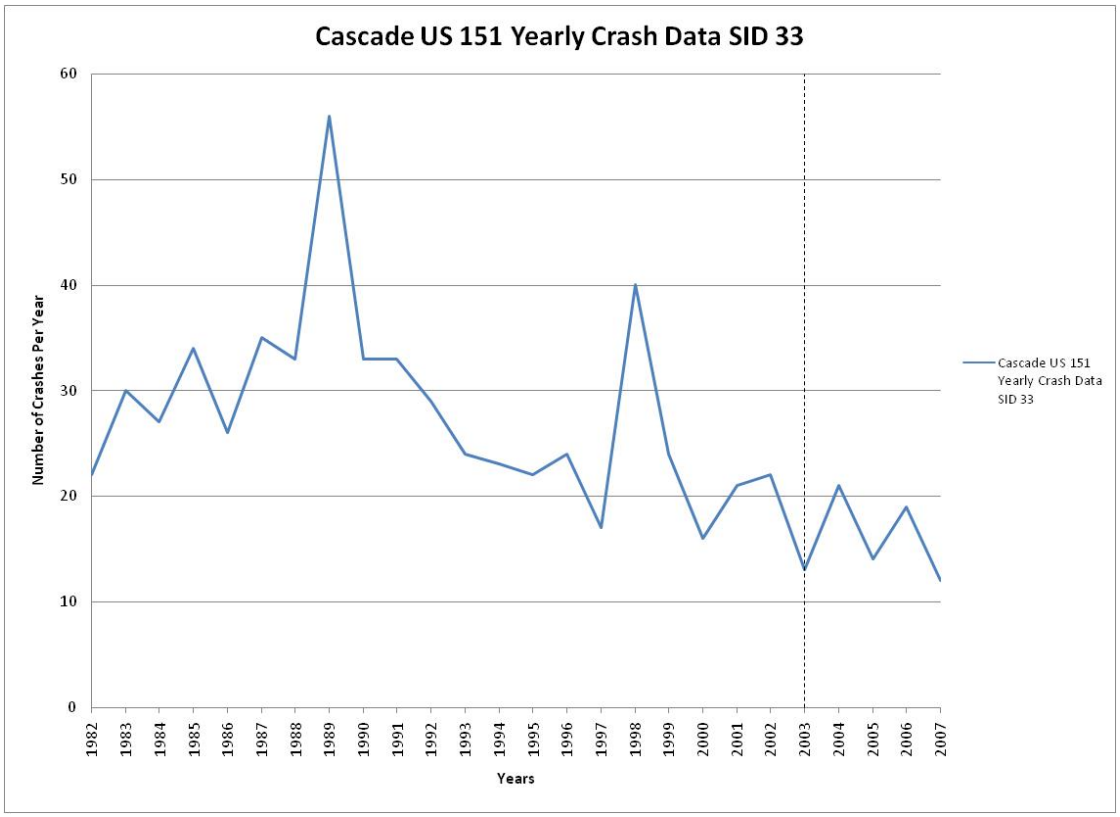
SID 30 - Blue Grass



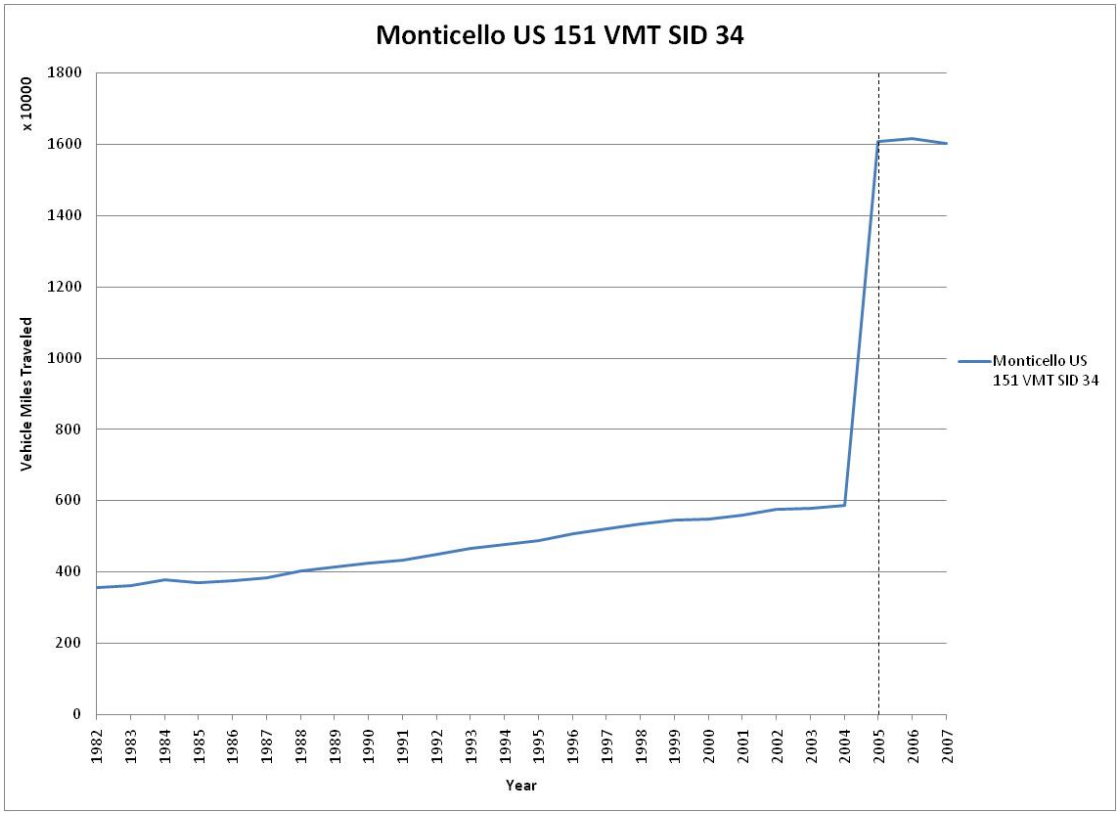


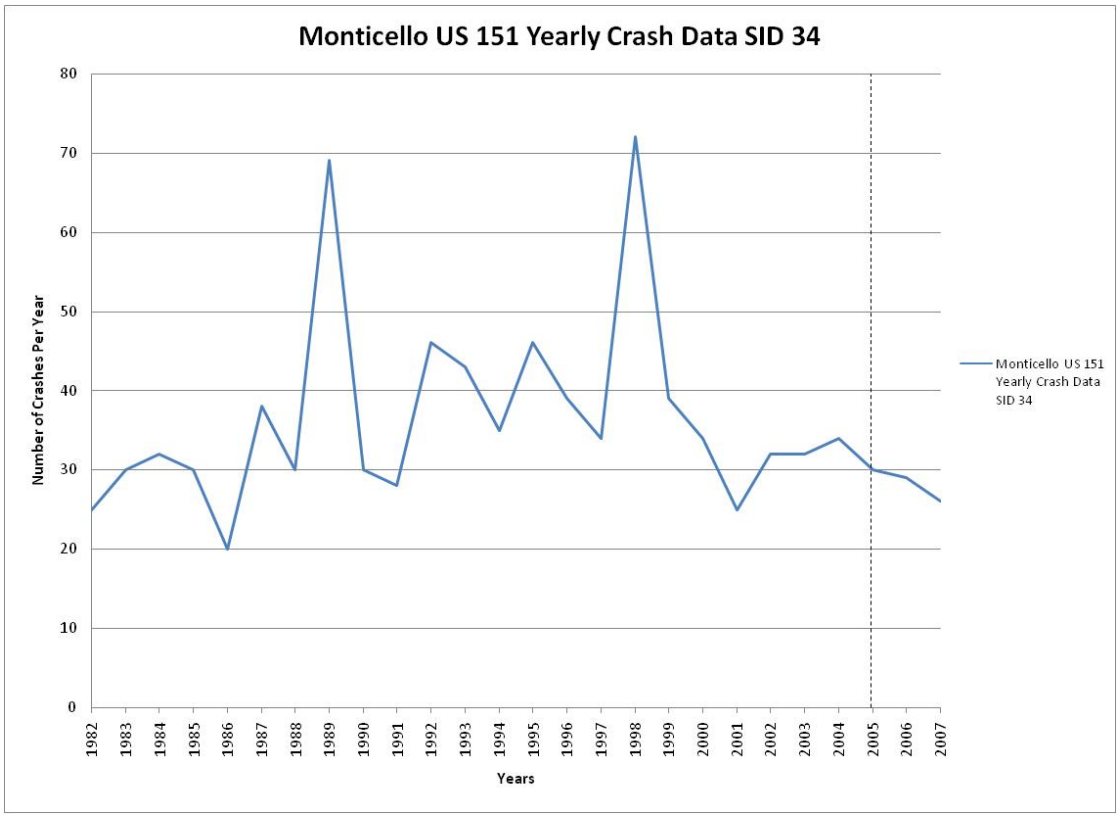
SID 33 - Cascade



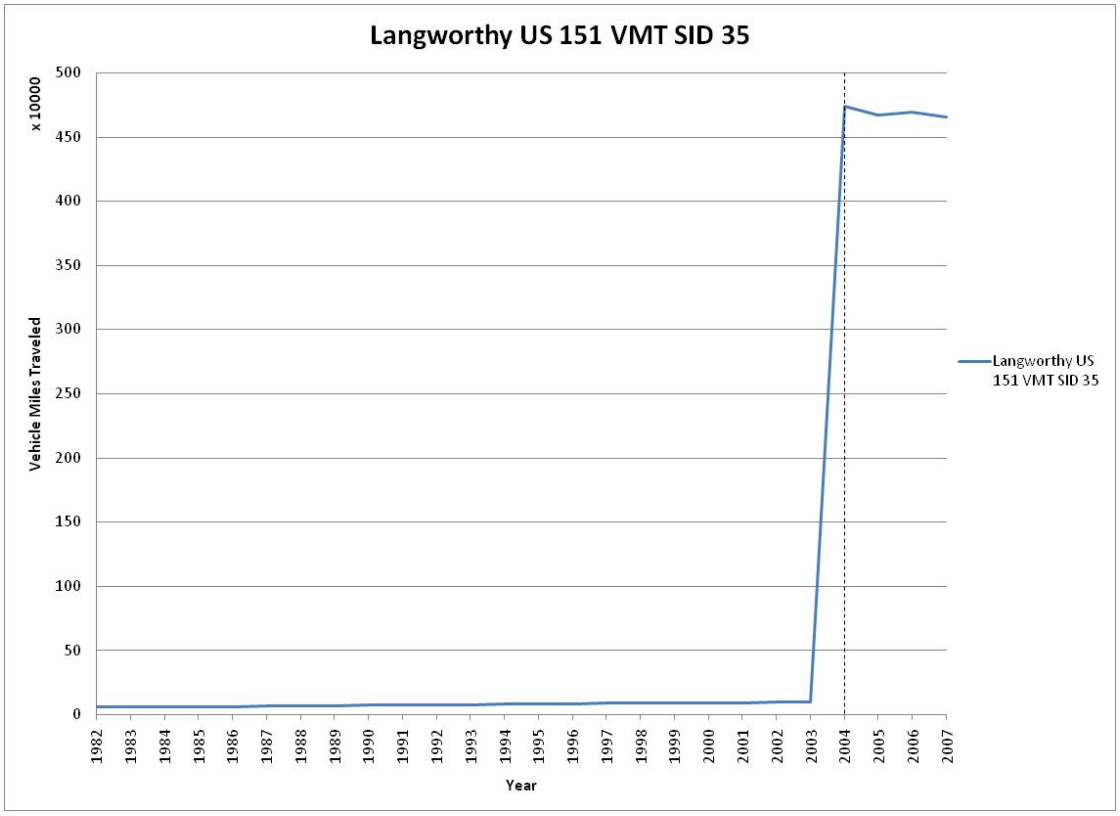


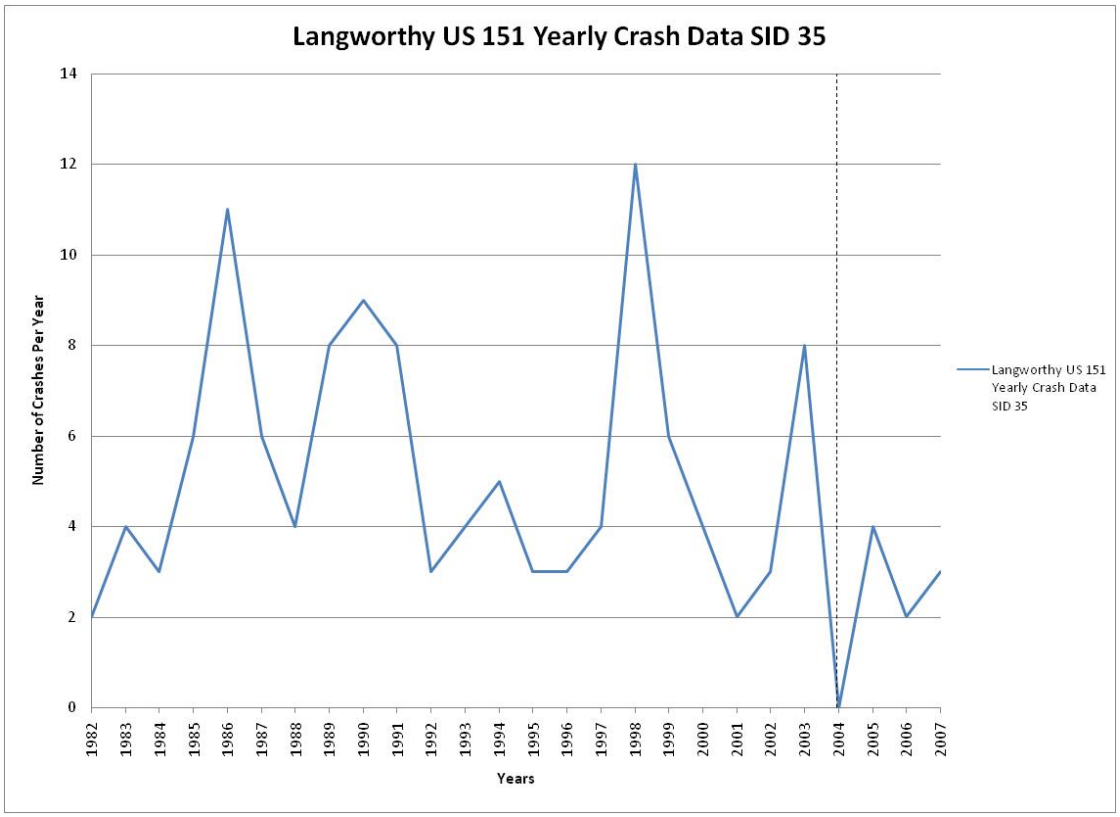
SID 34 - Monticello



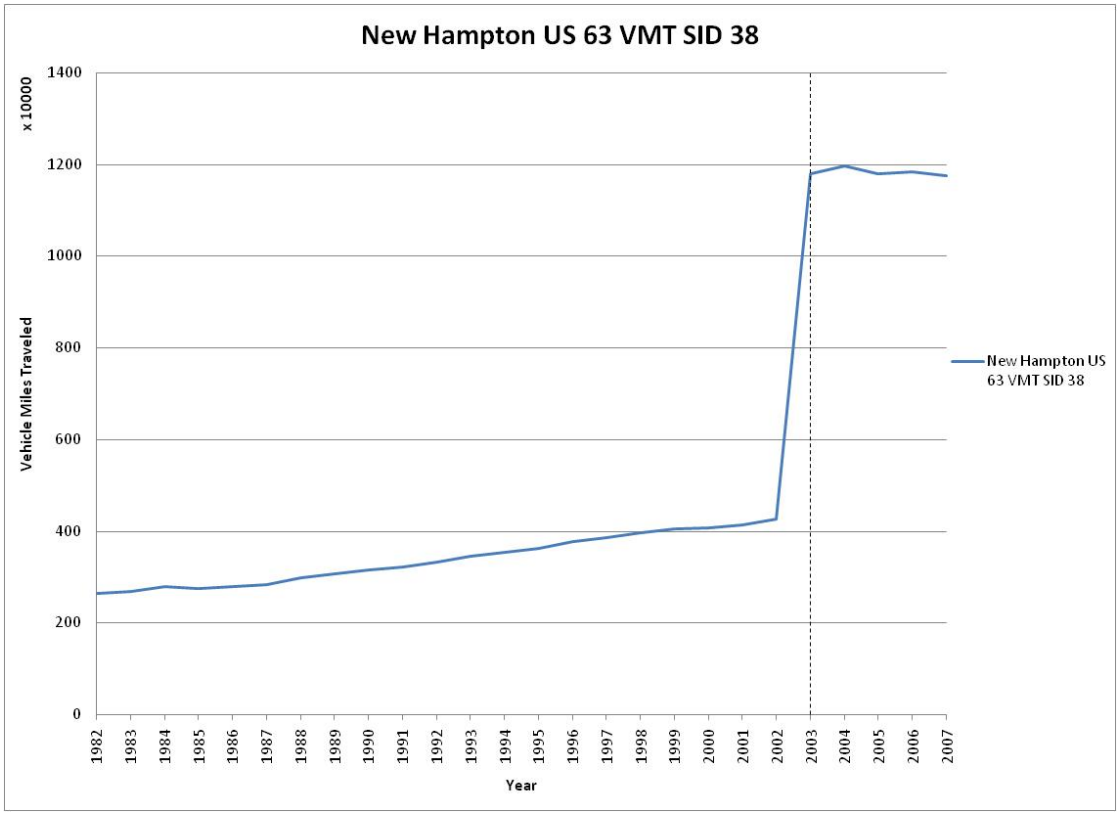


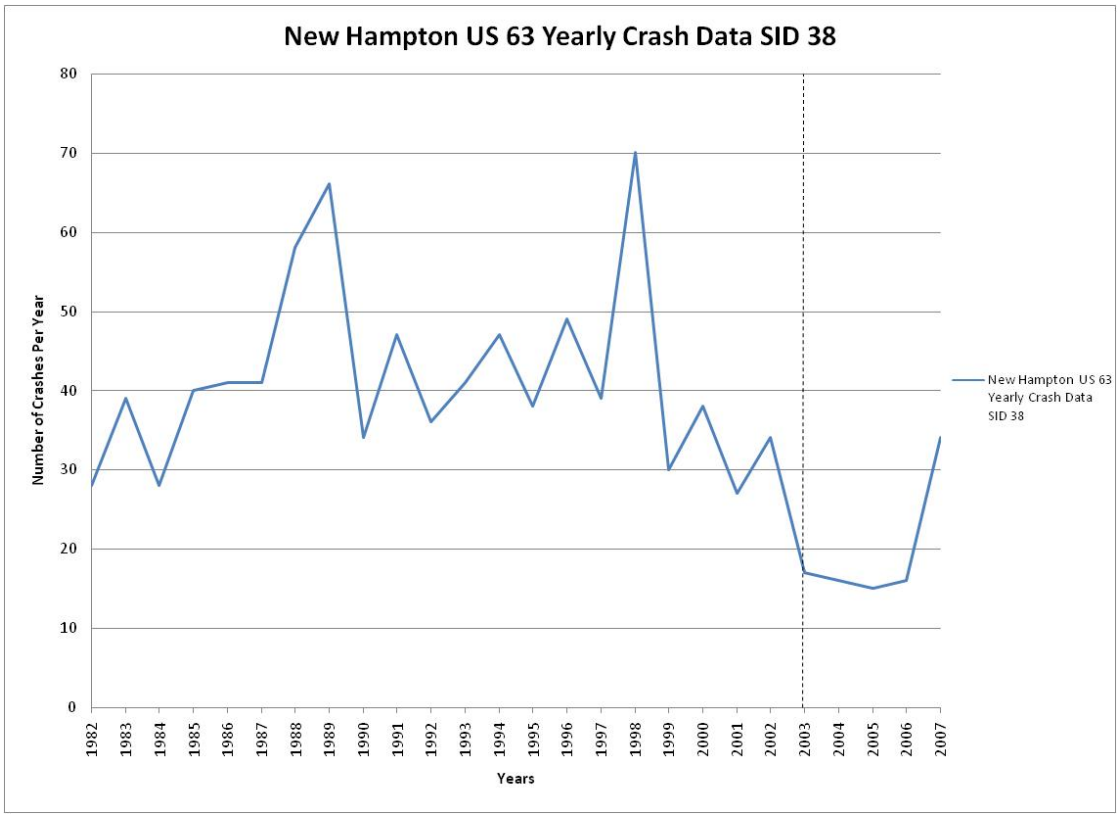
