REGION PAVEMENT PRESERVATION SYSTEM CONVERSION AND ENHANCEMENT PROTOTYPE

Chandrasekhar Swaminathan
Asha Ramrakhiani
Newell Crookston
William Grenney

Utah State University
Logan, UT

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ABSTRACT

Transportation agencies use many computer tools for managing infrastructure. Engineers in operating divisions at the lower end of the organizational hierarchy choose a variety of tools to meet their specific needs. Managers at the top of the organizational hierarchy want a uniform "enterprise" database system that provides them direct access to agency-wide data. Frequently, these two different approaches at different levels cause inefficiencies in the agency. This study was conducted to determine if efficiencies could be gained through the process of standardizing data storage mechanisms to permit diversity at the operating level while maintaining data compatibility for aggregation at higher levels in the organization.

A needs assessment regarding pavement inventory and maintenance scheduling conducted at the regional level provided the information for developing a computer-based tool for operations. The needs at headquarters for aggregating data were accommodated by exposing regional data in standard database (.dbf) formats. A variety of visual development tools were considered for the project. Borland Delphi™ was selected because it provides satisfactory connectivity for enterprise as well as local database back-ends, it provides a powerful development language (object Pascal) for engineering algorithms, and it provides an exceptionally good Integrated Developers Environment.

The Pavement Preservation Prototype software consists of three coordinated sections: Pavement Treatments, Paint Treatments, and Maintenance Management Quality Assurance. Each section was provided with a custom Graphical User Interface in conjunction with a standard database back-end. Because the data were converted and exposed in a standard format, straight forward GIS analyses could be applied. Examples provided for each of the three prototype sections demonstrate the advantages of standardizing regional data.

PAVEMENT PRESERVATION SYSTEM
CONVERSION AND ENHANCEMENT PROTOTYPE

Project Objectives

1. Needs assessment at the regional level: Pavement inventory and scheduling needs at the regions will be assessed. The regions are the operating level in the pavement information systems hierarchy. All data collection and primary analysis are conducted in this level. Hence a system that aids in this process must be developed. The primary attribute of such a system should be user-friendliness. Another desirable feature would be to develop a system that encompasses existing pavement preservation methodologies.
2. *Needs assessment at the headquarters level:* Headquarters is the level where all regional pavement databases are aggregated and statewide data analysis is facilitated. At any given time the regional databases must be accessible to the headquarters. The model should allow retrieving data from different data sets in an efficient manner.
3. *Develop architecture strategy:* This objective entails fulfilling the needs at the regional level and headquarters level. Objectives at this level would include data concurrency and multi-user access. Data concurrency ensures that data at both the regional and headquarters level are the same while preserving data integrity. Multi-user access allows multiple users to access the same data simultaneously. This would also prevent multiple copies of the same data.
4. *Develop prototype applications:* Prototypes must be developed for the pavement databases. Data structures will be defined for storing data appropriately. The application should be designed to ensure smooth transition between current practices and proposed practices. Demonstrate prototype: The prototype will be tested to demonstrate the pros and cons of the approach and to provide insight for implementation.

Development Tool Selection

Leading development tools for information systems were reviewed to insure that state-of-the-art technology would be used for the prototype. The following three terms are used by the industry and throughout this report:

1. Back-end applications: The back-end application is where the data reside. It also is known as the server; any computer process providing services to the client. The server processes provide *background* services for the client process. At one end of the spectrum are large enterprise database servers, such as Informix and Oracle. At the other end of the spectrum are local databases such as Access and Paradox. Microsoft SQL Server capabilities lie somewhere in between.
2. Front-end applications: The end-user usually interacts with the client process. The client is any computer process that requests services from the server. The client also is known as the *front-end* application. Modern software products for the development of the *front-end* commonly are referred to as "Visual Development Tools." The current principal competing products on the market are: Borland's Delphi, Microsoft Visual Basic, Sybase PowerBuilder, and Symantec Visual Cafe.
3. Middleware applications: Middleware is any computer process through which clients and servers communicate. The middleware is made up of several layers of software that aid the transmission of data and control information between the clients and the servers. The communications middleware usually is associated with a network. All client requests and server replies travel through the network in the form of messages that contain control information and data.

Microsoft Component Object Model (COM) and the Object management Group Common Object Request Brokered Architecture (CORBA) are competing architectures for addressing the problem of how to define, construct, and deploy software elements that comprise complex systems. Both architectures

attempt to achieve database server independence by allowing front-end applications to access data from multiple server databases without the need to write separate specific code for each database. CORBA implementations support a wider range of languages and platforms than COM. In contrast to COM, CORBA was designed specifically for distributed systems. However, COM and CORBA seem to be converging toward a consensus industry standard.

State-of-the-art visual development tools are used for developing middleware and for developing the front-end applications.

Evaluation of Development Tools

Visual Development Tools

Visual development tools are used for the development of front-ends and middleware. A World Wide Web search was conducted to gain current evaluations of the principal visual development tools: Borland's Delphi, Microsoft Visual Basic, Sybase PowerBuilder, and Symantec Visual Cafe. The following six sites were selected in an attempt to provide a balanced summary:

- PC Magazine (www.zdnet.co.uk/pcmag/labs/1999/04/visual/004.html), which contains the most up-to-date, in-depth, independent comparative evaluation that we could find.
- BYTE Magazine (www.byte.com/art/9611/sec12/art6.htm), contains an independent comparison of Delphi, Visual Basic, and PowerBuilder.
- Microsoft (www.microsoft.com) because Microsoft produces Visual Basic. Its web site contains an in-depth comparative evaluation of Visual Basic, Delphi, and PowerBuilder. The evaluation was prepared by NSTL, Inc.
- Sybase (www.sybase.com/products/powerbuilder/gigaart.html), which produces PowerBuilder. Its web site contains a cursory comparison of PowerBuilder and Visual Basic.

- Borland (www.borland.com/delphi/papers/delvspowr/delvpowr.html), which produces Delphi. Its web site contains an in-depth comparison of Delphi and PowerBuilder.
- Symantec (www.symantec.com/vcafe/index_reviews.html), which produces Visual Cafe.

PC Magazine

This section reviews the evaluation of visual development tools published by PC Magazine. This is summarized in greatest detail because it is the most in-depth independent comparative evaluation available at the time that this study was conducted.

- Value for Money: Though Delphi and Visual Basic were close in terms of pricing and features, Delphi achieved higher usability and features scores as compared to Visual Basic and PowerBuilder.
- Help Information: Delphi and Visual Basic code prompts and online help were straightforward. PowerBuilder suffered from more erratic help information.
- Satisfaction: This index illustrates the consistent qualities of the products tested. Visual Basic and Delphi both achieved high scores on this index. PowerBuilder's confusing interface and lack of examples affected tester's perception of the product.
- Form Design: The testers found that creating Delphi forms was simple. Visual Basic also scored high, but faced some criticism for its time-consuming process of changing component properties. PowerBuilder received mixed reactions. Some features got an excellent rating, such as the ability to preview the form without having to run the project. However some features could be awkward for new users since the interface and associated help files don't make it clear where to find controls and tools.
- Reading from a database: Testers were asked to connect forms to a single table DBF database containing 21 columns and 8,400 rows of data. Delphi's database wizard simplified the procedure, contributing to the product's overall productivity scores.

Making the initial connection between the database and its associated form was more awkward in PowerBuilder. Lack of good help affected PowerBuilder's scores in all usability indices. However, once the databases were incorporated, PowerBuilder was found to have one of the strongest set of tools for database related applications. Options for creating reports and labels were appreciated.

- Adding event code: Delphi automatically added code into the project. This reduced the amount of code creation that testers had to complete. However lack of comments for such generated code hampered debugging programs. On the other hand, PowerBuilder required manual operations to carry out many tasks automated in most other packages.
- Compiling and debugging code: Testers found debugging Delphi source code difficult due to much of the code being generated automatically. By contrast, Visual Basic provided easy-to-use debug facilities. PowerBuilder, with its lack of help and confusing controls, ranked low.

BYTE Magazine

The article "Upgraded C/S Tools: How Much Better?" included Visual Basic, Delphi, and PowerBuilder. The article "New Leaders of the Client/Server" included Visual Basic, Delphi and PowerBuilder. The context of the articles could be summed up by the "Making a Choice" section in the second article:

> But good as {Visual Basic and PowerBuilder} are, Borland's Delphi takes top honors. Developers will find its procedures for form design and accessing of components similar to Visual Basic's, but in many little ways Delphi simply makes it easier and more convenient to access data from a client/server database. And its speed, both in database and non-database operations, is far ahead of all the competition.

Microsoft

Microsoft commissioned NSTL, Inc. to prepare an in-depth comparative evaluation of "Rapid Application Development Tools" including: Visual Basic, Delphi, and PowerBuilder. A qualitative summary of their "Usability Results" would rank Visual Basic first, Delphi second, and PowerBuilder third.

Sybase

Sybase provides a cursory comparison of Visual Basic and PowerBuilder in nine categories: productivity, cross-platform support, skills availability and third-party support, general ease of use, support for three-tier architectures, performance, Java support, size and complexity of applications, and cost of deployment.. A qualitative ranking of their comparison gives Visual Basic four "strongs" and five "weaks," and gives PowerBuilder seven "strongs" and two "weaks."

Borland

Borland commissioned Sphere Data Systems, Inc. to prepare an in-depth comparative evaluation titled "A Comparison of Client/Server Development Tools; PowerBuilder vs. Delphi." The two products were rated on performance, Rapid Application Development (RAD), database application architecture, client and server tools, and user interface. The paper concludes that "Delphi surpasses PowerBuilder 5.0 when it comes to performance, ease of use, object oriented technologies, database access, client/server rapid application development, and scalabiltiy."

Symantec

Symantec does not provide any comparisons between itself and its competitors. Symantec announces that Visual Cafe offers excellent performance and features for new Java developers wanting a RAD environment with client/server database support.

Development Tools Used for the Prototype

Back-End Tools

Two distinctive categories of database back-ends exits: "enterprise" and "local." Two of the leading enterprise database tools are Informix and Oracle. They are intended for storage and manipulation of huge amounts of data. Consequently, their implementation and maintenance require a huge investment in time and money.

Local database back-ends, like Access, Paradox and dBase, primarily are intended for use by an individual or a small group. They are relatively inexpensive and easy to learn. dBase was the first local database to dominate the market. dBase file formats (.dbf) are still the common denominator for sharing data between databases. However, the dBase commercial product essentially has become extinct. Microsoft Access has acquired major market share in recent years.

The applications for this project are intended for use by the UDOT Regions. An enterprise back-end, such as Informix, is not available locally at the Regions. Besides, an enterprise back-end would be over-kill for a project of this scope. However, Access is available at both Region 1 and Region 2 — the sites where prototypes would be guided and evaluated.. Therefore, Access was the back-end chosen for the project. Part way into the project UDOT requested dBase format files so data could conveniently be imported to ArcView and other applications. dBase format files then became the back-end data formats for this project.

Front-End Tools:

As described in the previous section, the principal competing tools in the marketplace for front-end development are Borland's Delphi, Microsoft Visual Basic, Sybase PowerBuilder, and Symantec Visual Cafe. All four currently are being used extensively in practice. Delphi was selected for the following reasons:

- Visual Cafe was not chosen for several reasons, but primarily because it is specifically tailored for Java applications, and Java was not required for this project.
- PowerBuilder has a strong user base that was built up in the past when PowerBuilder was the best and most widely accepted front-end development tool for large scale client/server applications. It is intended for use with large enterprise database systems such as Informix. It is relatively expensive and has a long learning curve. It supports MS Windows, Mac, and UNIX. It is not intended for development with local database back-ends such as Access. It is not commonly used by university students, and is never used by engineering students. PowerBuilder was not highly rated in the independent reviews.
- Visual Basic is emerging as a powerful visual development tool for client/server systems. It is relatively inexpensive and has a short learning curve. It can be used to develop front-ends for enterprise database back-ends, such as Informix, as well as for local back-ends such as Access. In addition, it is the basis for Visual Basic Application, the consistent macro language for all Microsoft Office Products. It is the most prevalent computer language currently being taught to engineering students. It only supports MS Windows. It was rated high in all independent reviews. Visual Basic is becoming a tempting alternative for front-end development over a wide range of information systems applications.
- Delphi has many of the same attributes as Visual Basic (VB). VB is judged better in that Delphi has a slightly longer learning curve and is not used by university engineering

students. On the positive side, Delphi provides class structures similar to C++ and Java that are not available in VB. Delphi was rated high in all independent reviews. Because of its all-round performance capabilities, and its similarity to the C++ computer industry standard, Delphi was selected for development of the front-ends for this project.

PAVEMENT PRESERVATION PROTOTYPE

Background

Pavement Preservation currently is done in unison with paint preservation and the Maintenance Management Quality Assurance (MMQA) program. The roads are divided into segments based on beginning and end mile posts on a given route for a controlling station. All the pavement, paint and MMQA attributes are keyed to these segments. Data is stored in sequential order in a Quattro-pro file. The screen shot below captures part of that Quattro-pro file. As can be observed, data is entered in rows. No structural separation exists between the pavement attributes and the paint attributes.