SID 35 - Langworthy



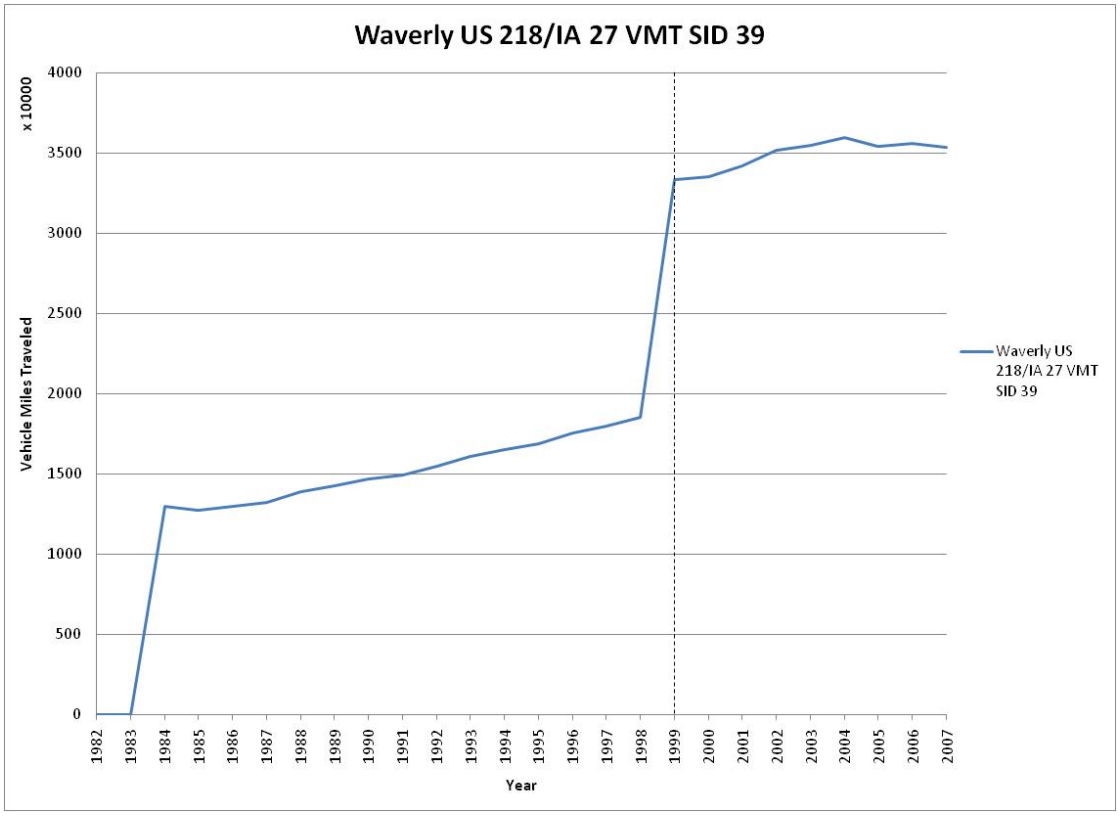


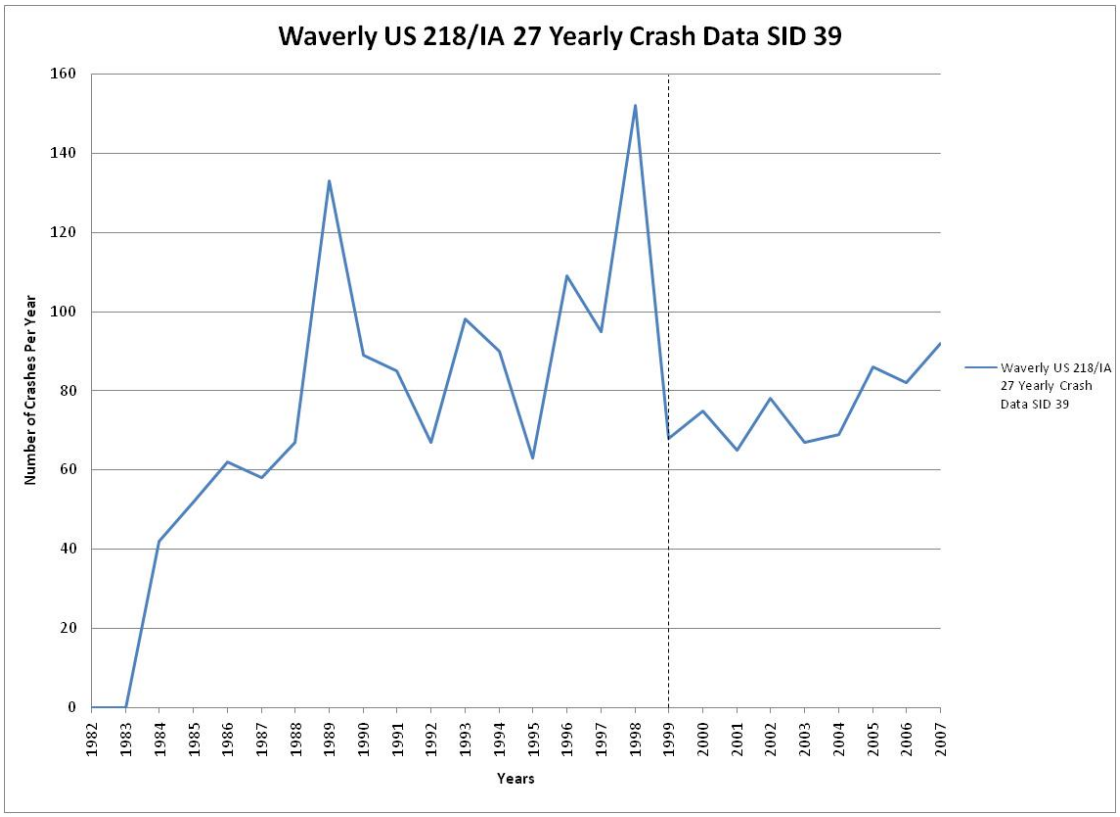
SID 38 - New Hampton



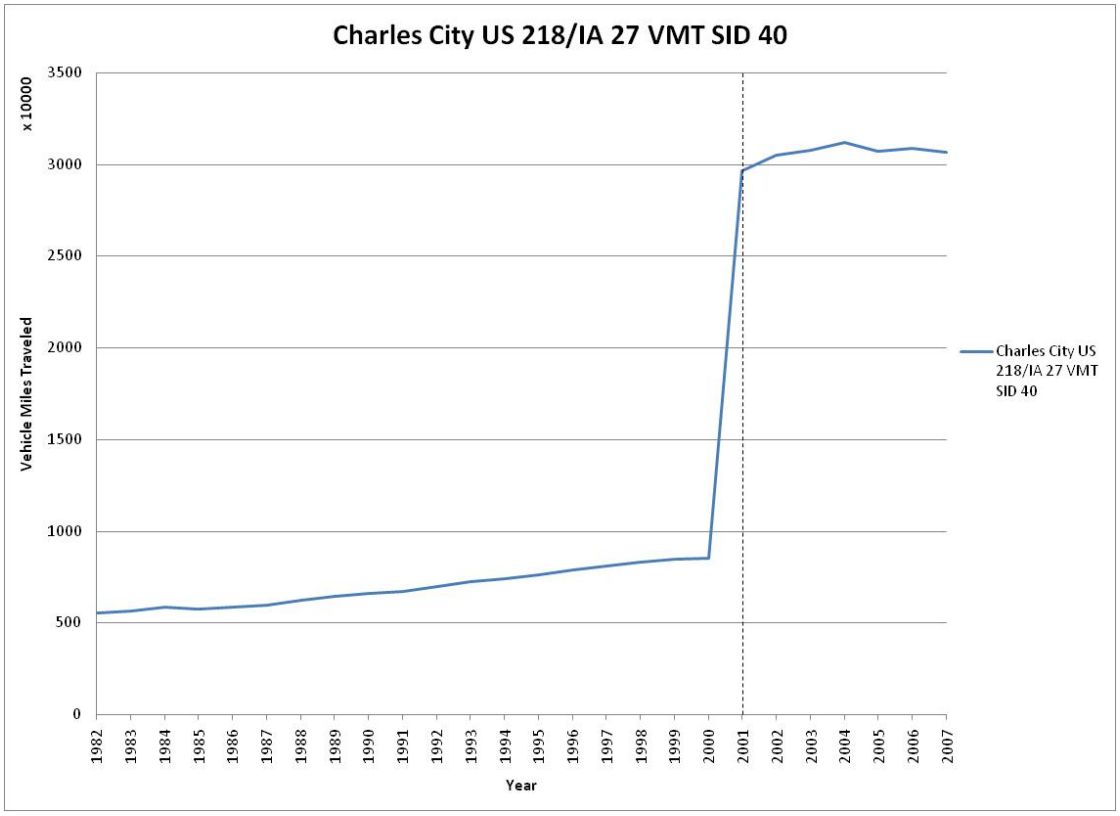


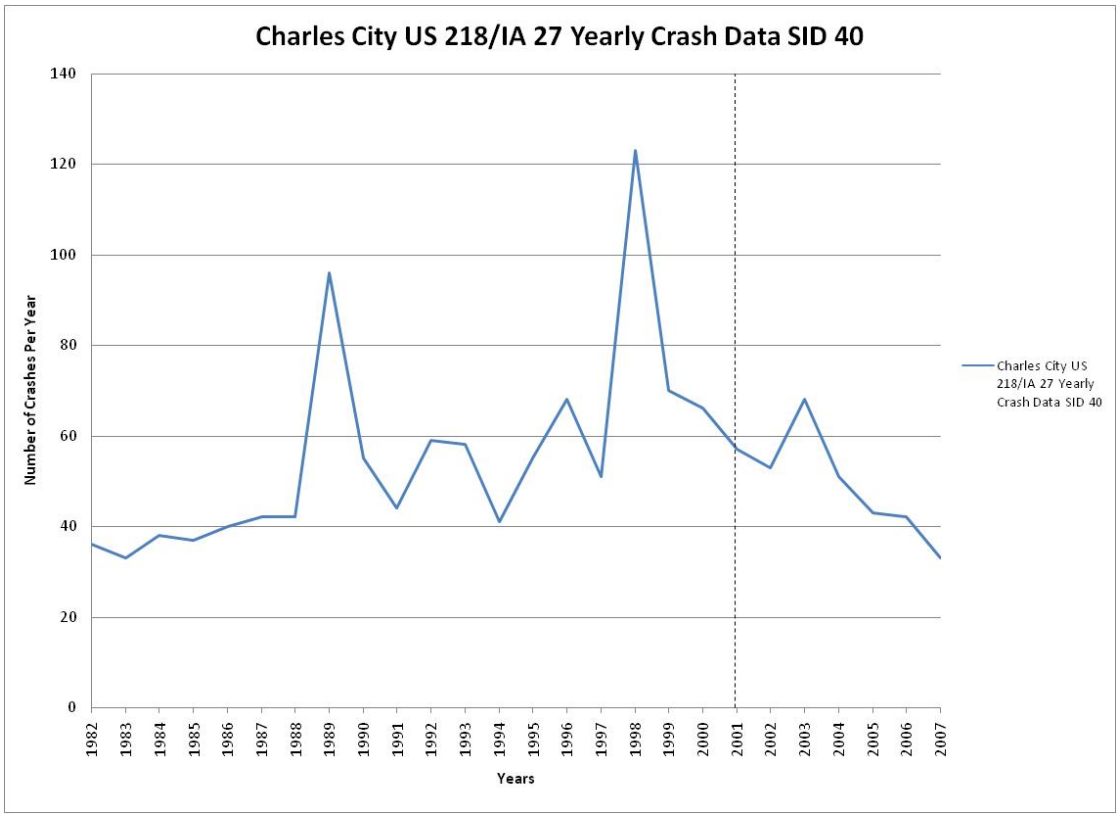
SID 39 - Waverly



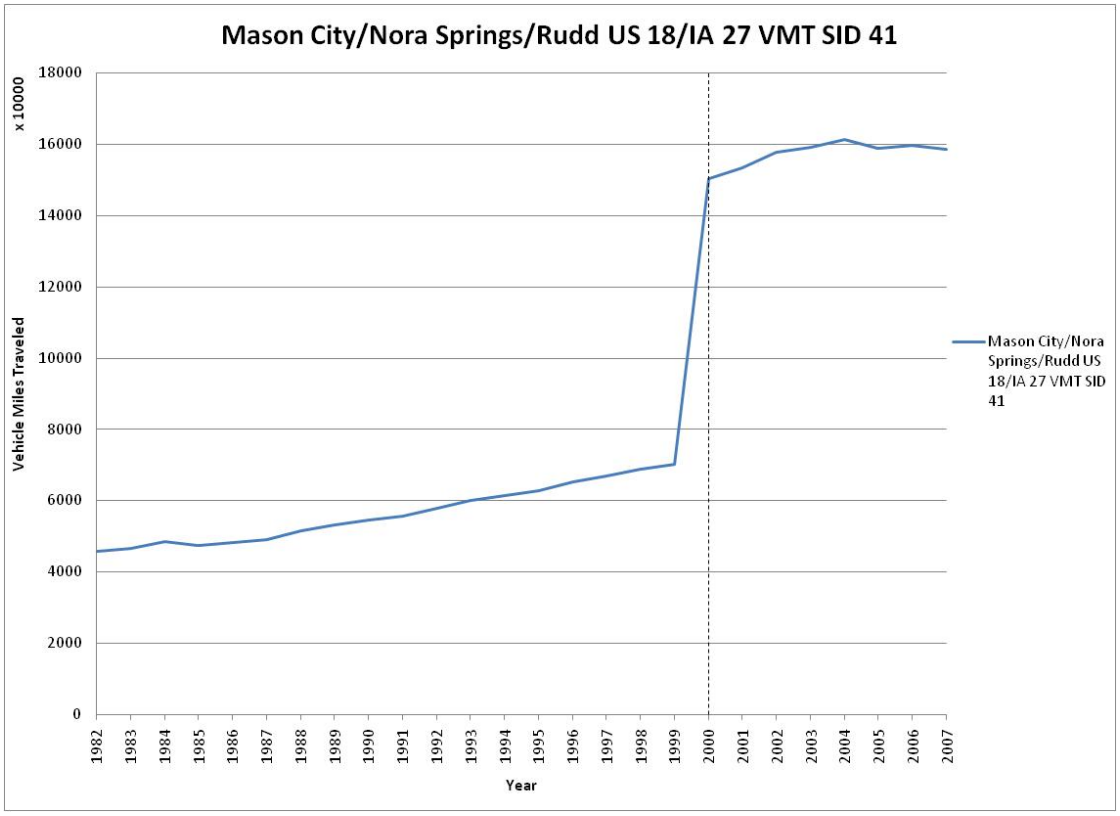


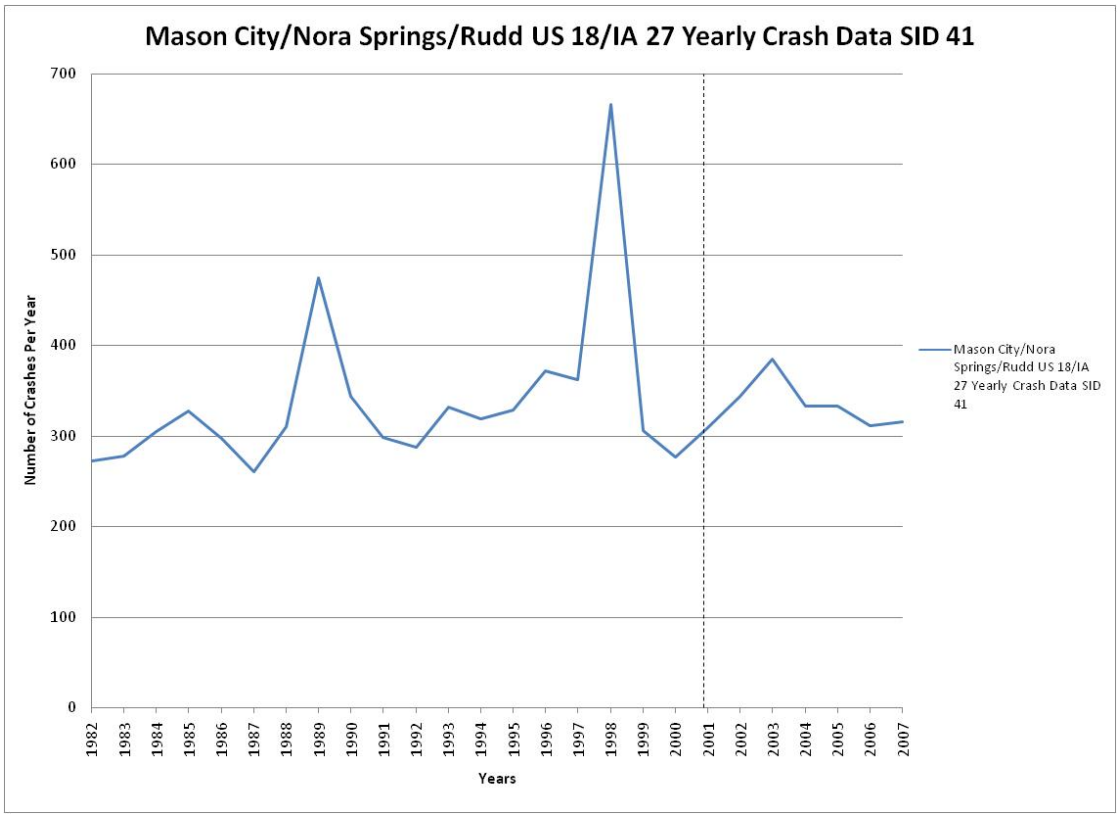
SID 40 - Charles City



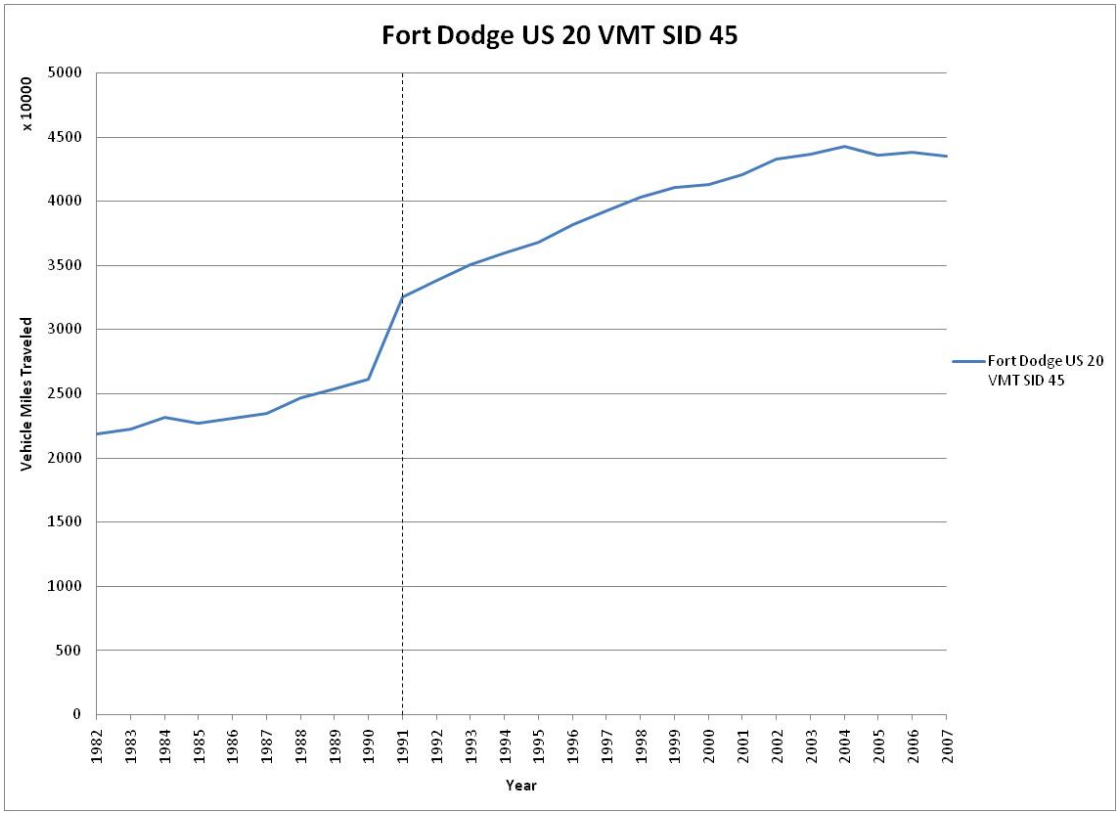


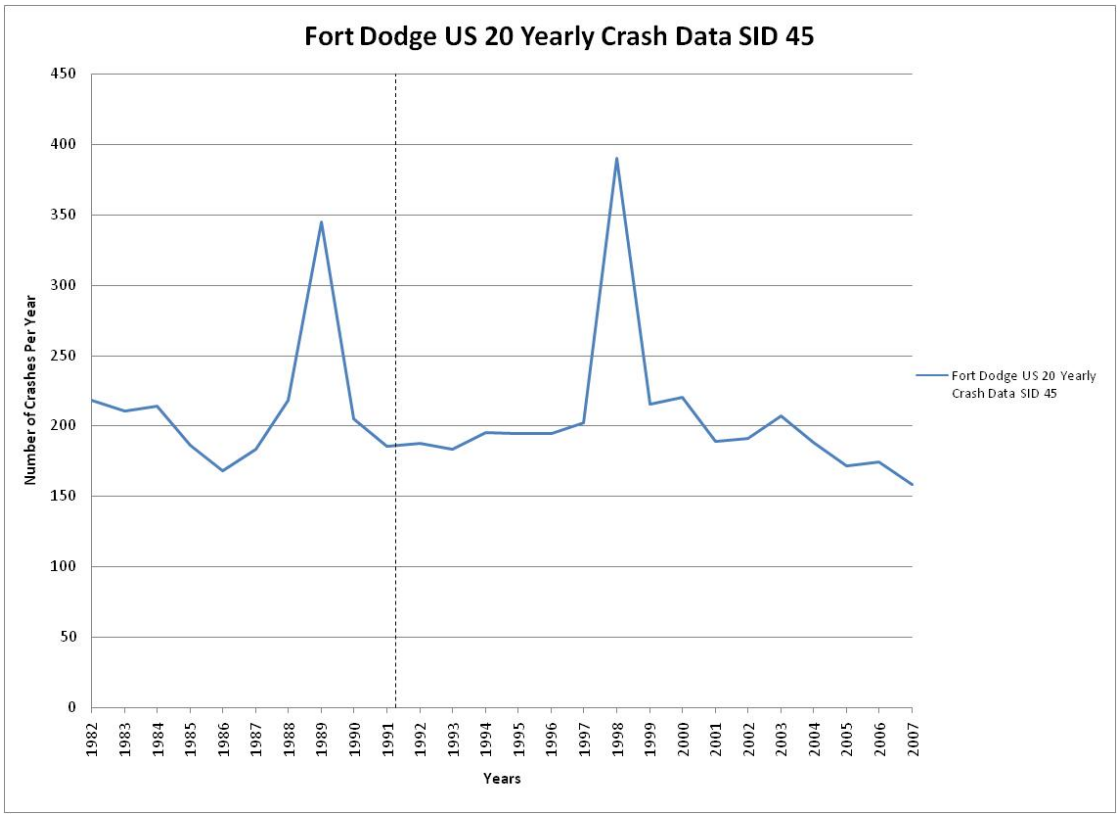
SID 41 - Mason City



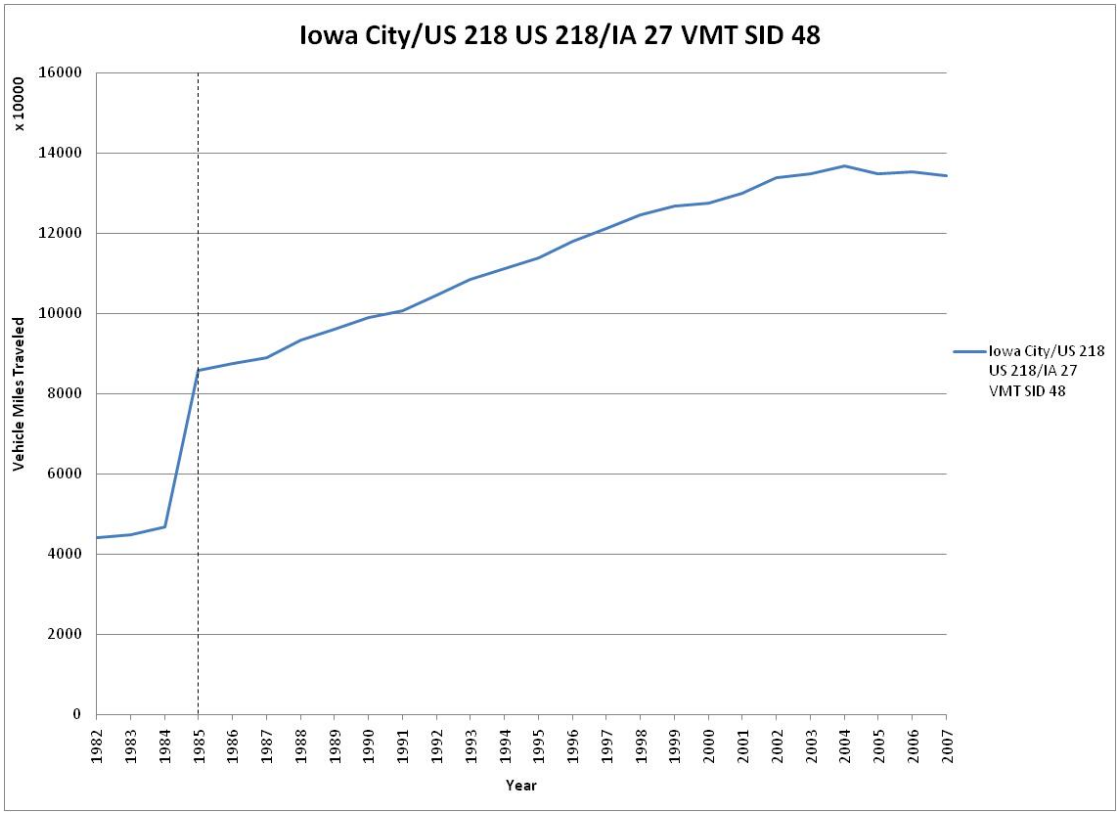


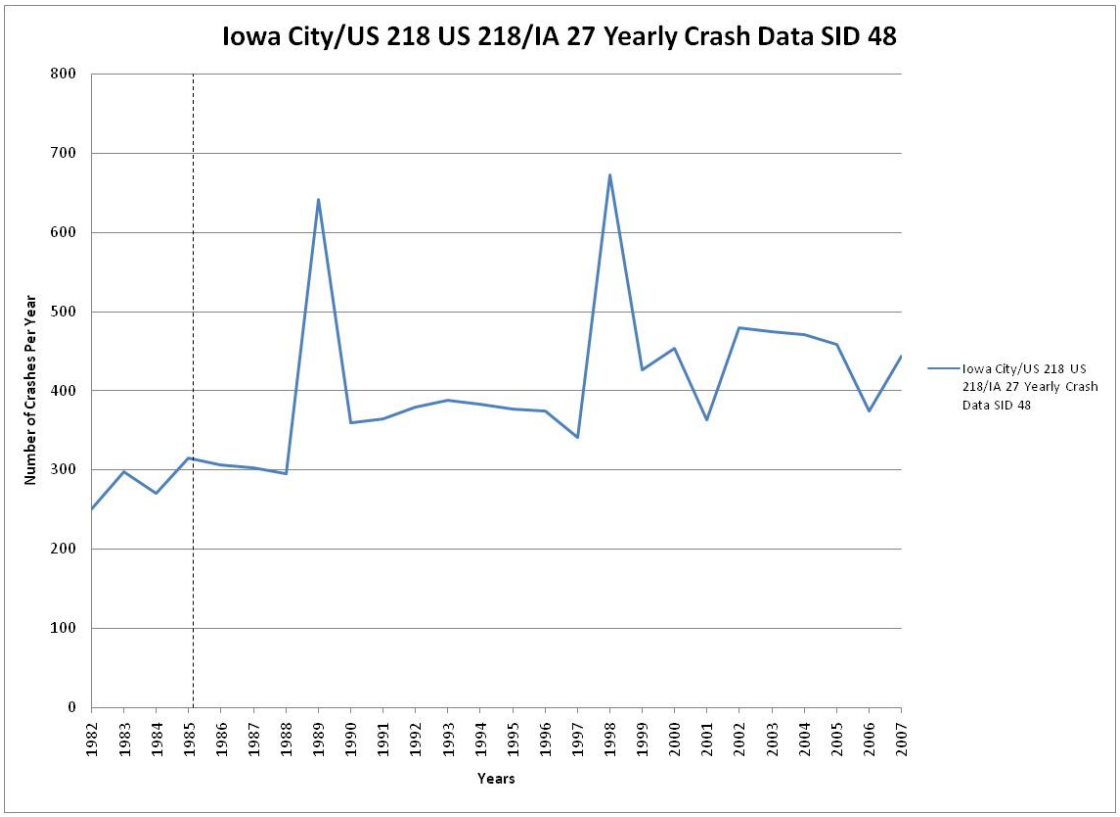
SID 45 - Fort Dodge



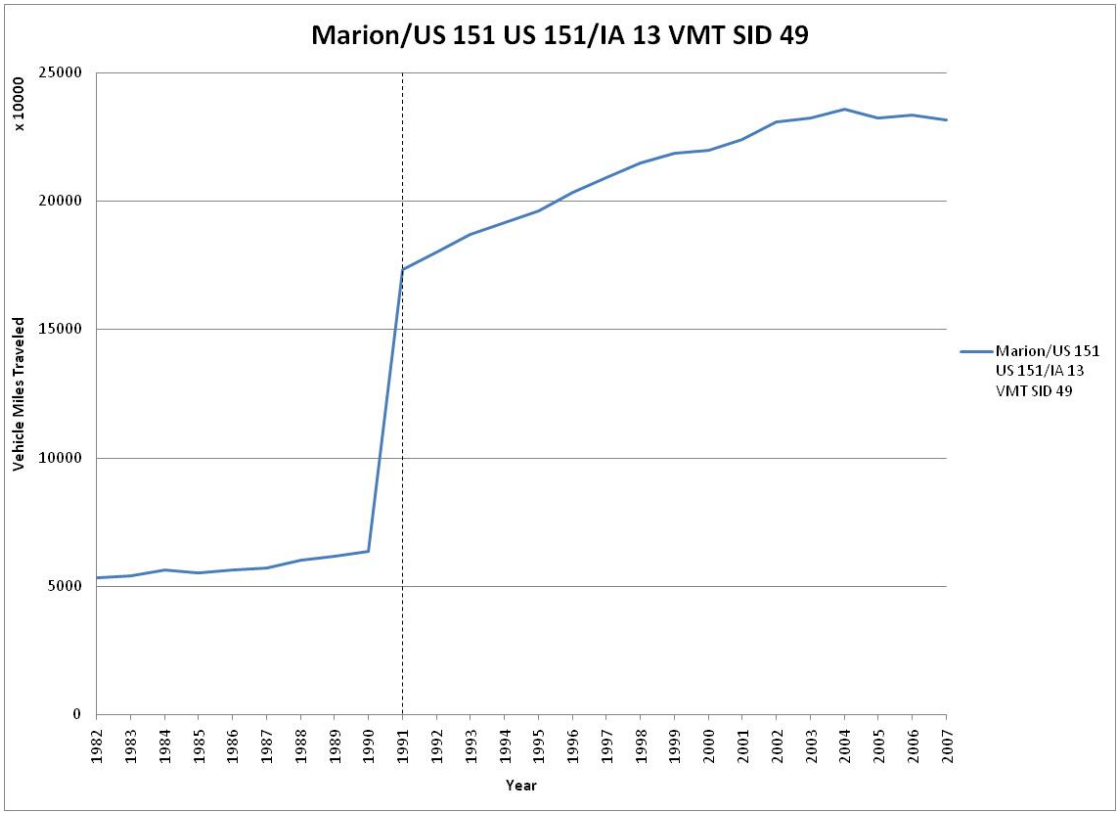


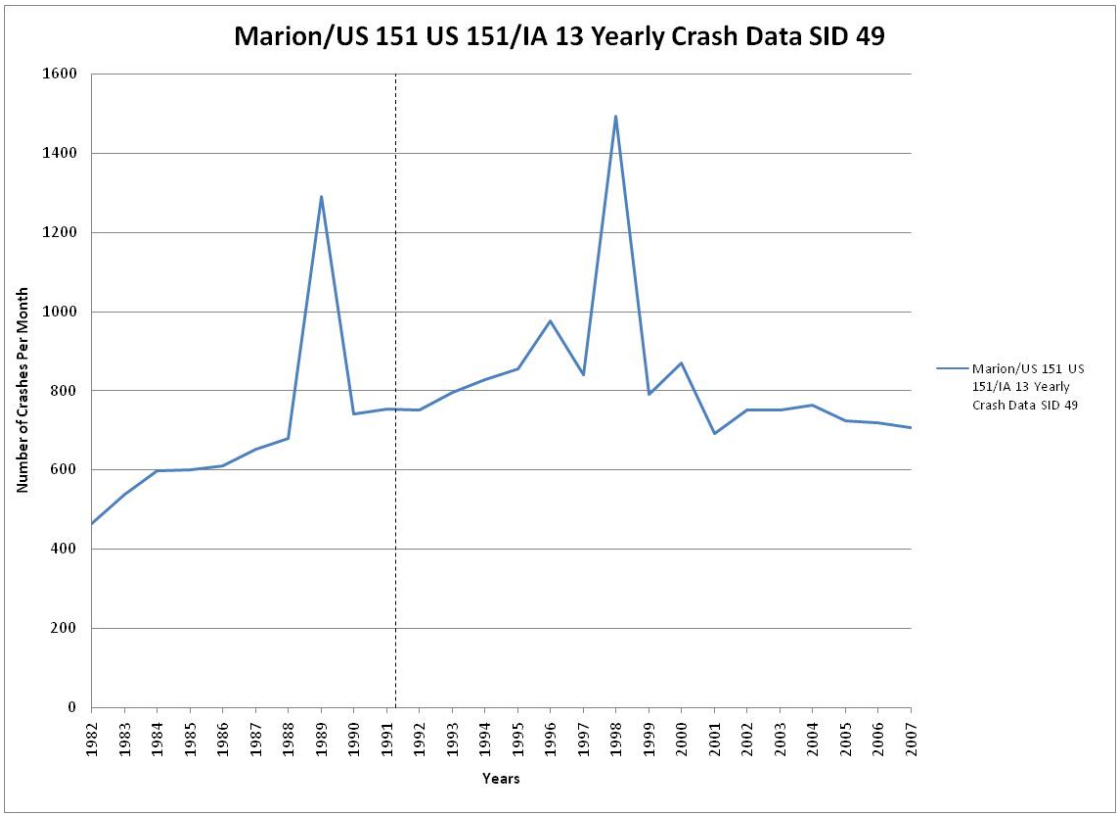
SID 48 - Iowa City



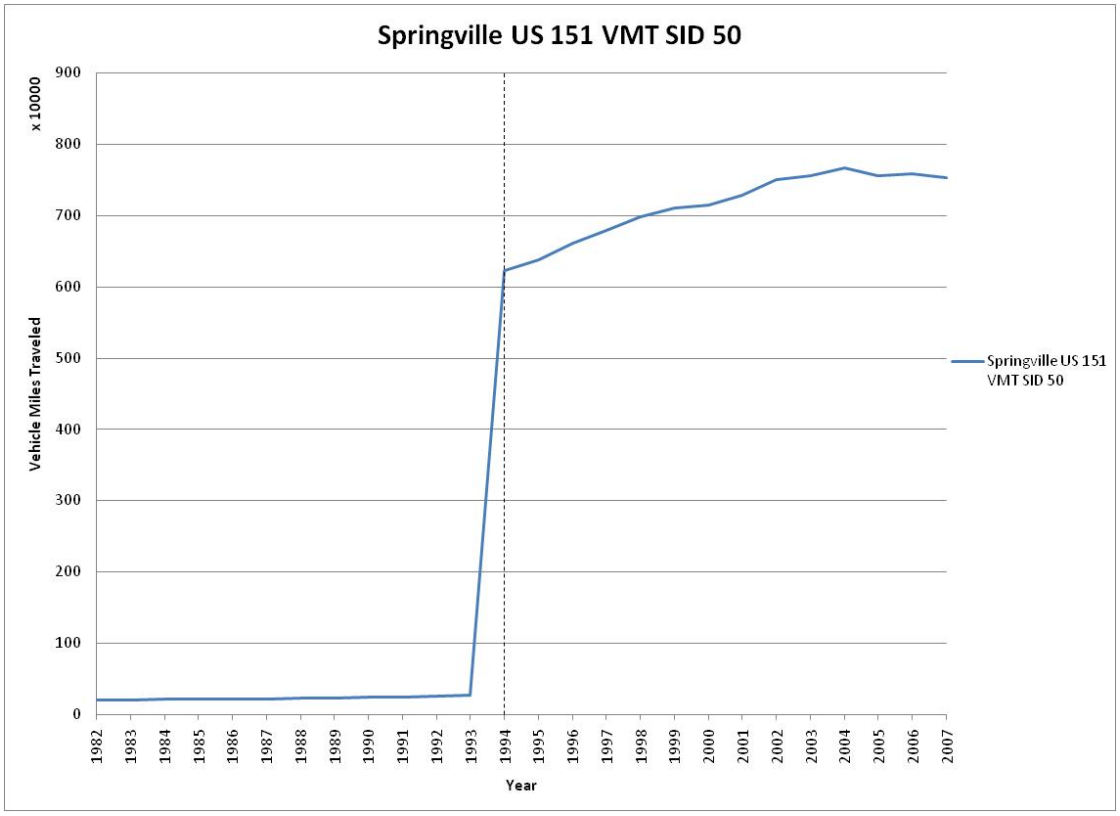


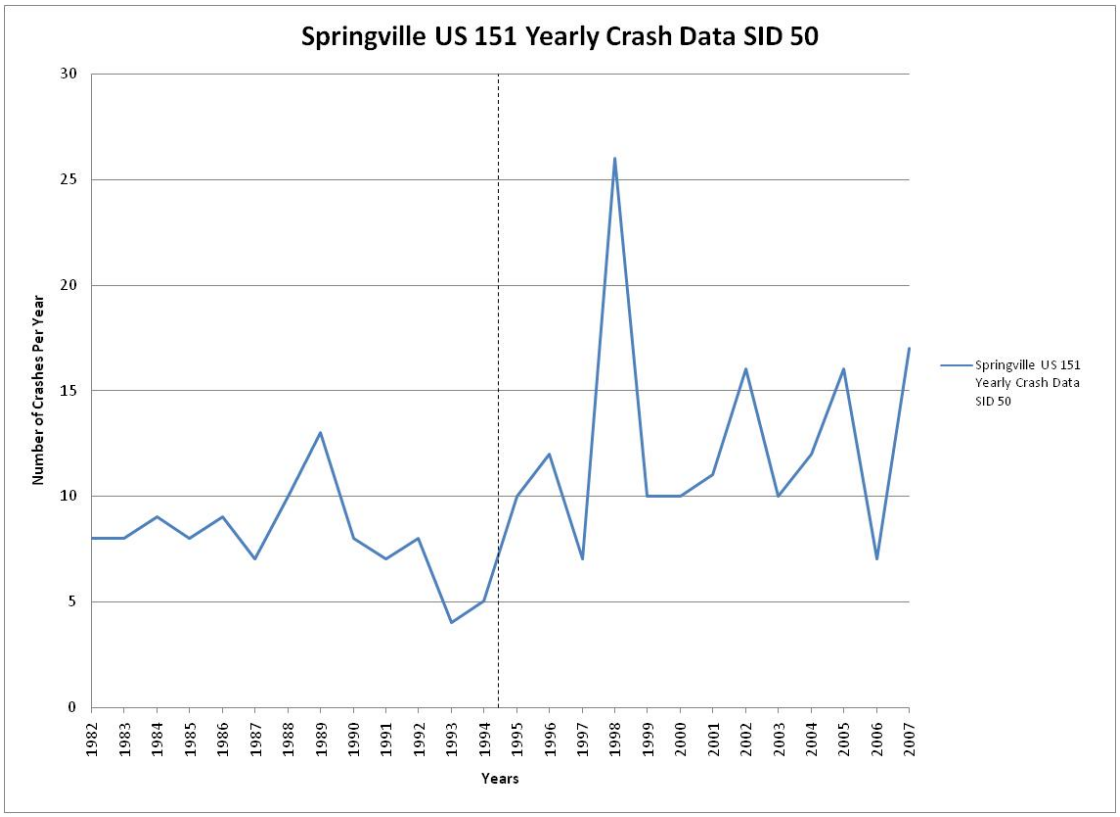