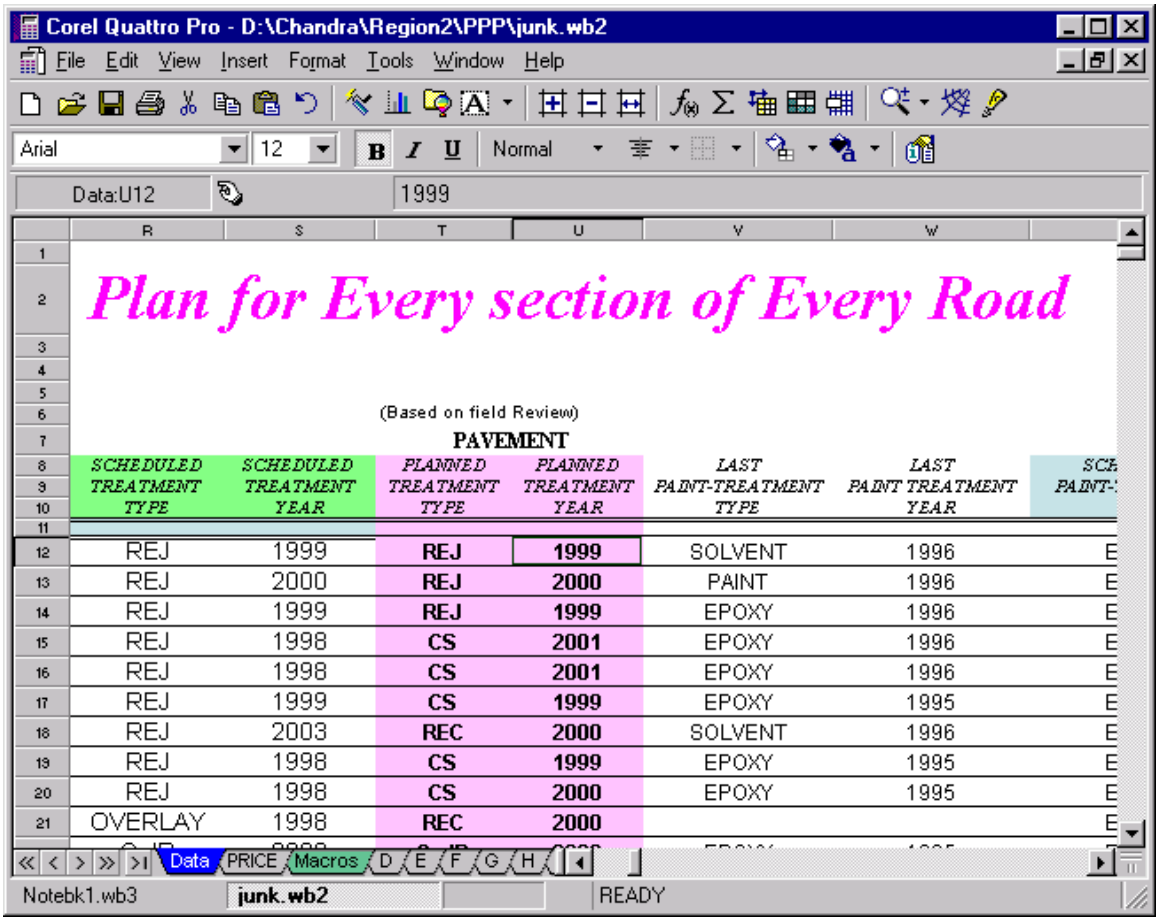


Figure 1. Quattro Pro Spreadsheet Data Entry and Analysis Form

Though pavement management using a spreadsheet brings with it advantages such as ease of use, familiarity of personnel, it has several shortcomings which must be overcome. A few of those shortcomings follow:

- Data, essentially spatial in nature, is not readily accessible to a spatial representation like a GIS.
- Multi-user environment may lead to Data Redundancy (multiple copies of the same data).
- Difficult to consolidate data from multiple users.
- Data security not enforced rigidly.
- Not intended for large data sets.
- Difficult to query and filter data.
- Complex macro language that is difficult to maintain and debug.
- Merging data from several regions is awkward and prone to error.

A model was needed would overcome the aforementioned pitfalls and still maintain functionality of the existing program.

Functionality for the Prototype

- *Data Display:* The prototype should allow easy display and access to records. Navigation through the records of a database table should be in an efficient and user-friendly manner.
- *Data Manipulation:* Key data manipulation operations such as insert, update, and delete should be easily facilitated by the model.
- *Order of Information:* Information is defined as "processed data." The prototype must allow for sorting data in an order defined by the user.
- *Information Retrieval:* Many a time, specific information must be retrieved from data. The prototype should possess good querying abilities.

- *Data Storage:* The format in which data is stored is an important issue. Data storage should be in a form conducive for various development tools to access it.
- *Data Analysis:* Data analysis is an offshoot of the previous need for standard data storage. Data must be amenable for analysis using tools such as ArcView GIS.

Approach Adopted

This section details the approach adopted in meeting needs for the pavement preservation model.

Data Standardization

The emphasis was on data standardization. All data were converted into the standard format. Once data is in the standard format, migration to any other format becomes easy. Also database development tools can access such data to perform various analysis and manipulation. dBase was chosen as the standard platform as it is the generic database which can be accessed/ translated into any other database with ease. dBase is a good fit in the architecture proposed, which calls for eventual transfer to an enterprise database. dBase can be used with a base level database such as access or an enterprise system such as SQL Server.

GIS Interoperability

All pavement management data is spatial in nature. Each of the road segments for which attributes are stored corresponds to some specific geographic location. Keeping this fact in mind, the prototype was developed to work well with a Geographic Information System. ArcView was the GIS tool adopted. dBase tables are the standard format employed in ArcView. For this reason the pavement management prototype is interoperable with ArcView.

Determination of Data Structures

The pavement management database was organized into different topical modules. Therefore there are tables dealing with data about pavement treatments, paint schedules, MMQA, pavement evaluation and so on. Each of these tables has a mirror table for storing archived information. A list of the tables and the fields contained in them is provided in Appendix A at the end of this report.

Data Entry and Manipulation

Specific input screens were developed for data entry and manipulation. These dialog boxes are better than entering records in rows for the following reasons.

- Chances of data entry errors are minimized as the dialog box is focused on one record and selected special fields.
- The user need not go over the whole row if only a few values are to be entered.
- Choice of values for certain attributes can be restricted by the use of drop-down boxes. This ensures that the user does not input undesirable values.
- Access to these dialog boxes may be restricted, thereby increasing security.

Information Retrieval and Ordering

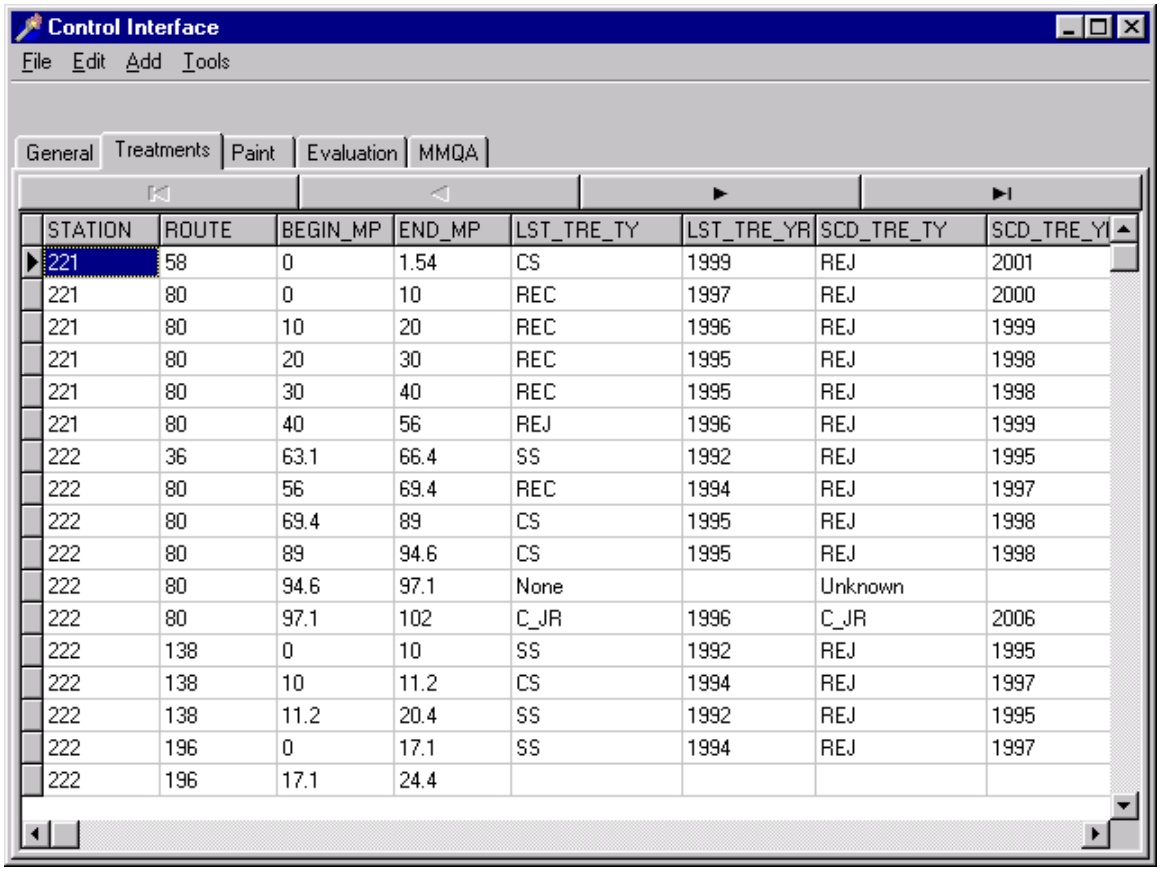
The prototype introduces improved querying and sorting capabilities as opposed to the spreadsheet. Easy to use interfaces have been built which allow for data to be queried and sorted. Such tasks would have involved cumbersome clipping and pasting in the original spreadsheet environment.

PAVEMENT PRESERVATION MODEL EXAMPLE

This section deals with implementing the pavement management prototype to a real world pavement preservation program. The emphasis is on illustrating the methodology and benefits accruing by using this model.

Data Display

The opening screen shows the display of data already contained in the pavement table. Tools have been provided to navigate through the record with ease.



STATION	ROUTE	BEGIN_MP	END_MP	LST_TRE_TY	LST_TRE_YR	SCD_TRE_TY	SCD_TRE_YI
221	58	0	1.54	CS	1999	REJ	2001
221	80	0	10	REC	1997	REJ	2000
221	80	10	20	REC	1996	REJ	1999
221	80	20	30	REC	1995	REJ	1998
221	80	30	40	REC	1995	REJ	1998
221	80	40	56	REJ	1996	REJ	1999
222	36	63.1	66.4	SS	1992	REJ	1995
222	80	56	69.4	REC	1994	REJ	1997
222	80	69.4	89	CS	1995	REJ	1998
222	80	89	94.6	CS	1995	REJ	1998
222	80	94.6	97.1	None		Unknown	
222	80	97.1	102	C_JR	1996	C_JR	2006
222	138	0	10	SS	1992	REJ	1995
222	138	10	11.2	CS	1994	REJ	1997
222	138	11.2	20.4	SS	1992	REJ	1995
222	196	0	17.1	SS	1994	REJ	1997
222	196	17.1	24.4				

Figure 2. Database Display of Data by Category.

Data Manipulation

Pavement data is always dynamic. Records are to be updated constantly to keep track of surface treatments and schedules. A history of such changes also must be maintained to provide an idea about pavement durability and can be invaluable for various analysis such as life cycle analysis and benefit-cost studies. This archiving facility was lacking in the spreadsheet model which is rectified in the prototype. The tool for data manipulation brings up the following dialog box. The fields in the dialog box are populated by values corresponding to the location of the cursor in the main form. Refer to the previous screen shot to locate the cursor position.

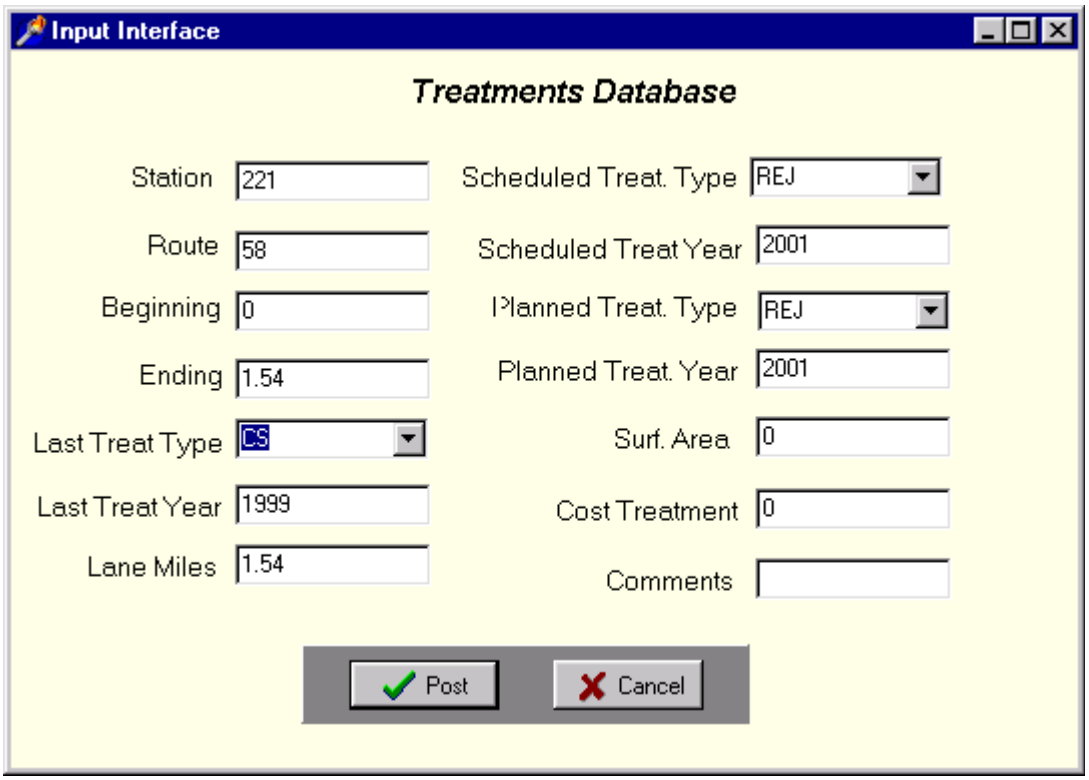


Figure 3. Data Entry Dialog Box.

Notice the drop down boxes for the treatment types. These will ensure that the user will only use the specified treatment type, eliminating the possibility of an error. The post button on this form performs two functions.

1) The main form (opening screen) gets updated showing the latest values, and

2) The old values are stored in an archive table which can be viewed conveniently as shown in Figure 4.

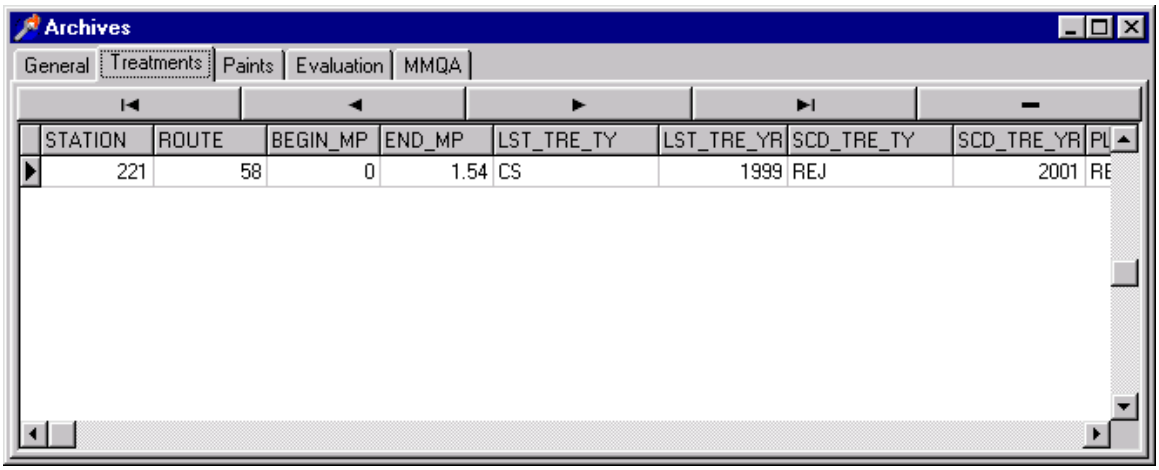


Figure 4. Display of Archived Data.

Ordering of Information

The prototype allows flexibility to order data depending on the constraints decided upon by the user. For example, the user might want to see all data grouped by the routes and see the last treatment type as a sub-group. The order of sort can easily be defined by using the sort tool shown in Figure 5. In this example the user has designated a sort based on a primary field of "Route" and a secondary field of "LST_TRE_YR" (last treatment type).

The results of the sort are shown in Figure 6. It shows the table sorted in the precedence of routes and last treatment types. A sort also could be conducted on planned treatment years. This would give an

idea of the tasks at hand and help in prioritizing. Thus, ordering of data is a useful tool in planning for pavement treatments.