SID 49 - Marion



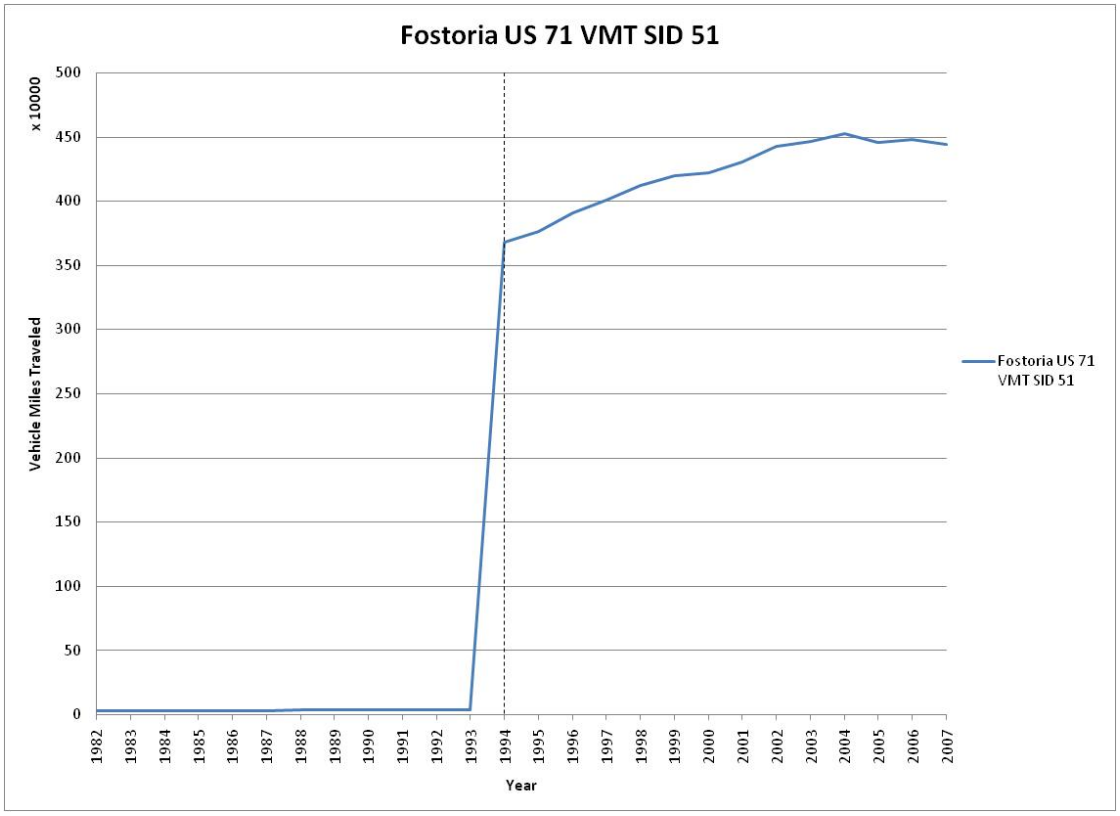


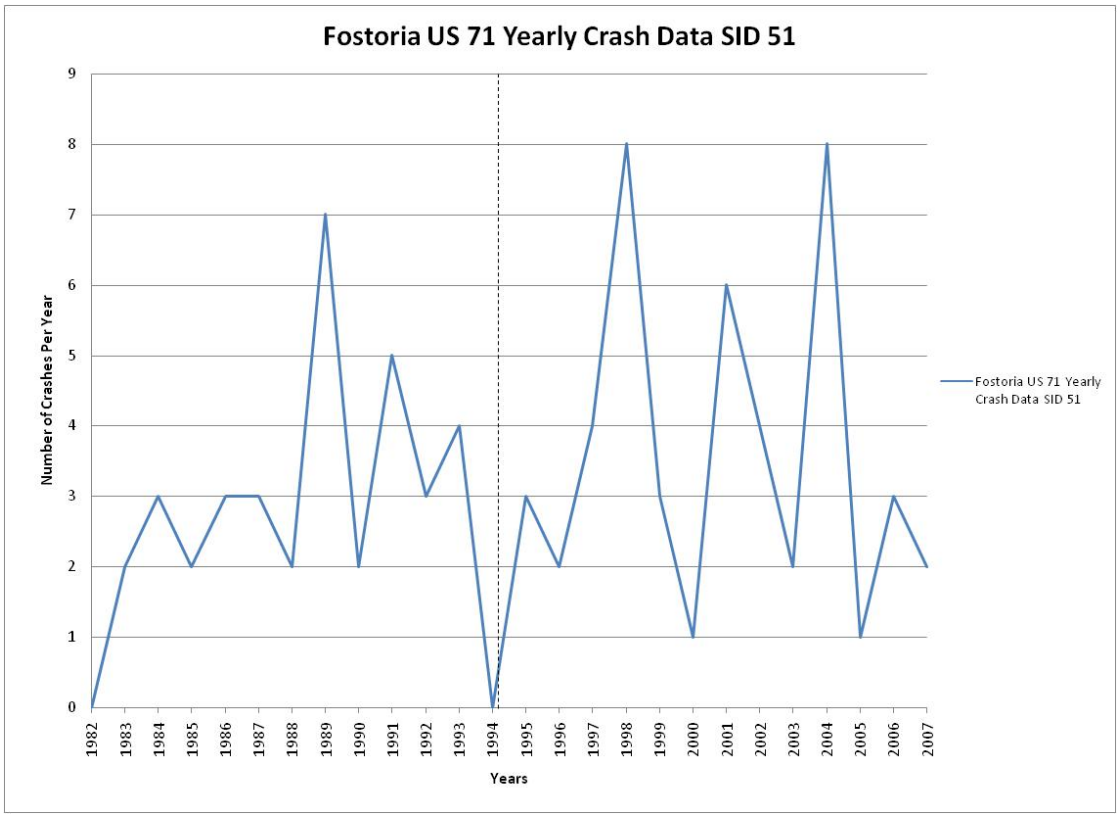
SID 50 - Springville



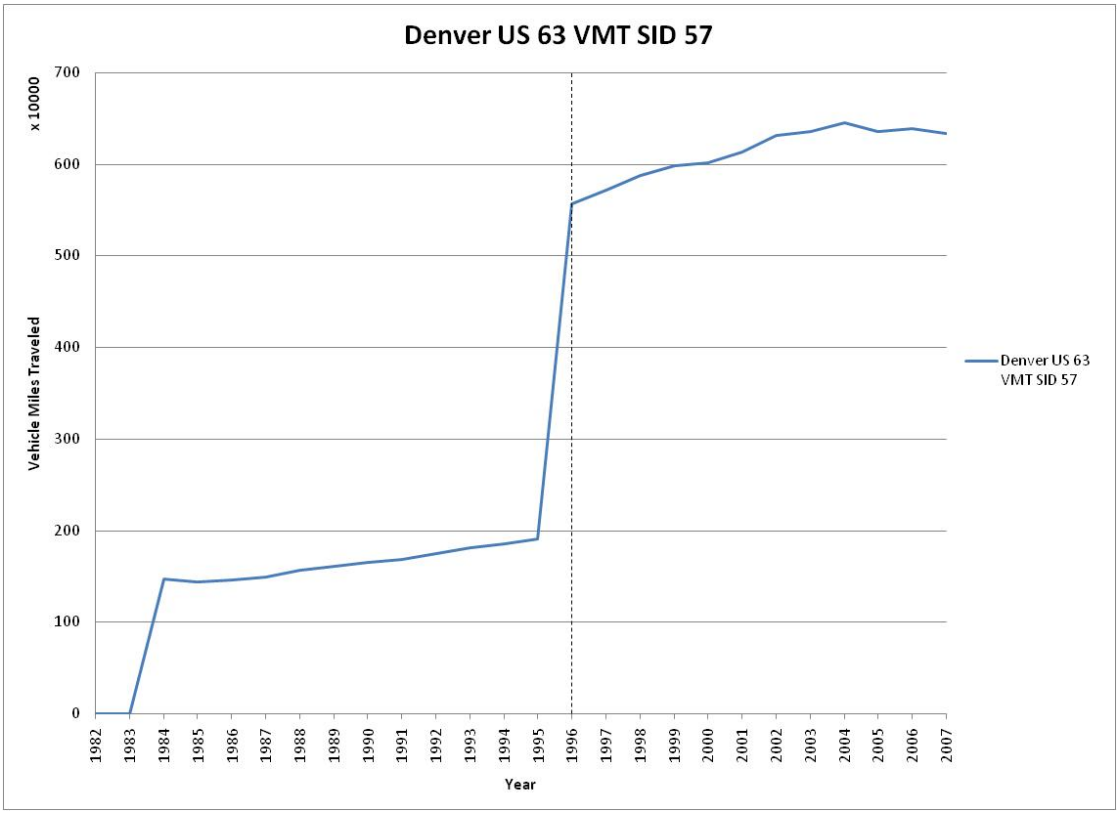


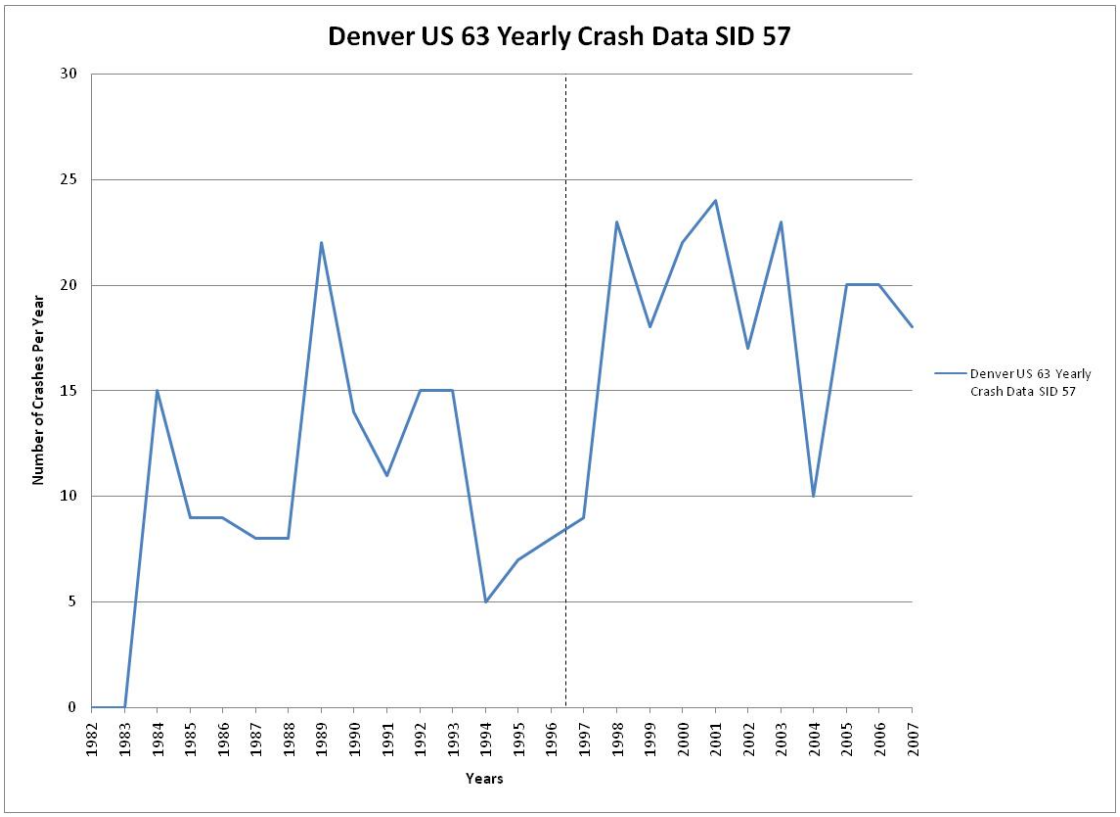
SID 51 - Fostoria



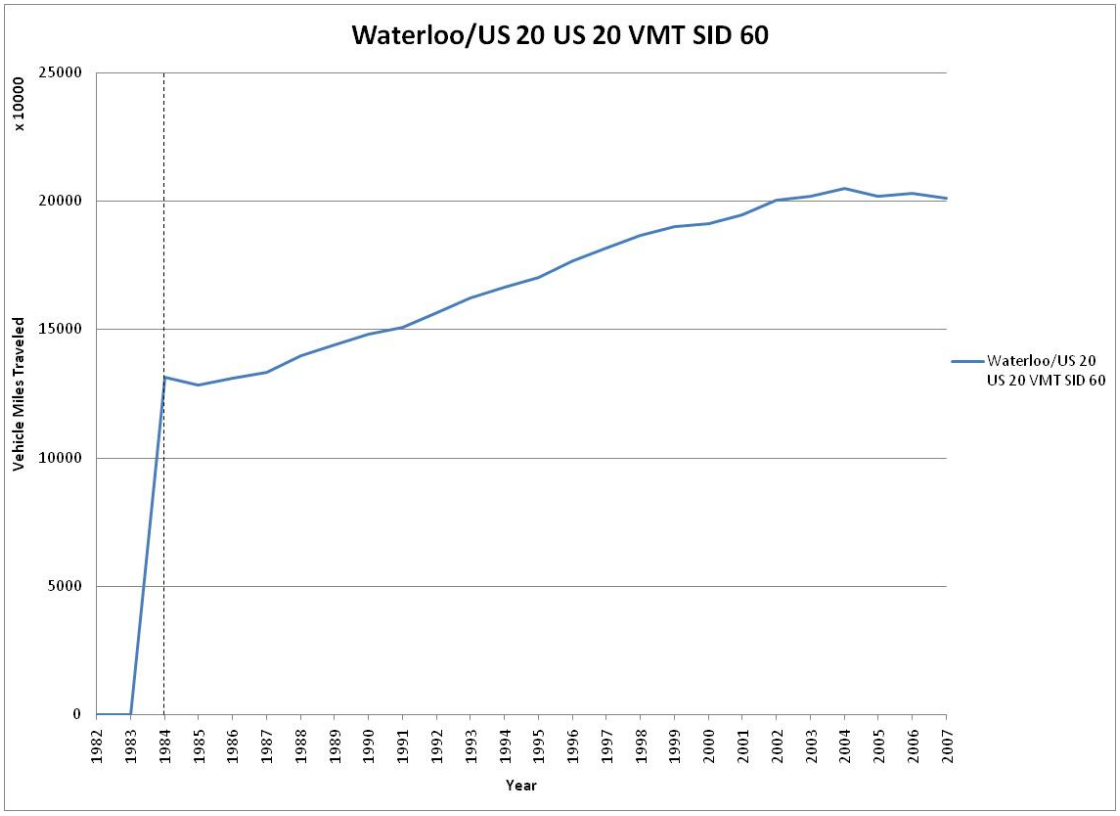


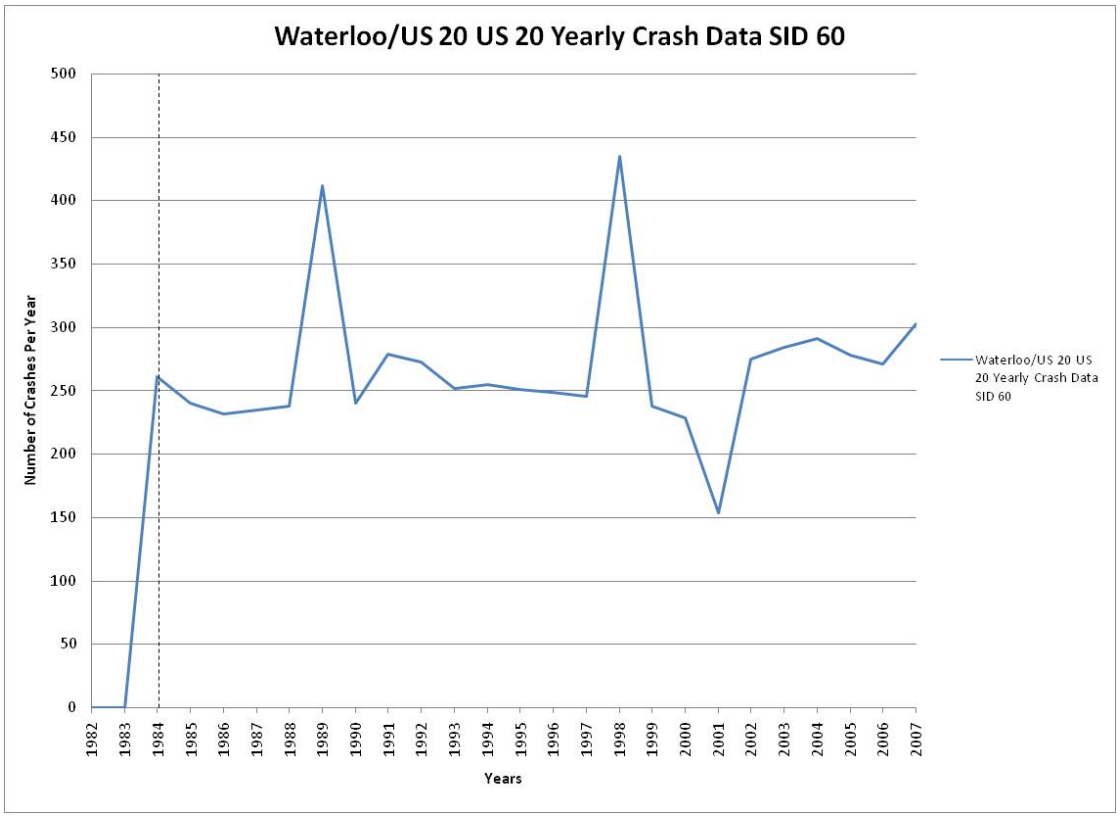
SID 57 - Denver



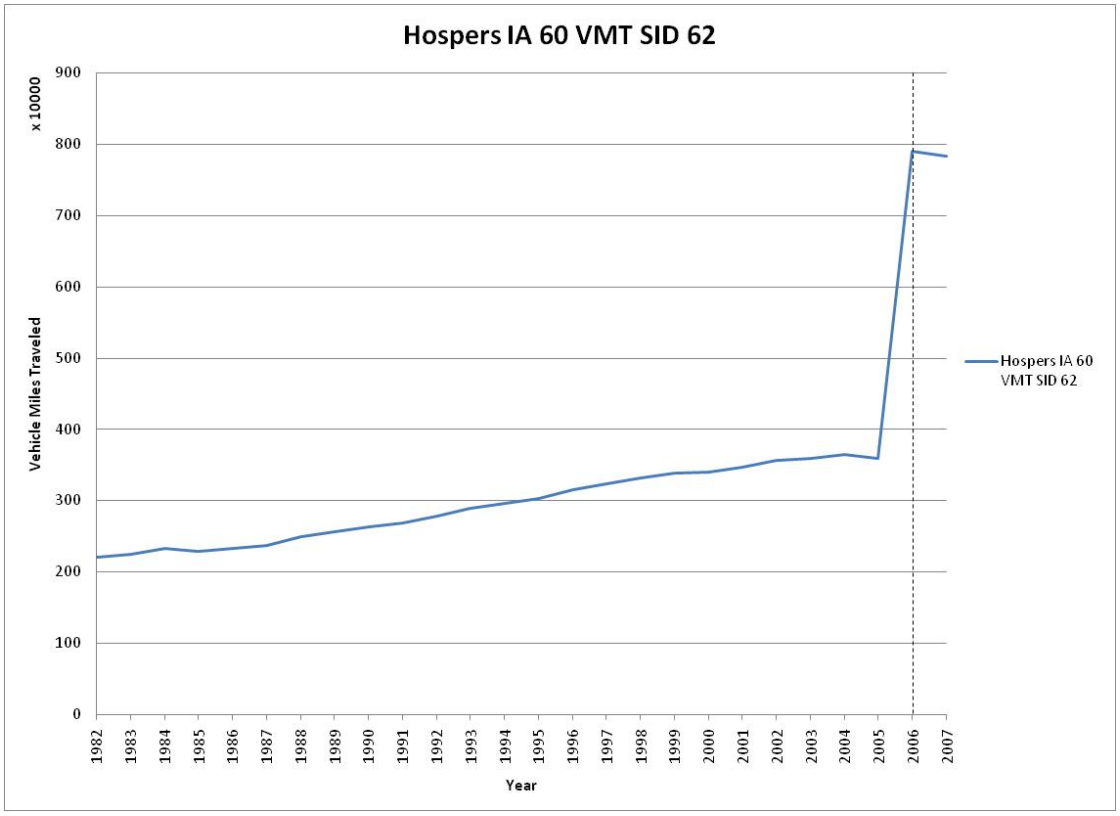


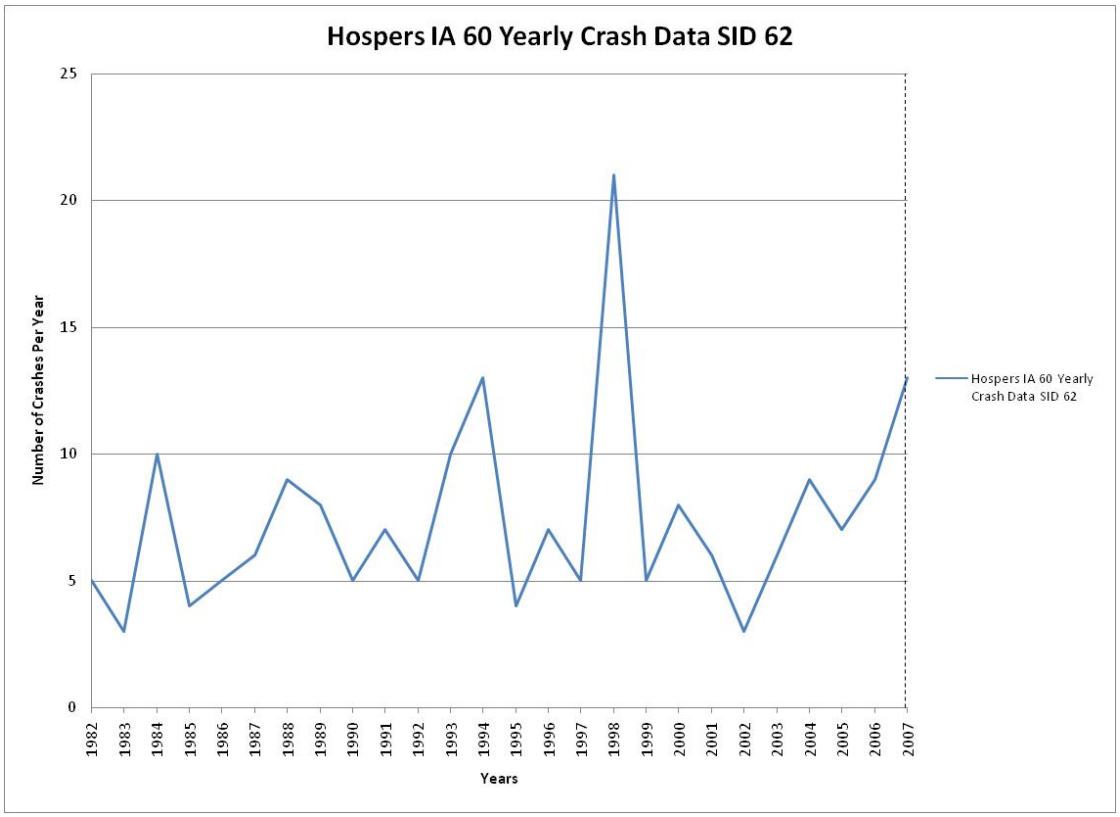
SID 60 - Waterloo



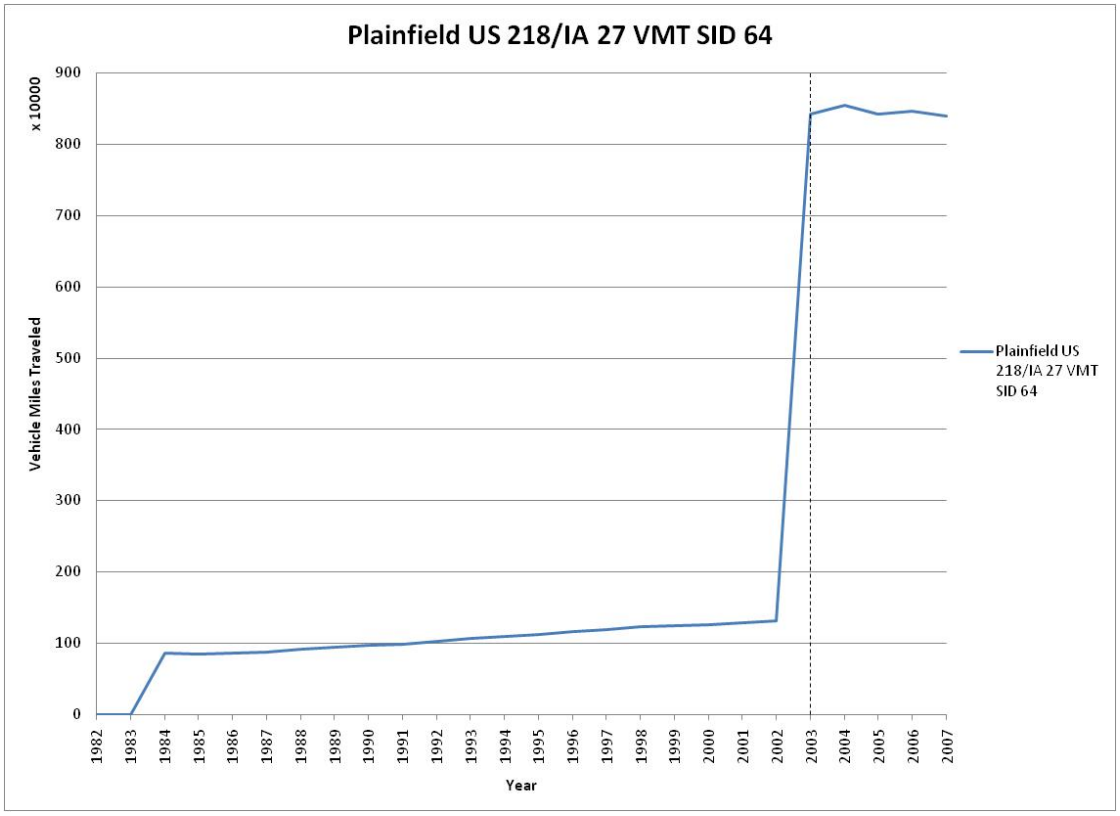


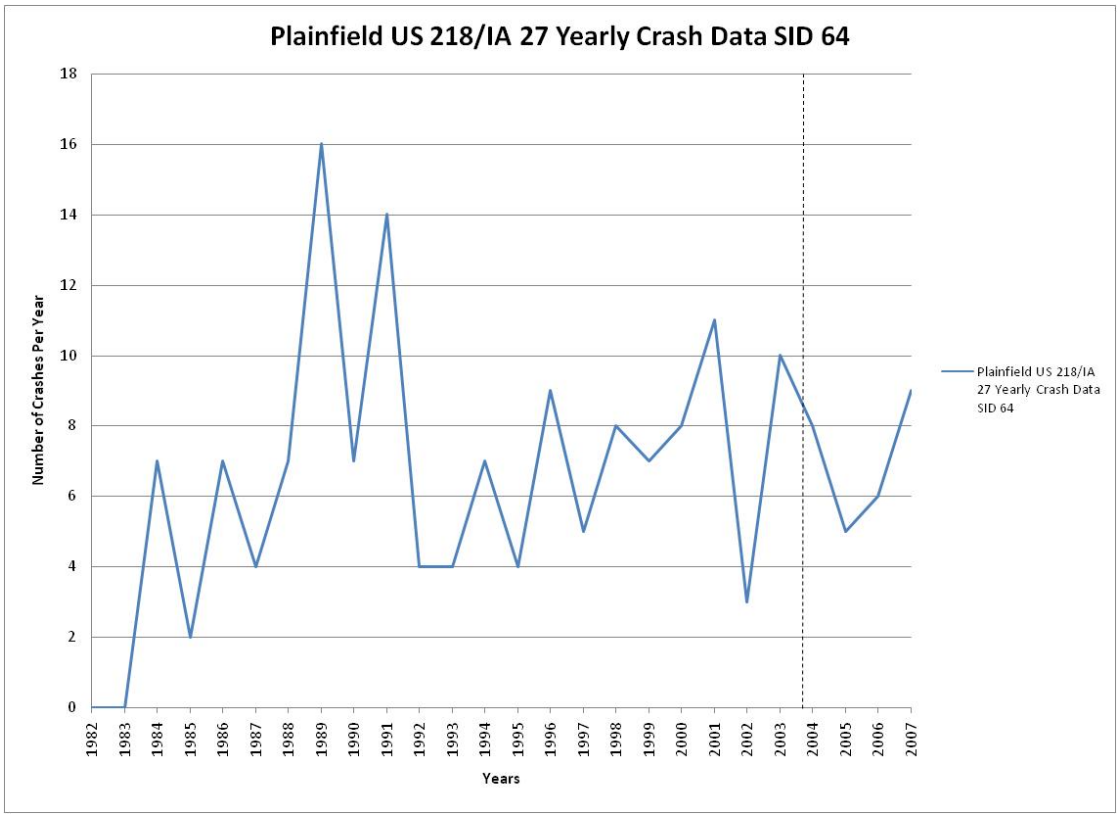
SID 62 - Hospers



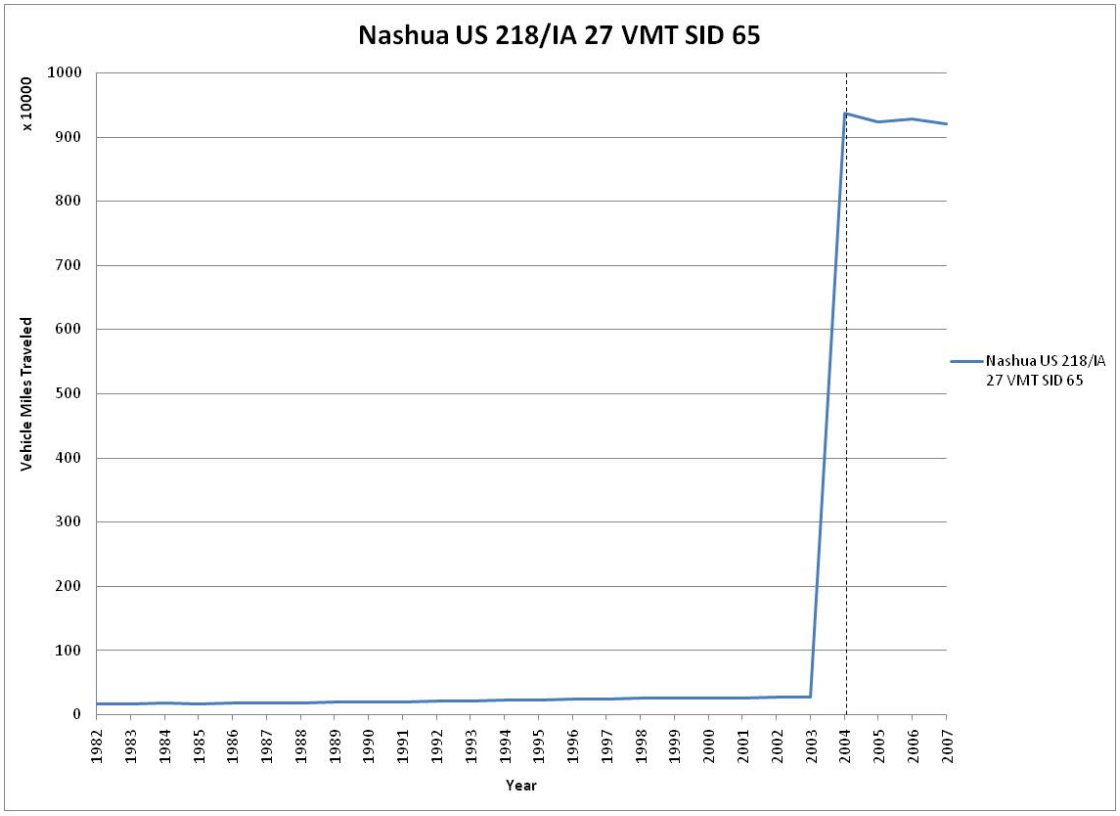


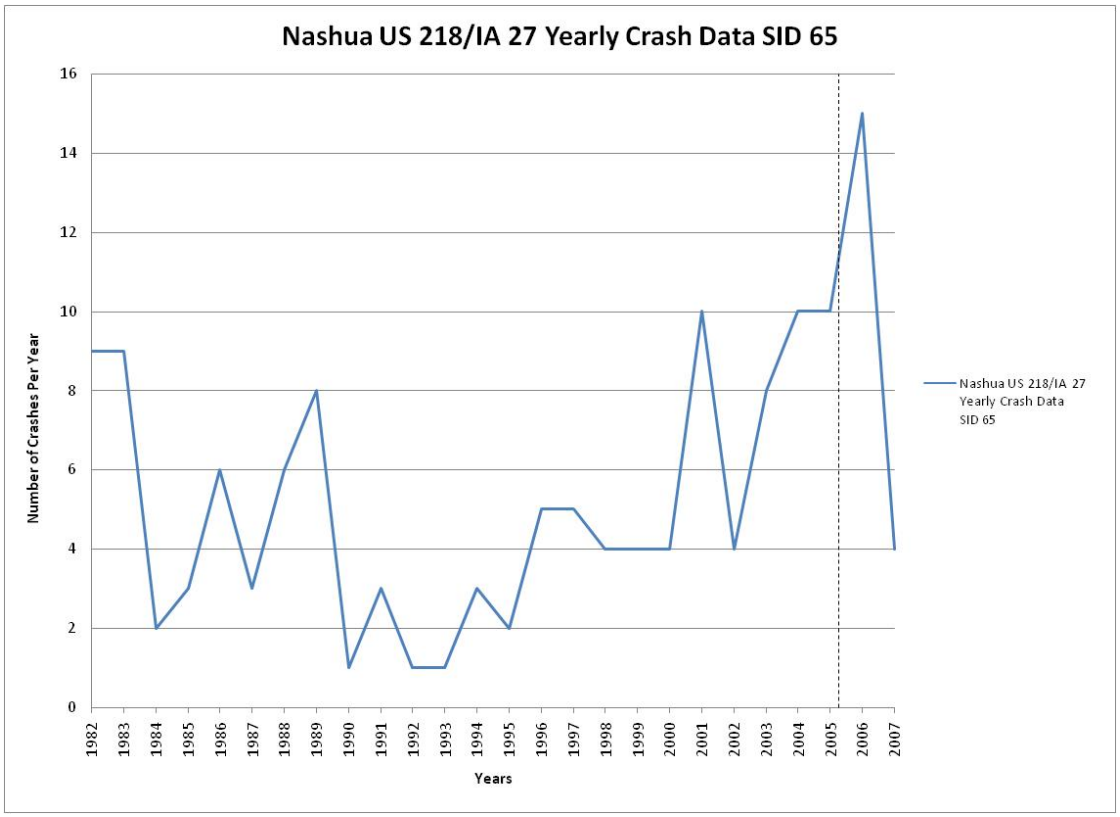
SID 64 - Plainfield



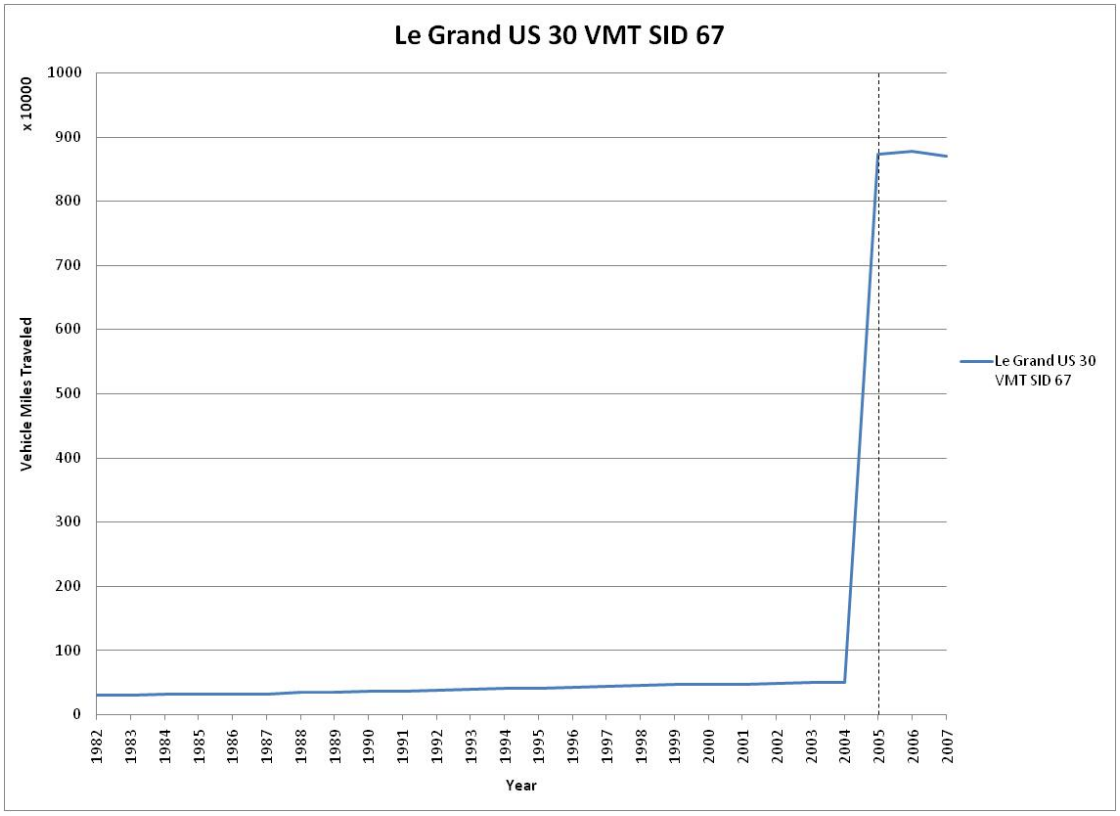


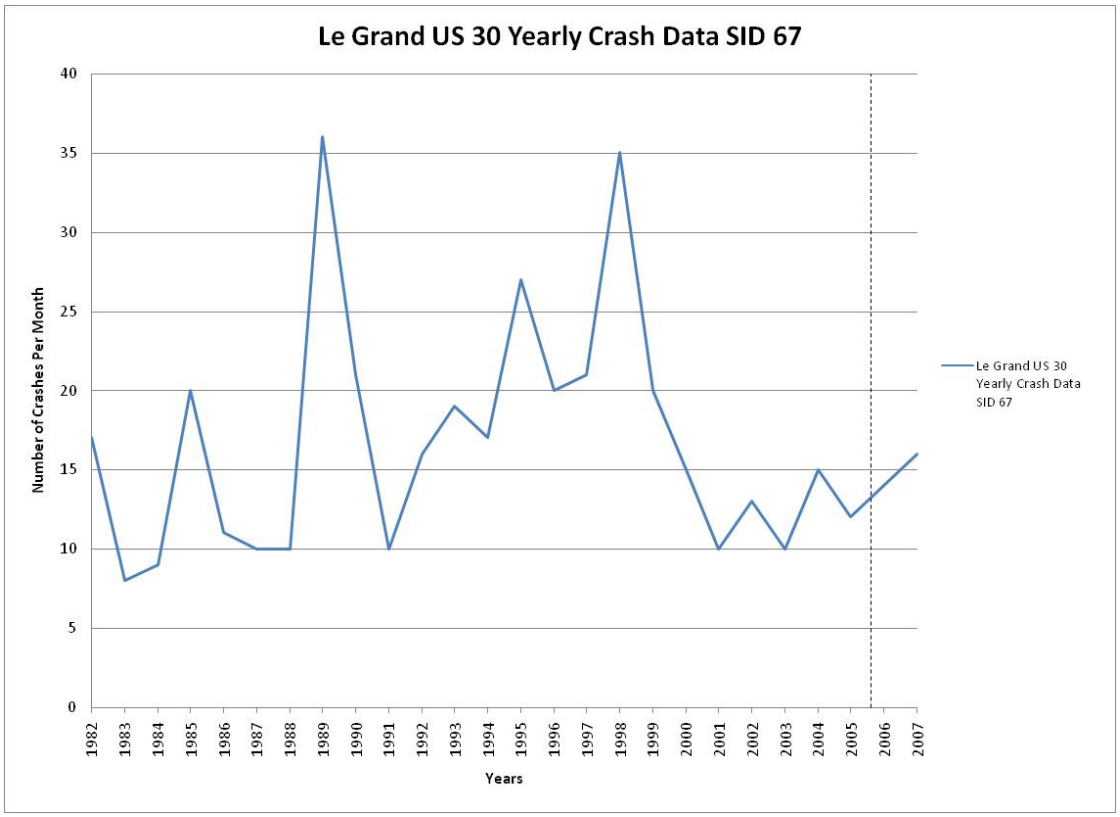