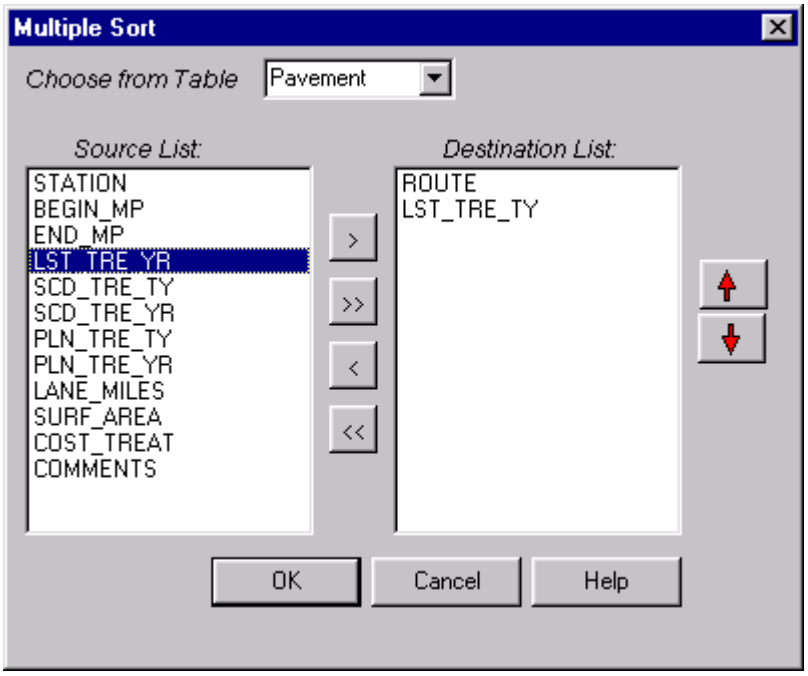
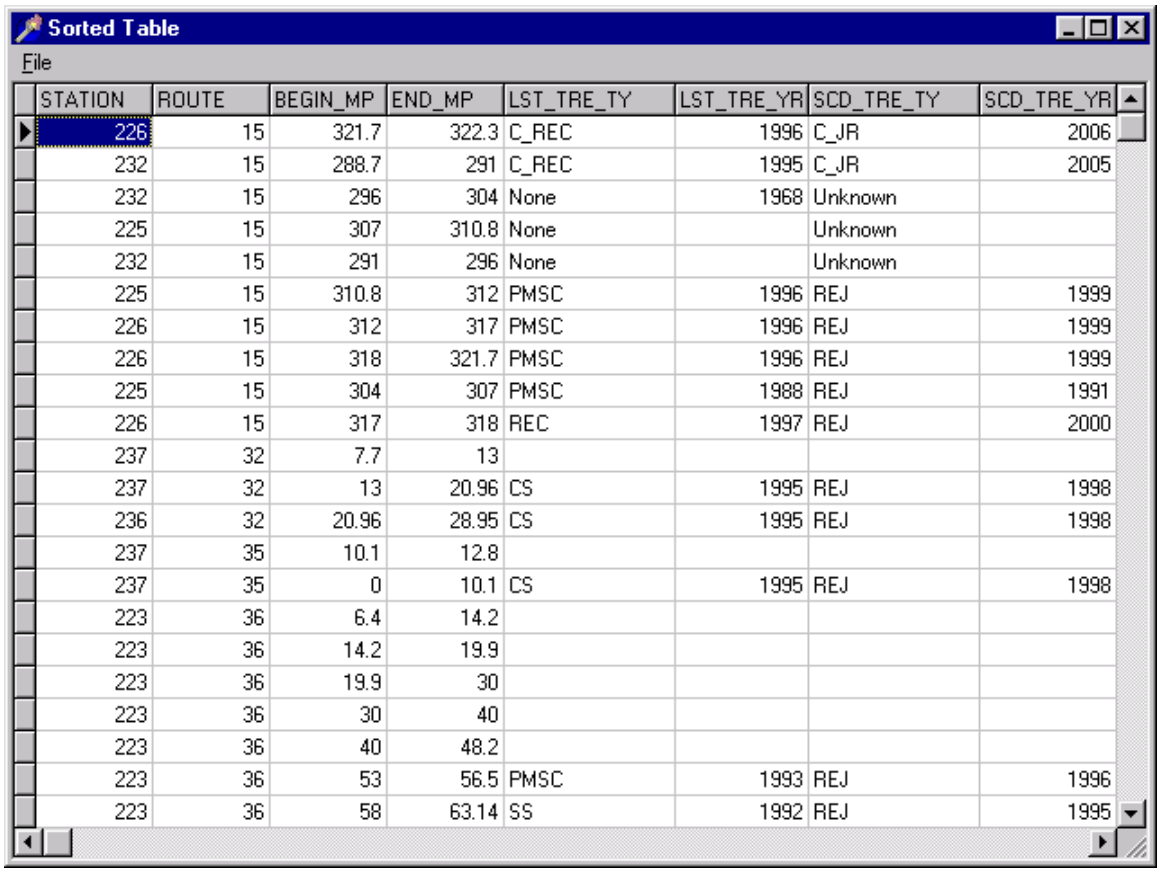


Figure 5. Dialog Box for the Sort Tool



STATION	ROUTE	BEGIN_MP	END_MP	LST_TRE_TY	LST_TRE_YR	SCD_TRE_TY	SCD_TRE_YR
226	15	321.7	322.3	C_REC	1996	C_JR	2006
232	15	288.7	291	C_REC	1995	C_JR	2005
232	15	296	304	None	1968	Unknown	
225	15	307	310.8	None		Unknown	
232	15	291	296	None		Unknown	
225	15	310.8	312	PMSC	1996	REJ	1999
226	15	312	317	PMSC	1996	REJ	1999
226	15	318	321.7	PMSC	1996	REJ	1999
225	15	304	307	PMSC	1988	REJ	1991
226	15	317	318	REC	1997	REJ	2000
237	32	7.7	13				
237	32	13	20.96	CS	1995	REJ	1998
236	32	20.96	28.95	CS	1995	REJ	1998
237	35	10.1	12.8				
237	35	0	10.1	CS	1995	REJ	1998
223	36	6.4	14.2				
223	36	14.2	19.9				
223	36	19.9	30				
223	36	30	40				
223	36	40	48.2				
223	36	53	56.5	PMSC	1993	REJ	1996
223	36	58	63.14	SS	1992	REJ	1995

Figure 6. Results of the Sort Based on the Parameters Specified in Figure 5.

Data Retrieval

Data Retrieval, as opposed to data sorting, is used to filter data. Only those records that satisfy a given condition are returned. Complex queries can be performed using this model. For instance, the user might want to see all the segments due to be treated in 1999 and due to occur on route 15. The query tool is put to use in such cases.