SID 65 - Nashua



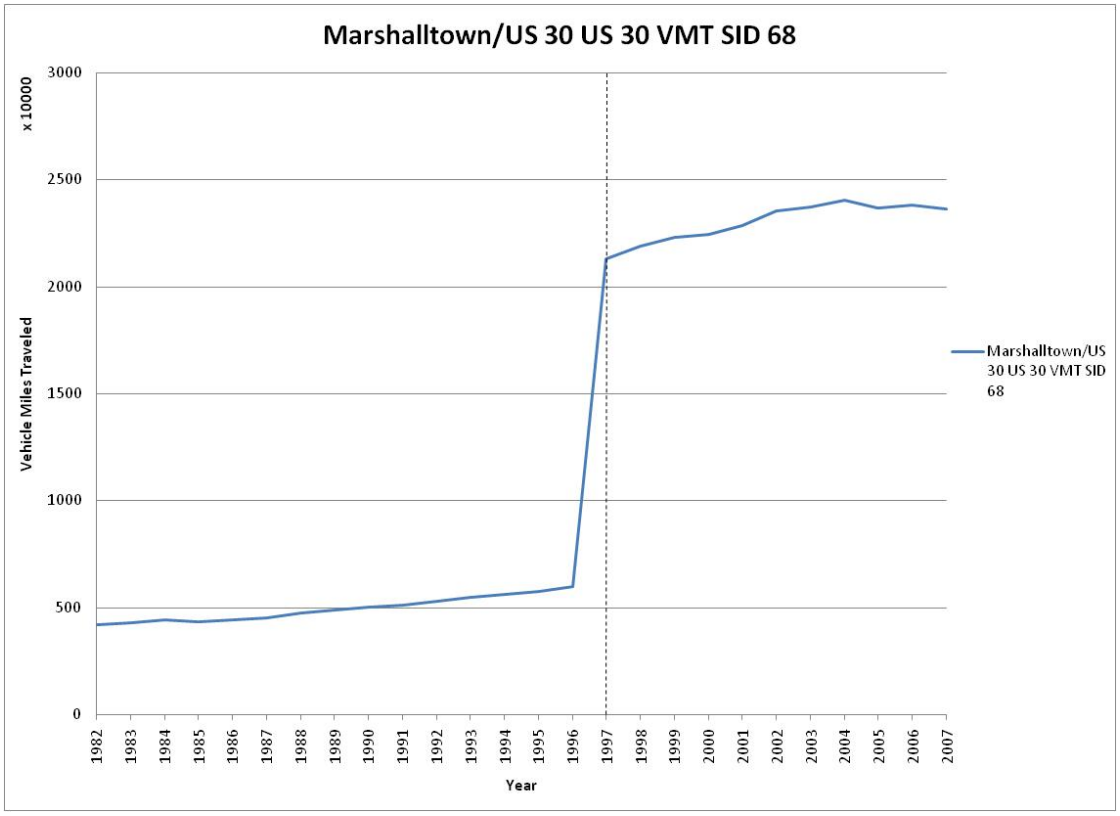


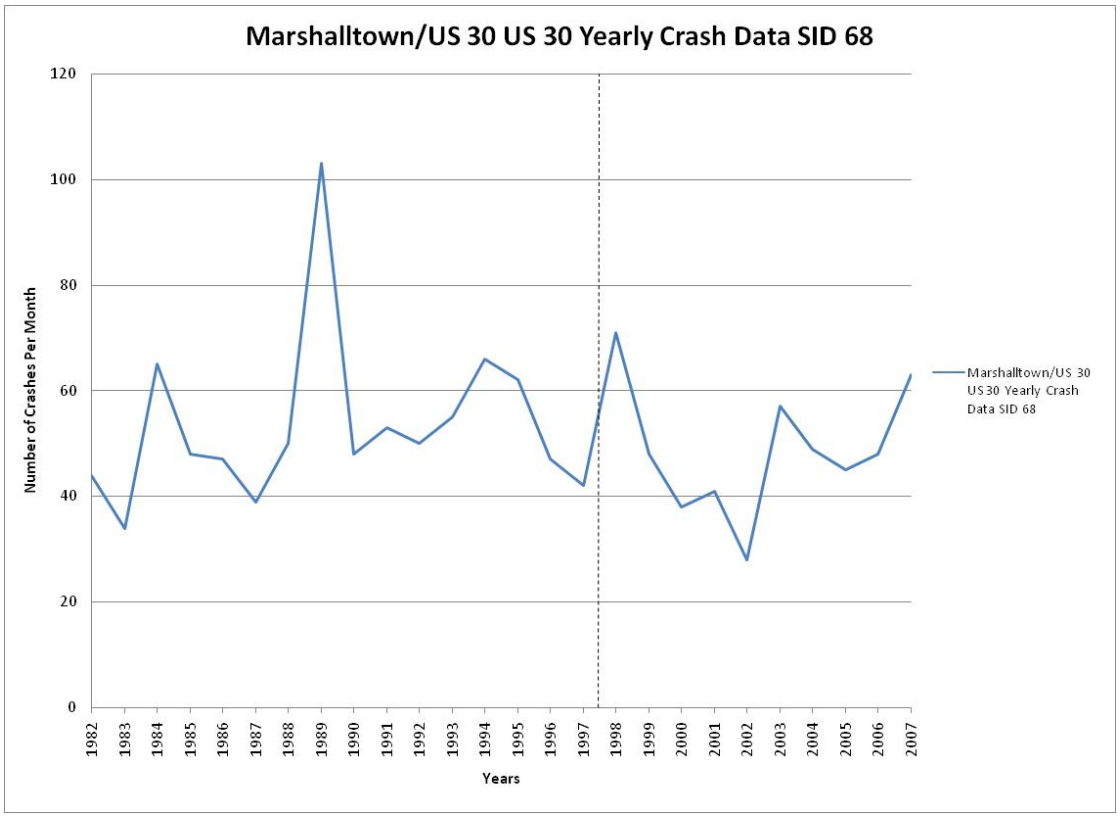
SID 67 - Le Grand



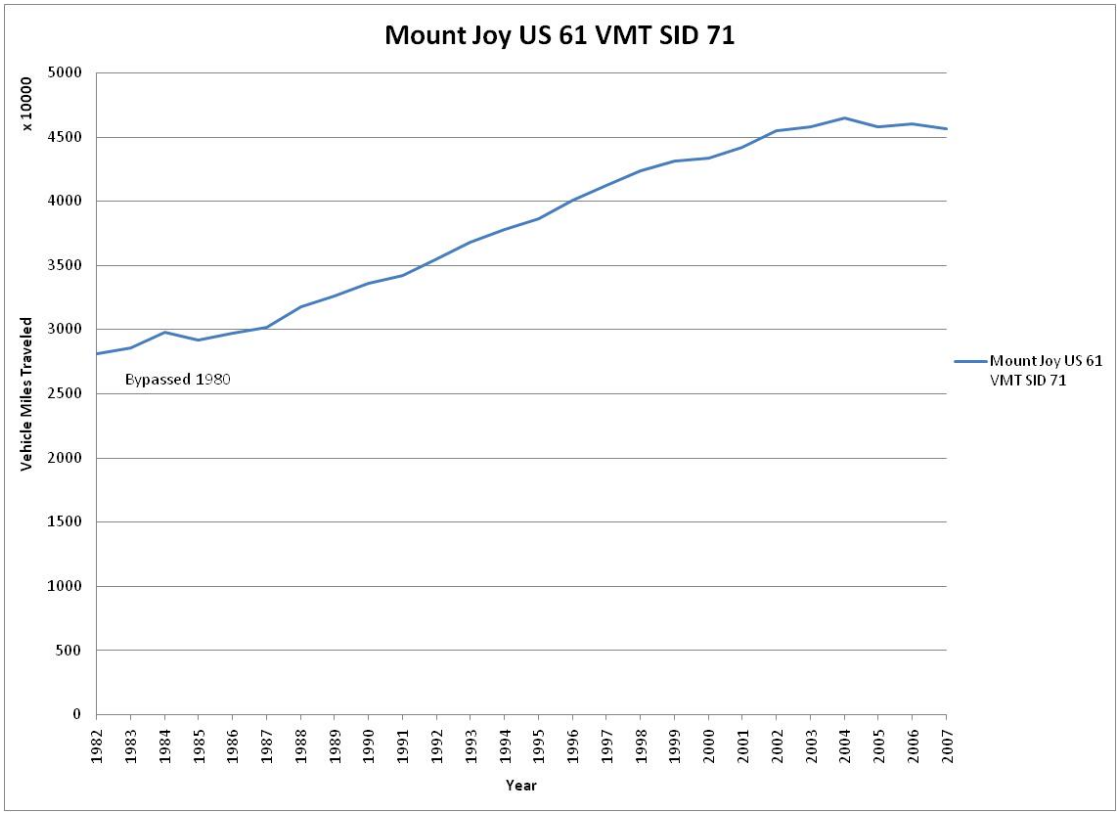


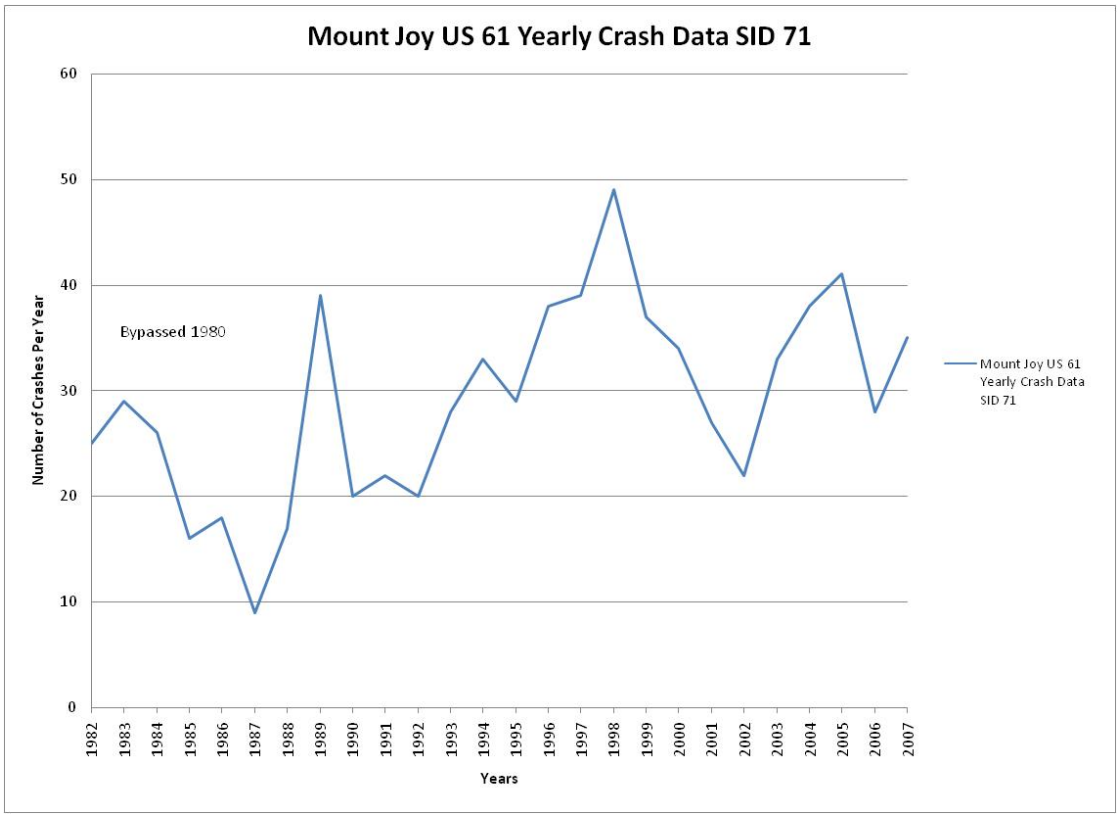
SID 68 - Marshalltown



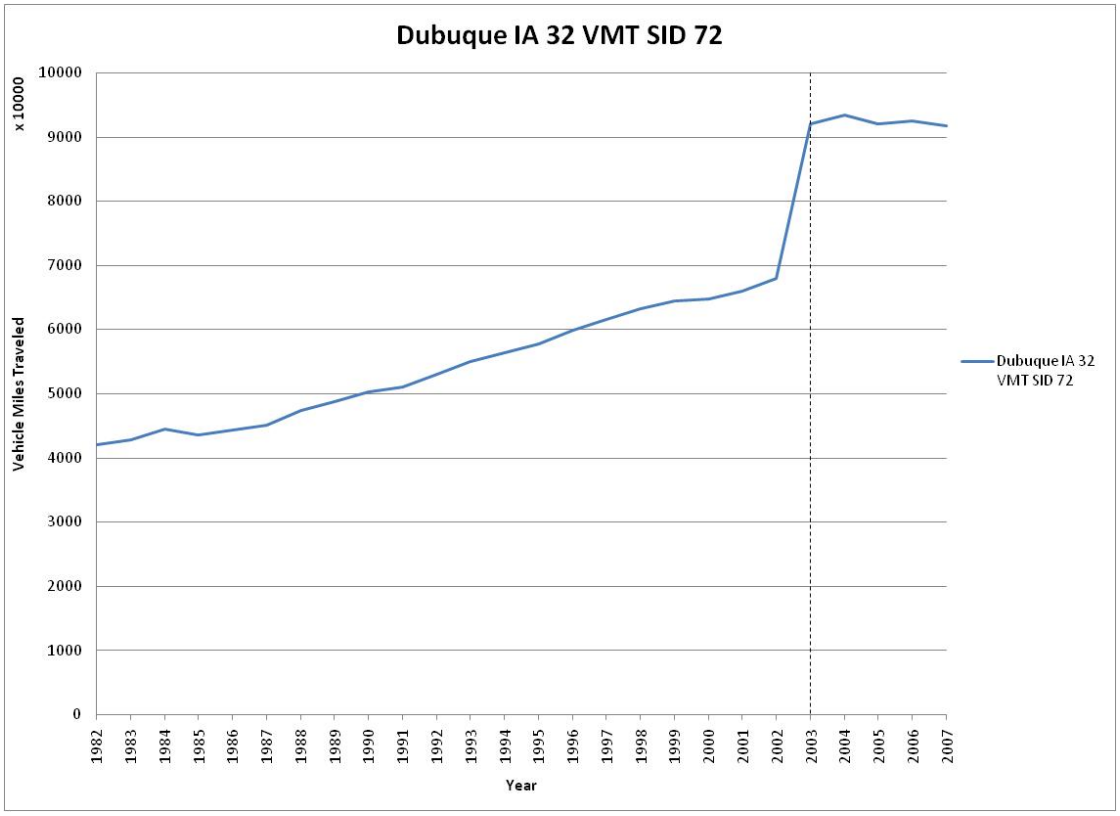


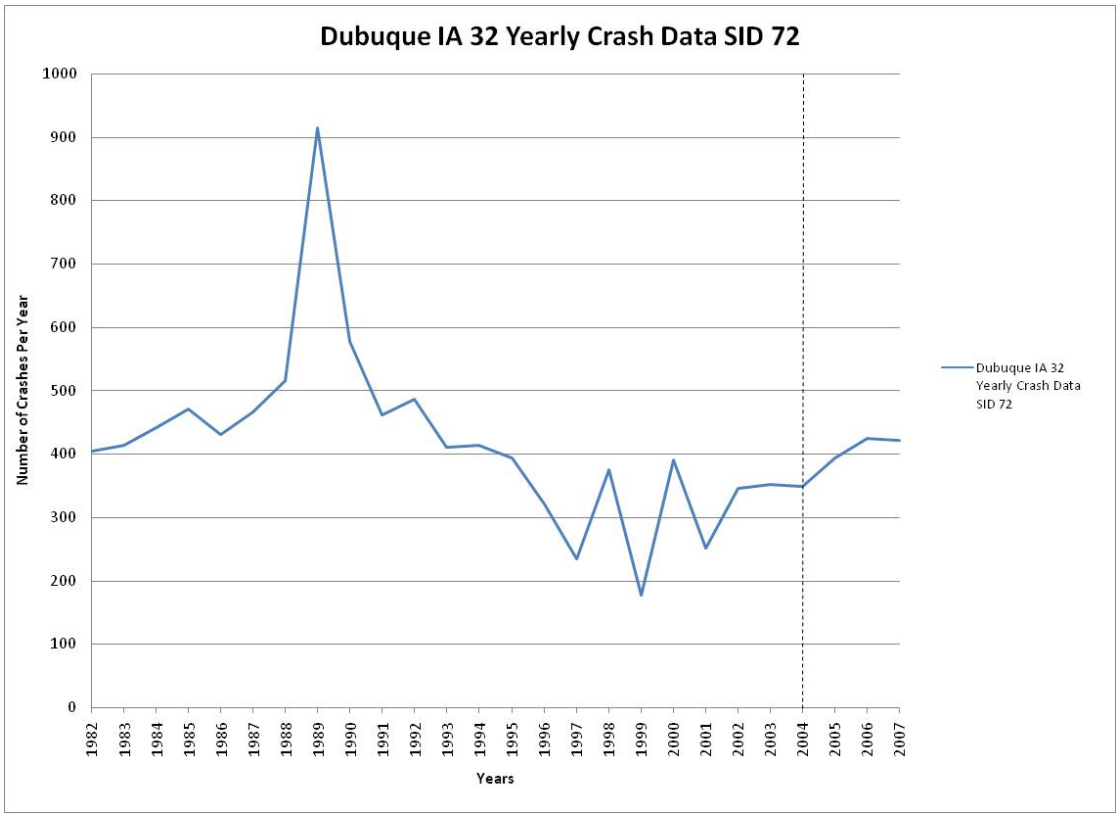
SID 71 - Mount Joy



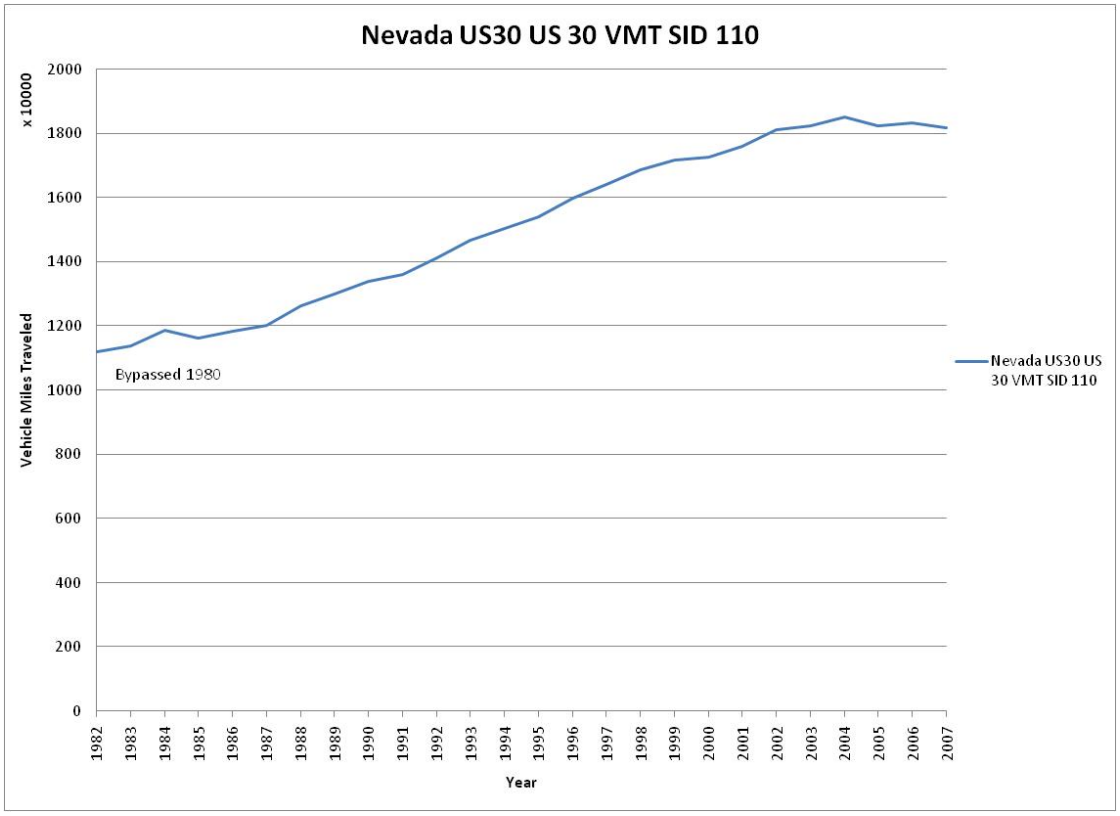