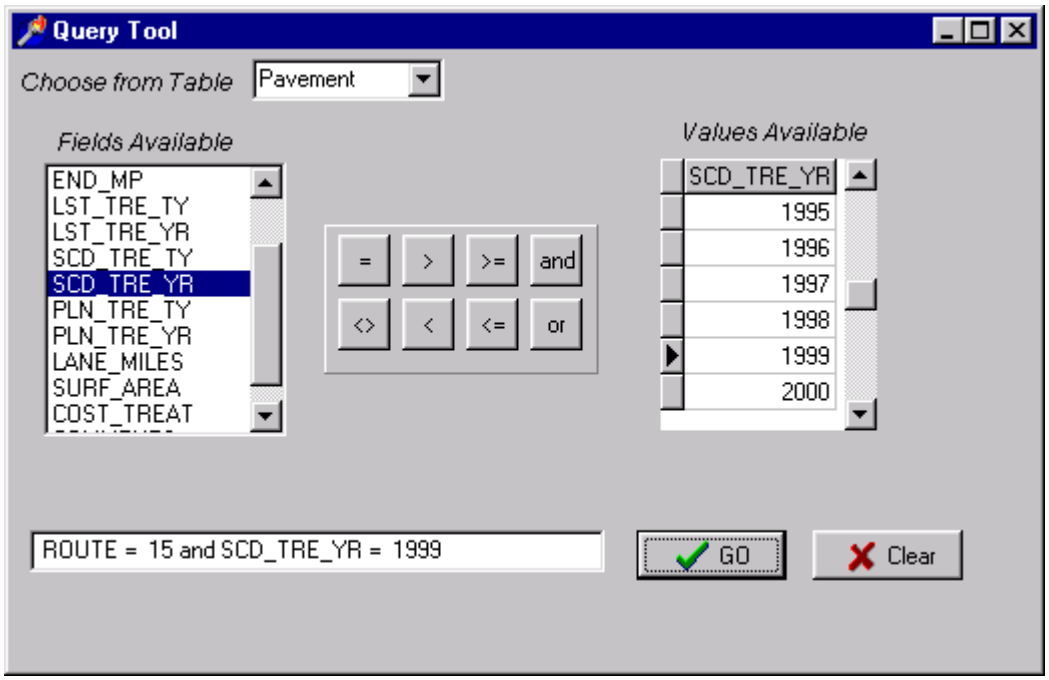
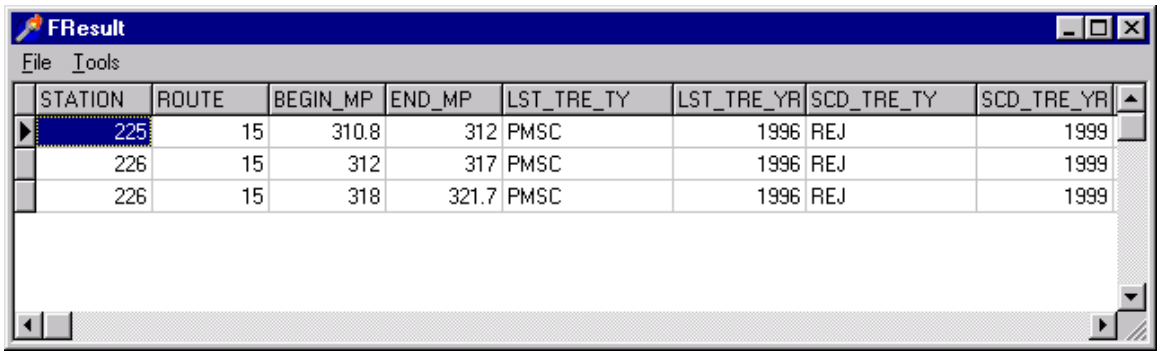


Figure 7. The Dialog Box for the Query Tool.



STATION	ROUTE	BEGIN_MP	END_MP	LST_TRE_TY	LST_TRE_YR	SCD_TRE_TY	SCD_TRE_YR
225	15	310.8	312	PMSC	1996	REJ	1999
226	15	312	317	PMSC	1996	REJ	1999
226	15	318	321.7	PMSC	1996	REJ	1999

Figure 8. Results of the Query Based on the Parameters Shown in Figure 7.

Data Analysis

Analysis and graphic display of pavement data can be efficiently performed using a GIS tool such as ArcView. The single biggest advantage of a GIS is that it lets the user visualize information in new ways that reveal relationships, patterns, and trends that would otherwise be intangible in a tabular system.

UDOT's pavement data was analyzed using ArcView. Numerous demonstrations of its power were made at UDOT seminars. The following series of screen shots show how GIS can be integrated with the pavement preservation model.

Figure 9. shows the GIS display of the road segments maintained by Region 2 in dark black. Utah State Highways are shown in gray.

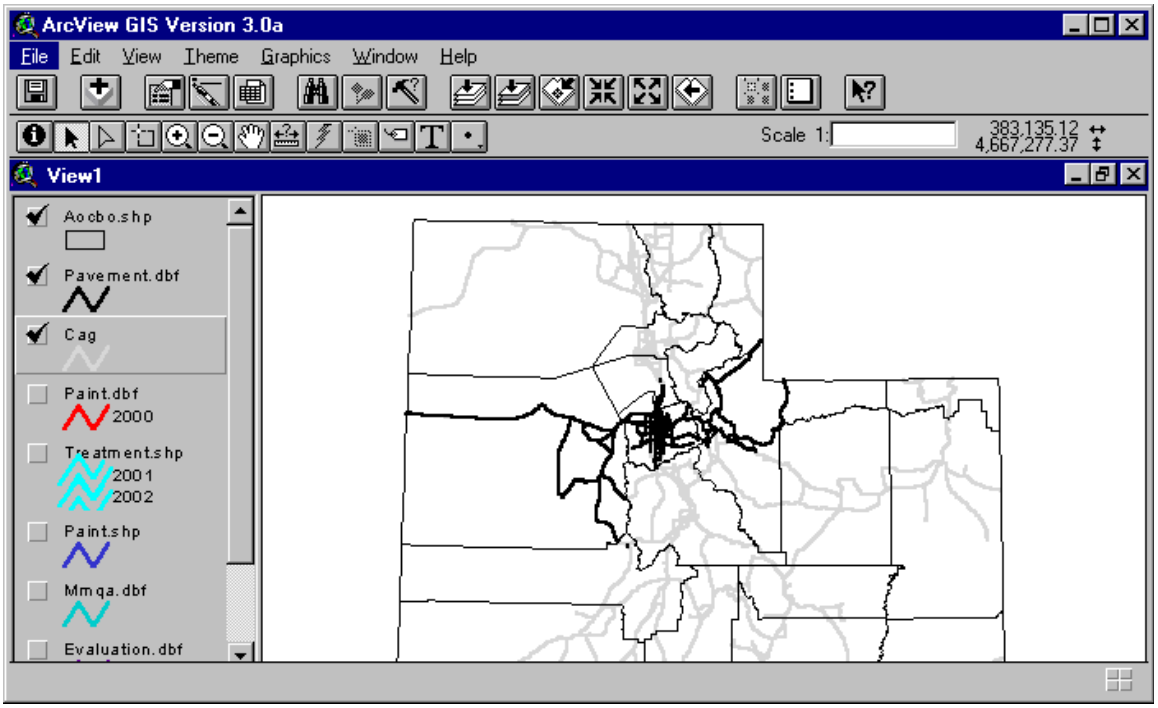


Figure 9. GIS Display Showing State Routes in Region 2.

Figure 10. This screen highlights roads that are due for surface treatments in the year 2000. These roads are shown in thicker lines. In this way, at a glance the manager can tell which roads are due for treatment planned for the year 2000, and can further prioritize tasks and schedule work among the maintenance crews.