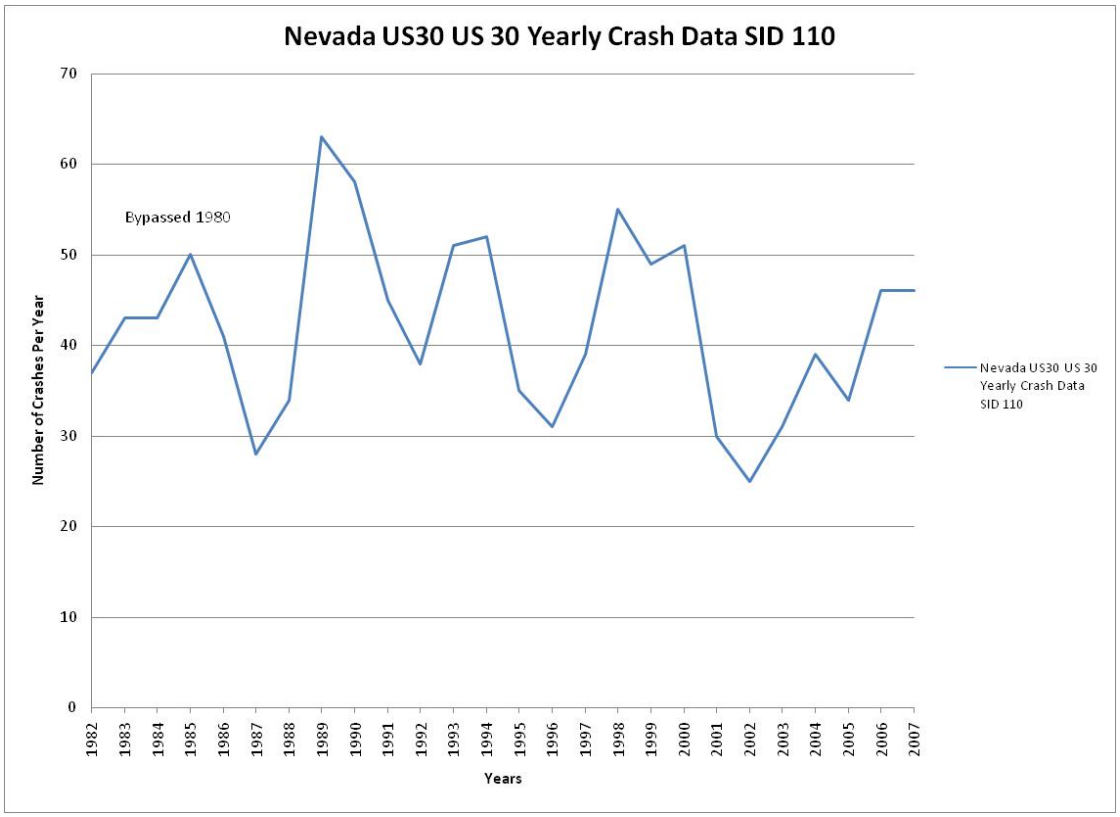
SID 72 - Dubuque



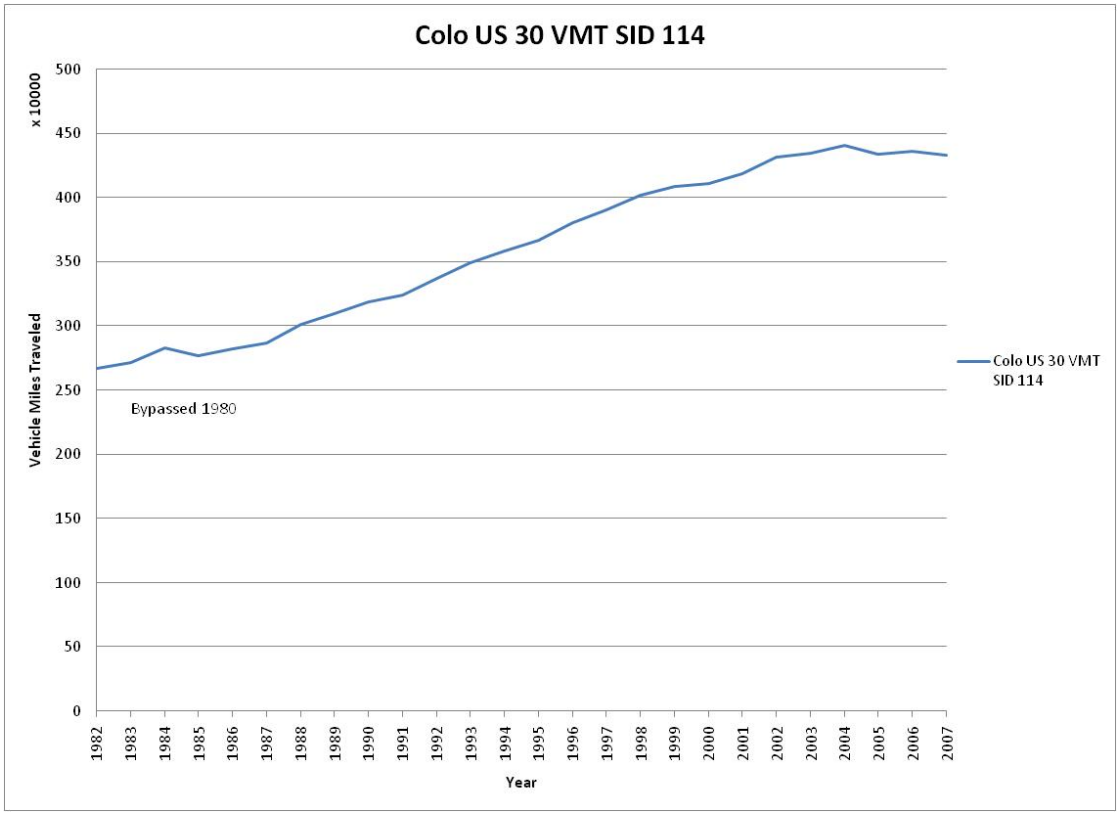


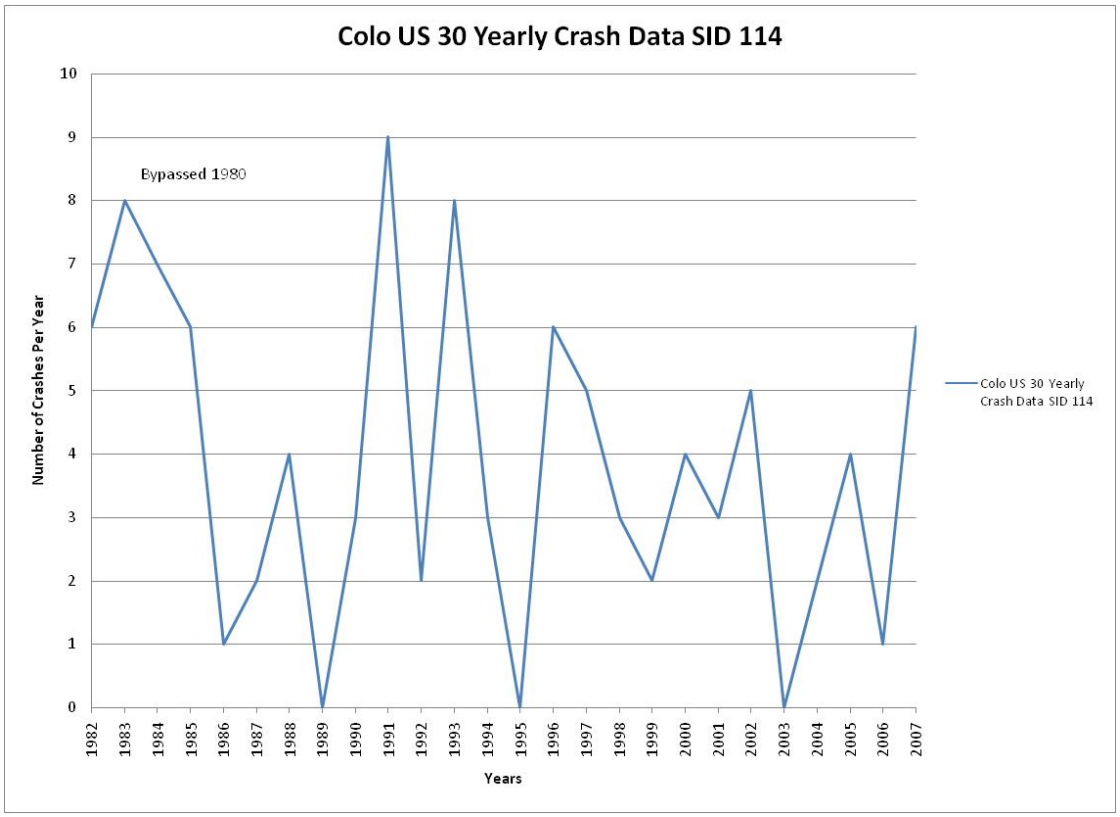
SID 110 - Nevada



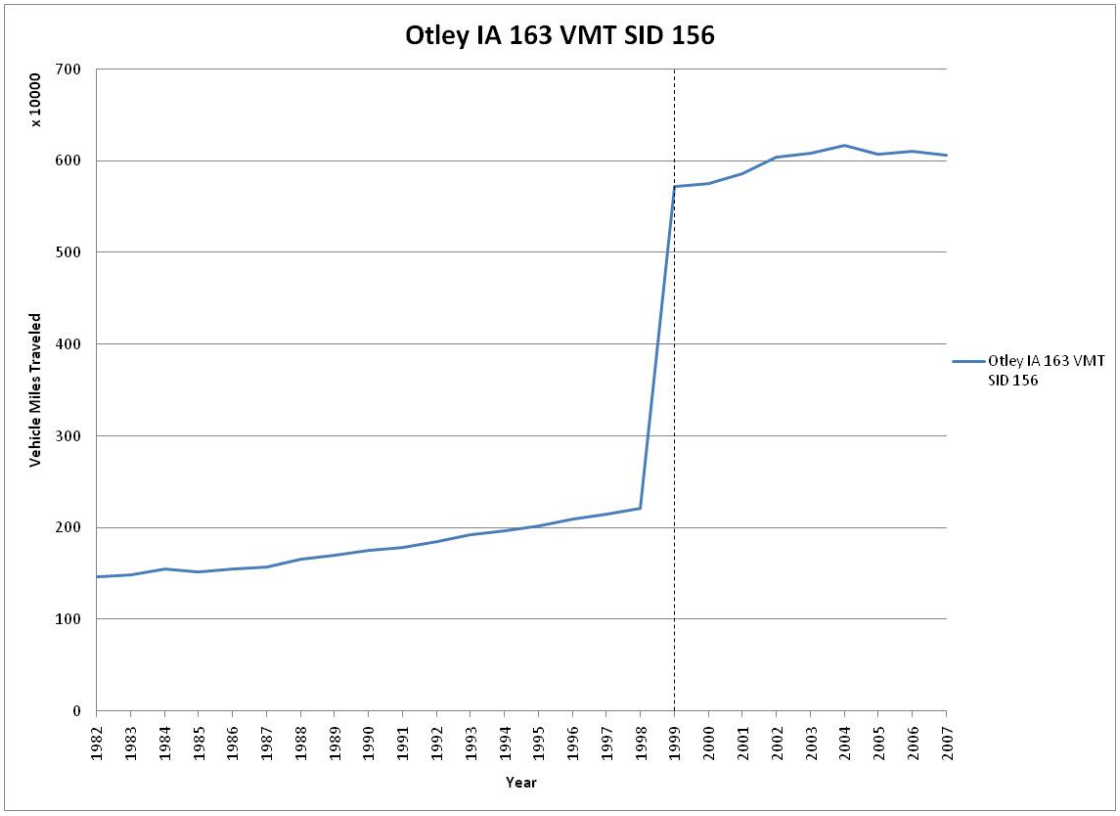


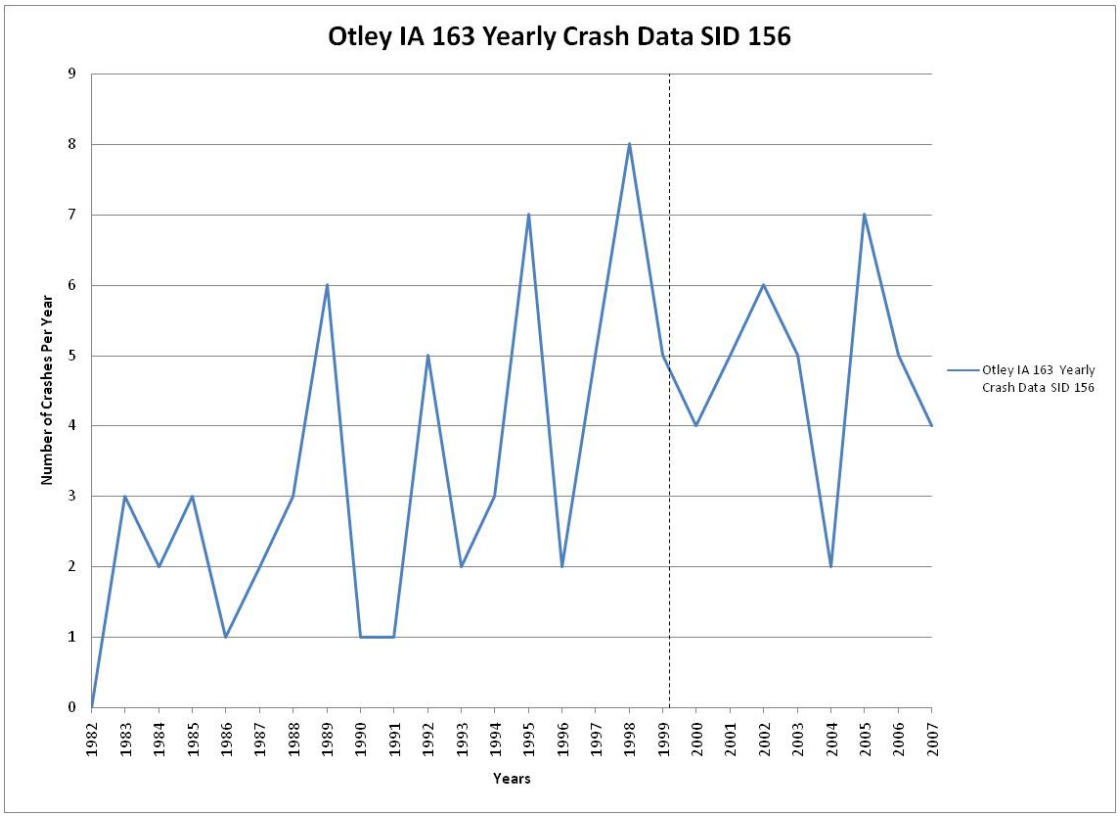
SID 114 - Colo


Colo US 30 VMT SID 114
x 10000
Vehicle Miles Traveled
Bypassed 1980
Year
Colo US 30 VMT SID 114