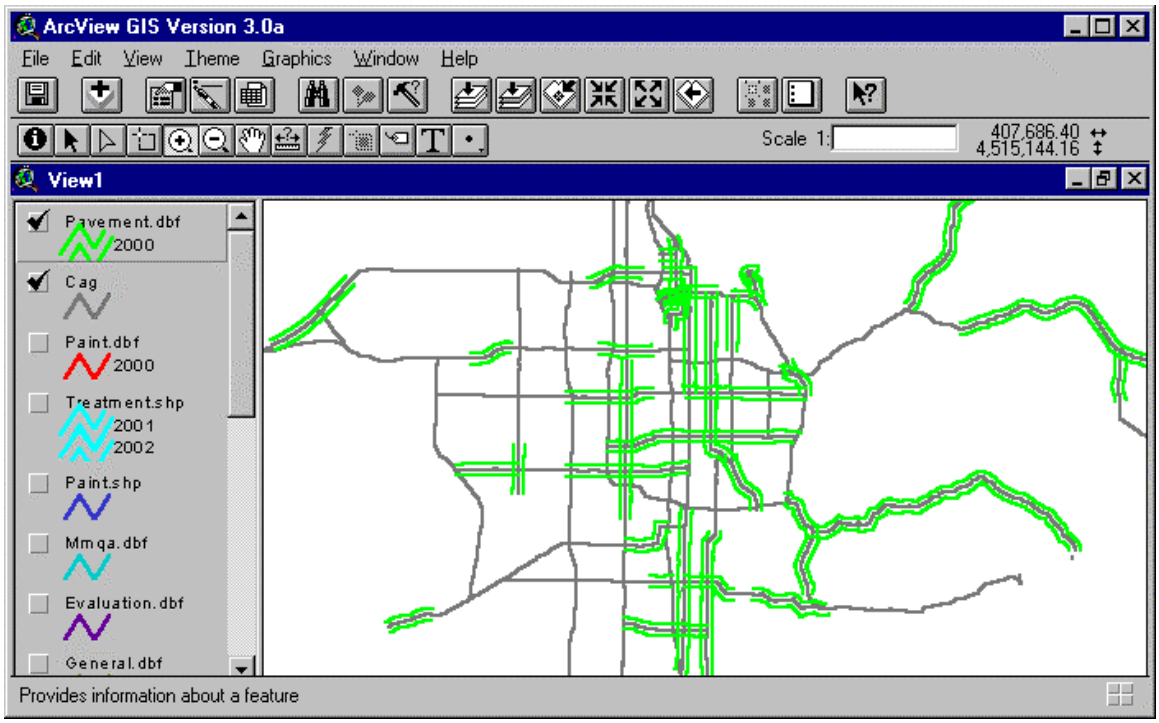
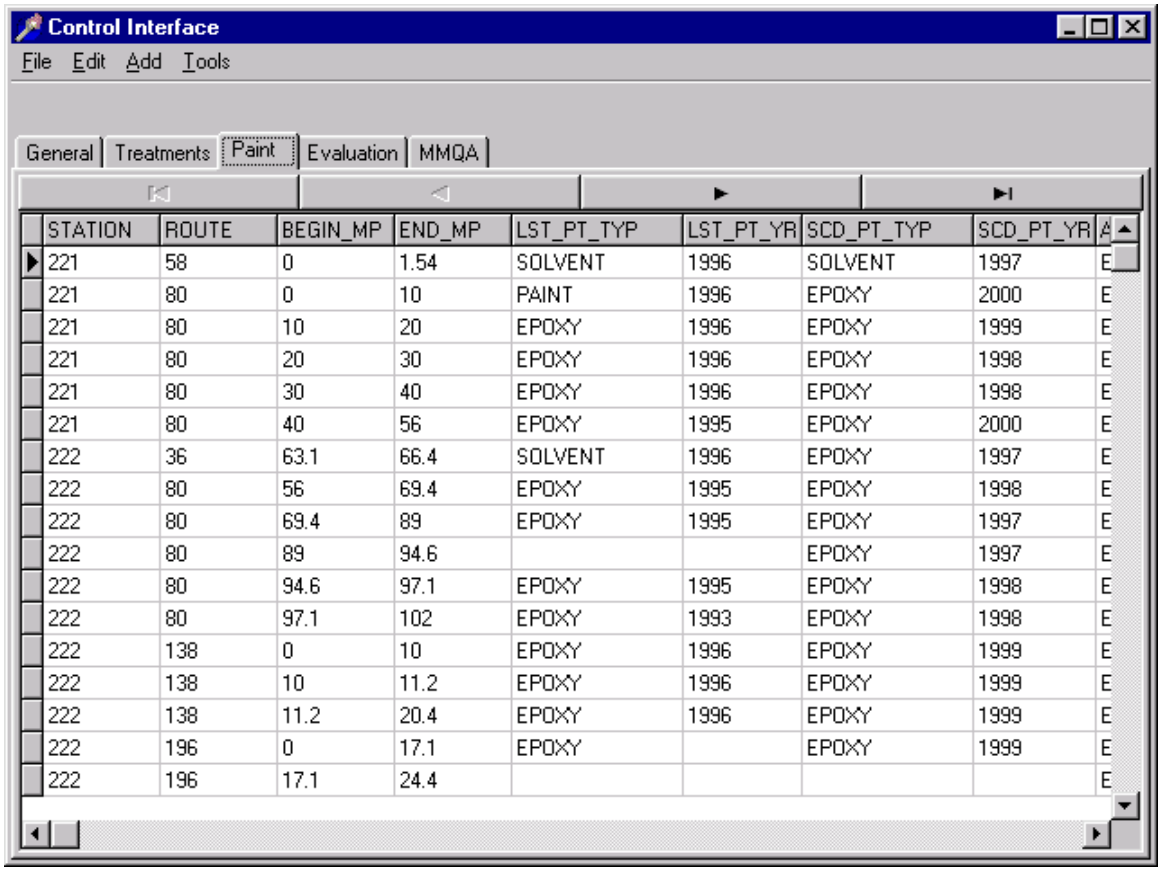


Figure 10. GIS Display of Surface Treatments Planned for the Year 2000.

PAINT PRESERVATION MODEL EXAMPLE

The Paint Preservation Model (PAINT) is similar to the Pavement Preservation Model (PAVE). Data are stored in a standard format. This makes the Paint preservation model readily amenable to a GIS analysis. Specific data manipulation dialog boxes have been built to provide the user with an easy interface. The following series of screen shots summarize the paint preservation model.

Figure 11 shows the PAINT database. Customary tools have been provided for navigating through the records.



STATION	ROUTE	BEGIN_MP	END_MP	LST_PT_TYP	LST_PT_YR	SCD_PT_TYP	SCD_PT_YR	A
221	58	0	1.54	SOLVENT	1996	SOLVENT	1997	E
221	80	0	10	PAINT	1996	EPOXY	2000	E
221	80	10	20	EPOXY	1996	EPOXY	1999	E
221	80	20	30	EPOXY	1996	EPOXY	1998	E
221	80	30	40	EPOXY	1996	EPOXY	1998	E
221	80	40	56	EPOXY	1995	EPOXY	2000	E
222	36	63.1	66.4	SOLVENT	1996	EPOXY	1997	E
222	80	56	69.4	EPOXY	1995	EPOXY	1998	E
222	80	69.4	89	EPOXY	1995	EPOXY	1997	E
222	80	89	94.6			EPOXY	1997	E
222	80	94.6	97.1	EPOXY	1995	EPOXY	1998	E
222	80	97.1	102	EPOXY	1993	EPOXY	1998	E
222	138	0	10	EPOXY	1996	EPOXY	1999	E
222	138	10	11.2	EPOXY	1996	EPOXY	1999	E
222	138	11.2	20.4	EPOXY	1996	EPOXY	1999	E
222	196	0	17.1	EPOXY		EPOXY	1999	E
222	196	17.1	24.4					E

Figure 11. Input Dialog Box for Manipulating the Paint Data.