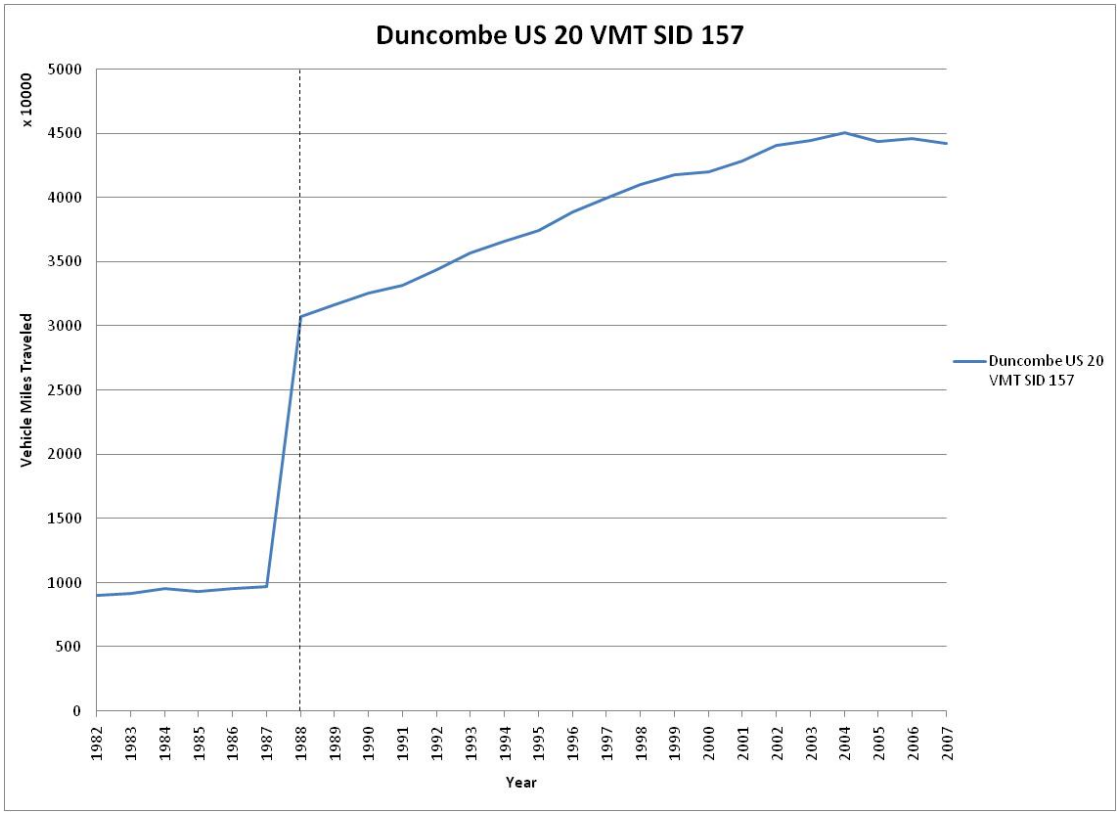

Colo US 30 Yearly Crash Data SID 114
Number of Crashes Per Year
Bypassed 1980
Years
Colo US 30 Yearly Crash Data SID 114

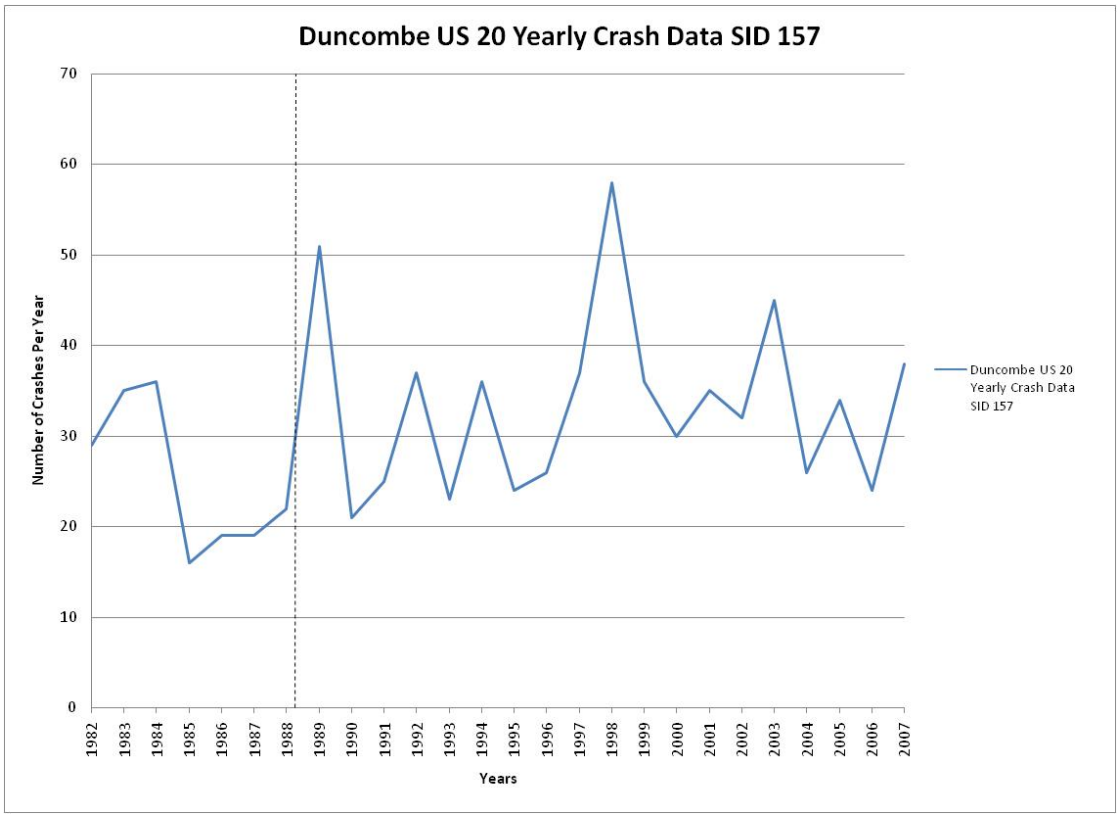
SID 156 - Otley



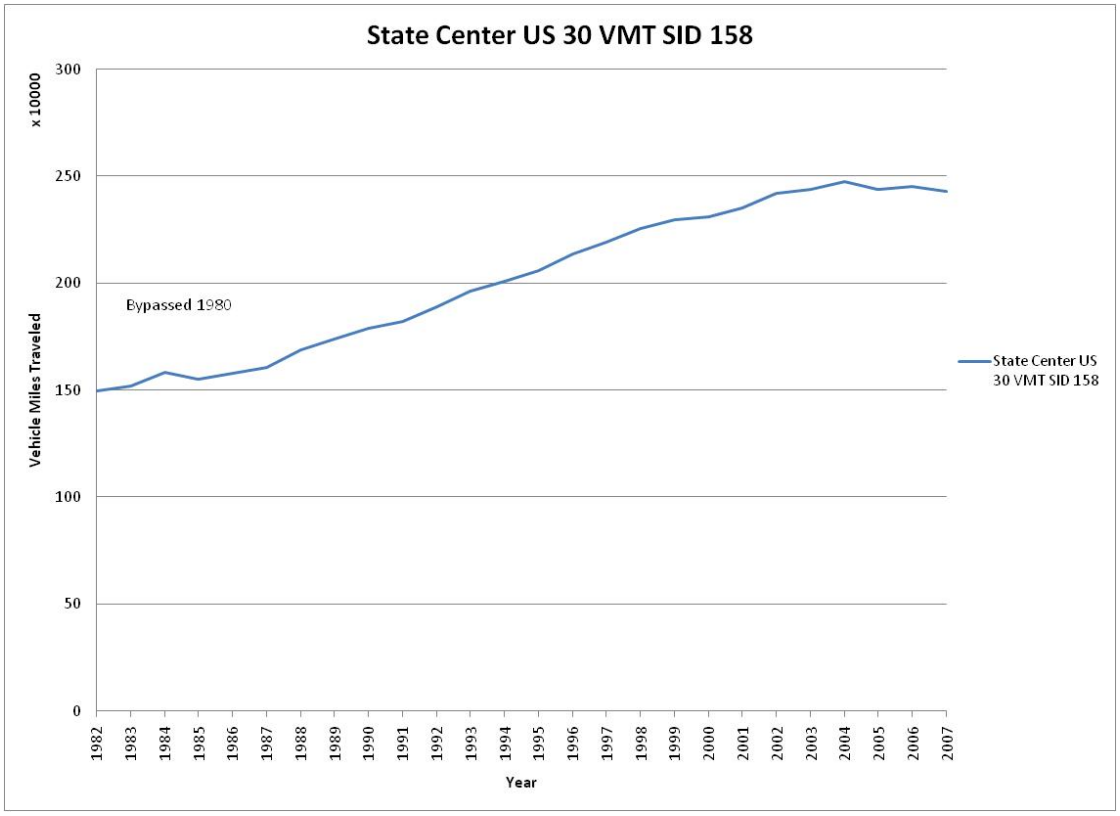


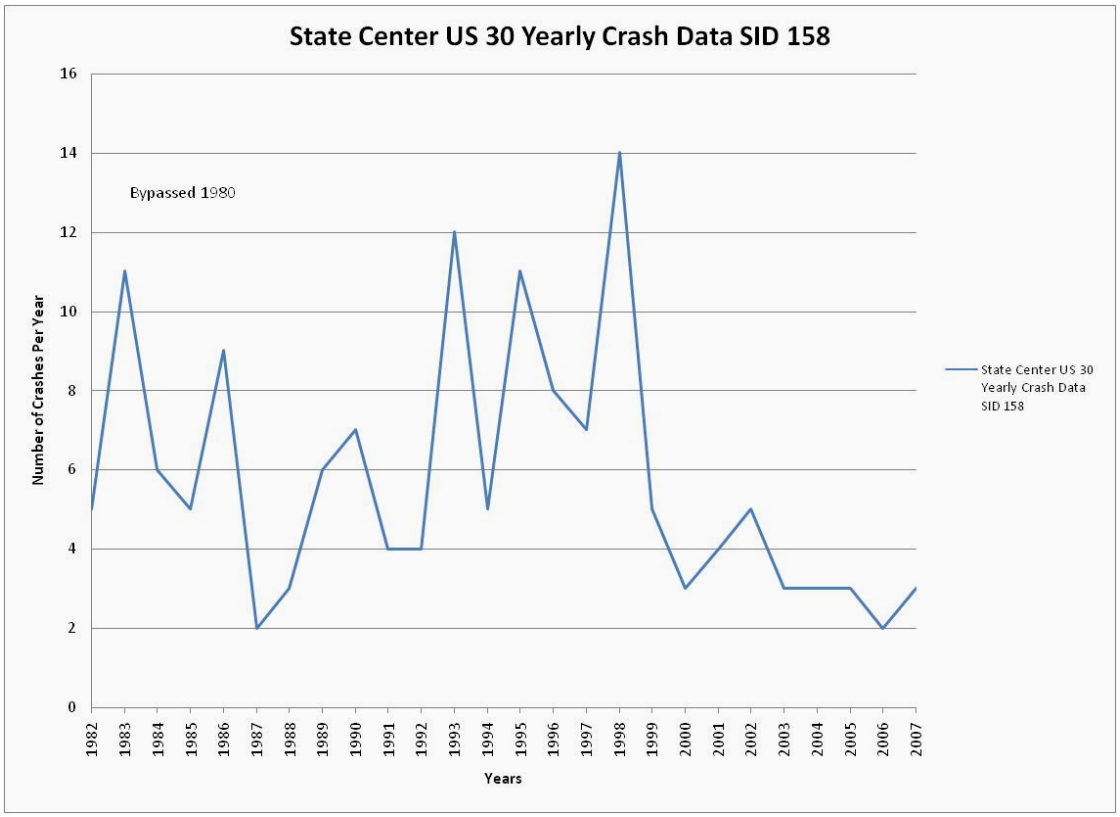
SID 157 - Duncombe



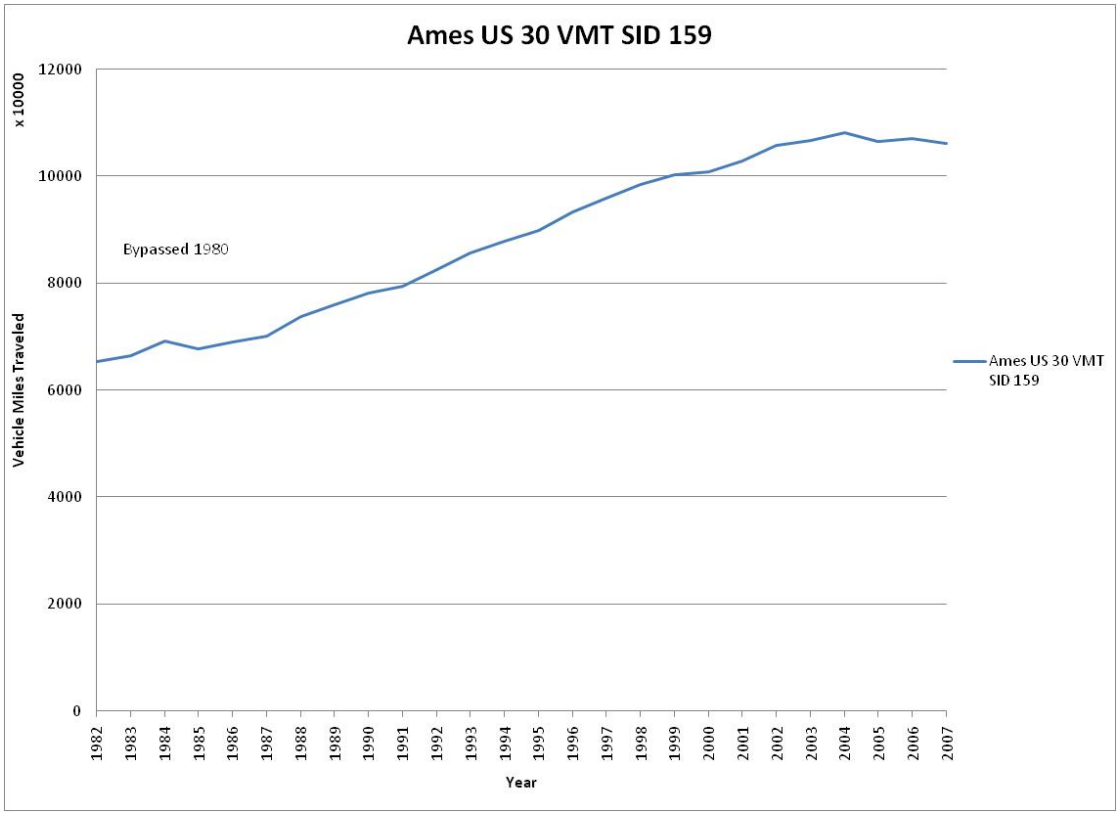


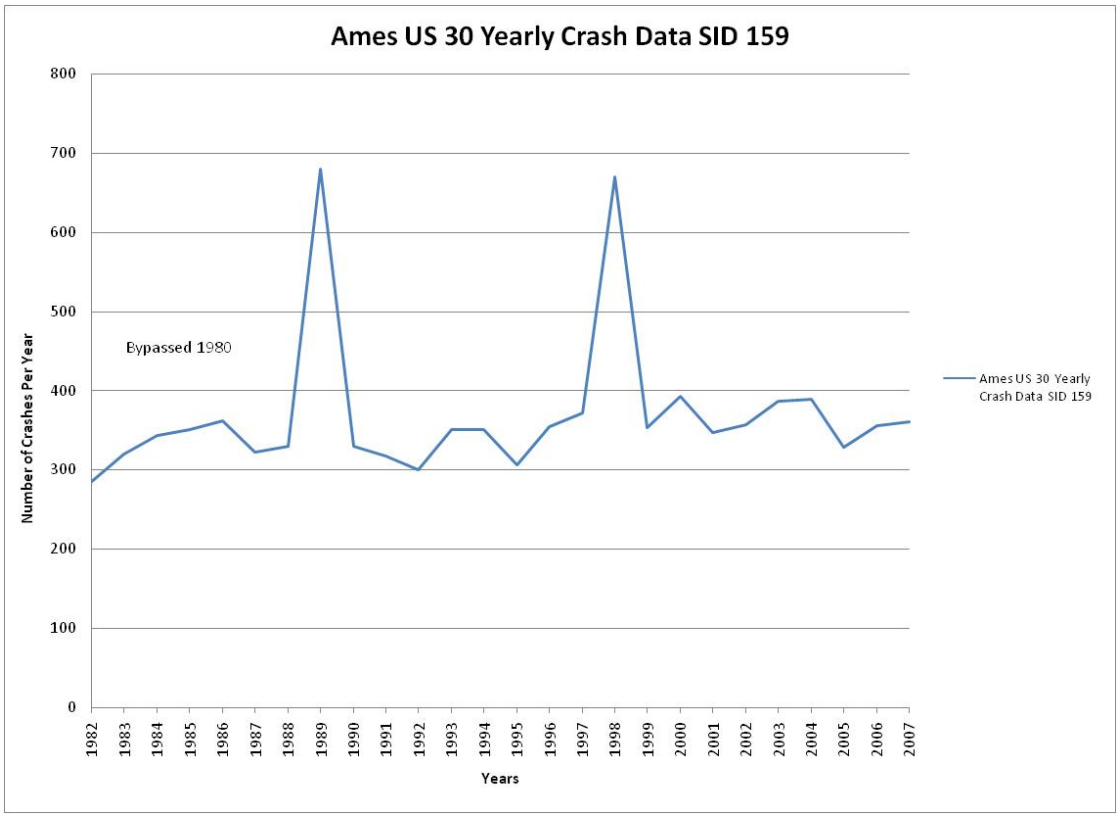
SID 158 - State Center





SID 159 - Ames


Ames US 30 VMT SID 159
x 10000
12000
10000
8000
6000
4000
2000
0
Vehicle Miles Traveled
Bypassed 1980
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year
Ames US 30 VMT SID 159


Ames US 30 Yearly Crash Data SID 159
800
700
600
500
400
300
200
100
0
Number of Crashes Per Year
Bypassed 1980
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Years
Ames US 30 Yearly Crash Data SID 159