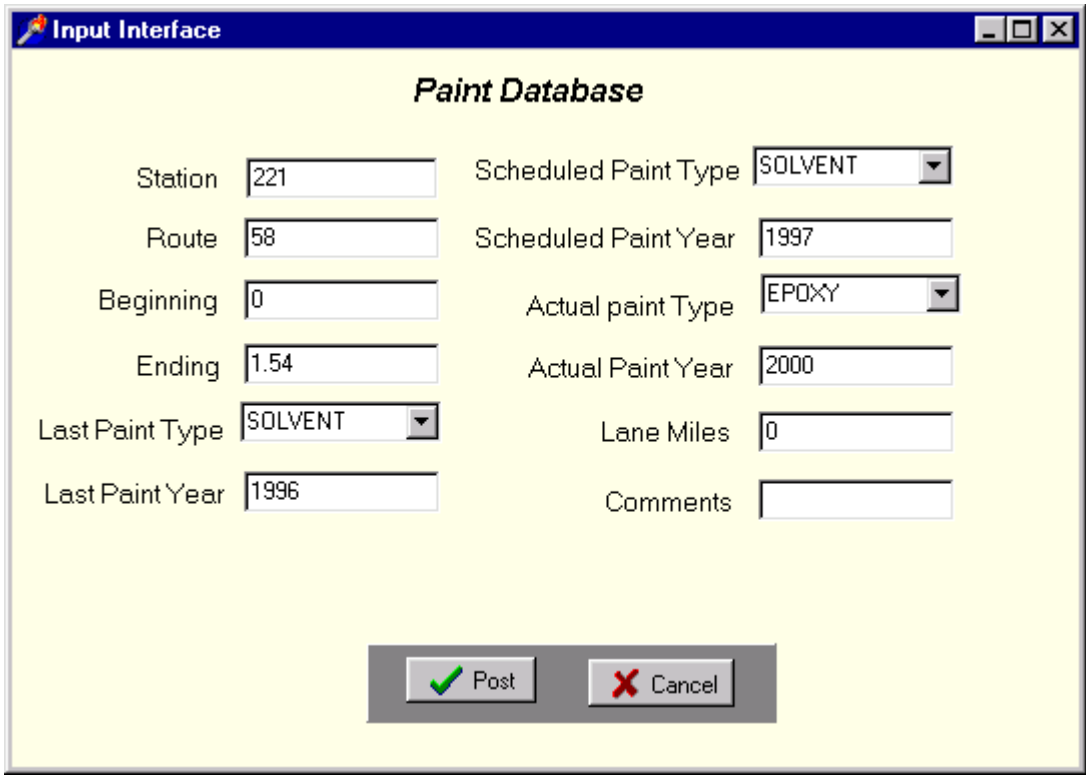


Figure 12. Dialog Box for Inputting Data to the PAINT Database.

The PAINT database also has the following features:

- auto archiving on post
- ability to perform multiple sorts on the database
- ability to query the paint database
- ability to generate tables derived from the main database. Refer to the user's manual section.

The PAINT database also can be analyzed using a GIS as shown in the following exhibits. Figure 13 displays the roads in Region 2 graded by the different paint types.

The database and GIS analysis also can be used to create charts and graphs as shown in Figures 14 and 15.

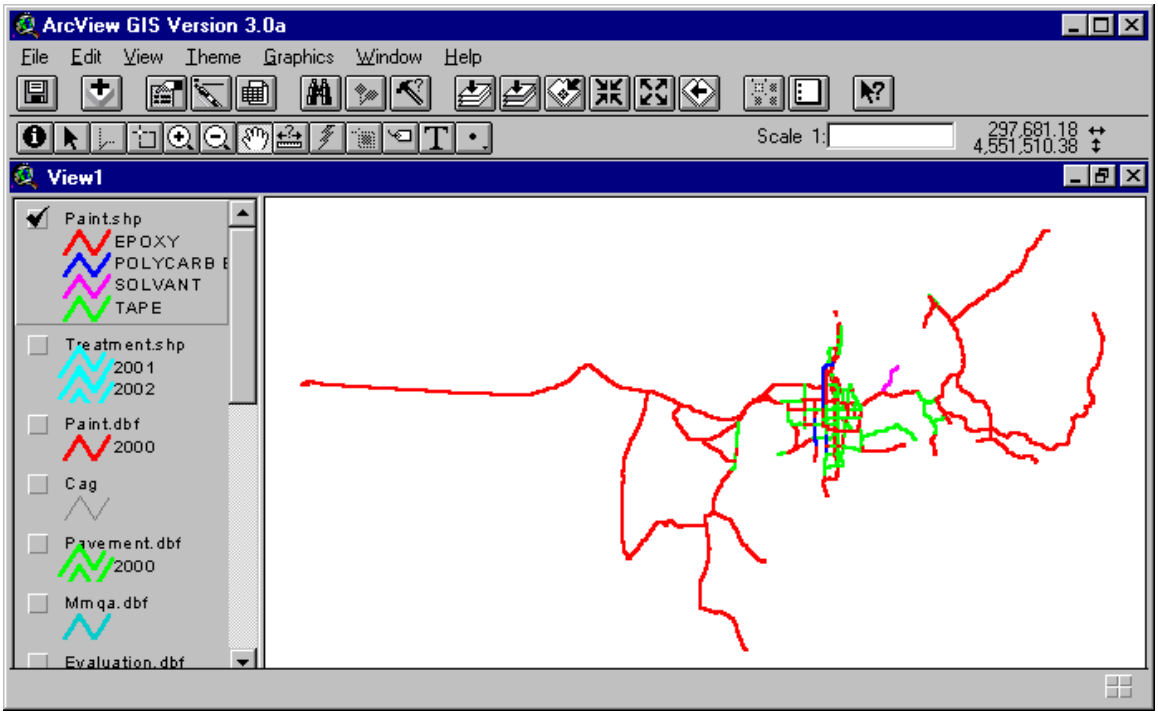


Figure 13. GIS Display of Paint Types in Region 2.

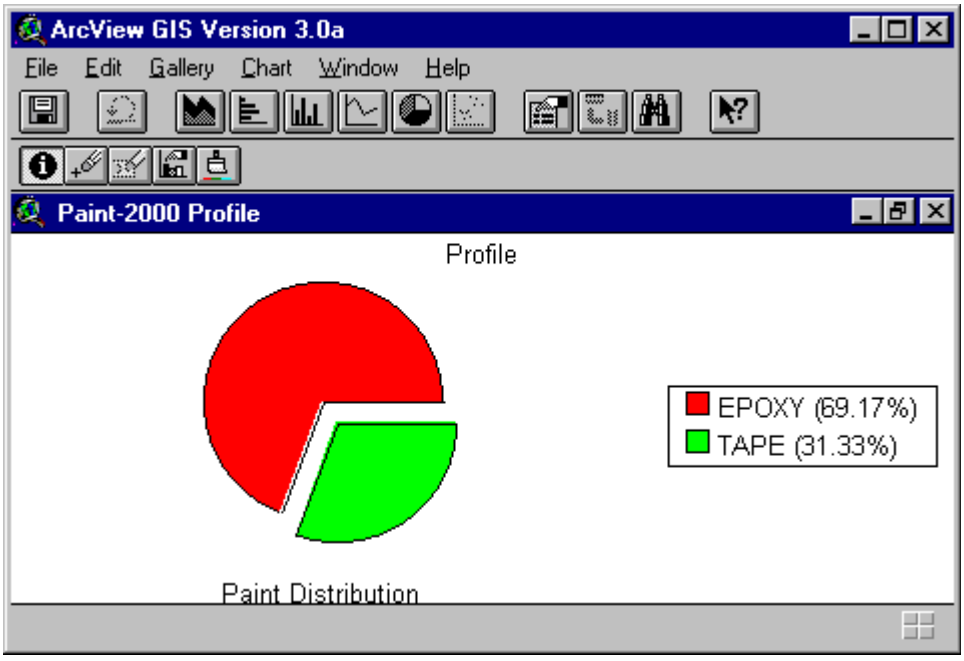


Figure 14. Graphic Display of the Paint Profile Planned for the Year 2000.

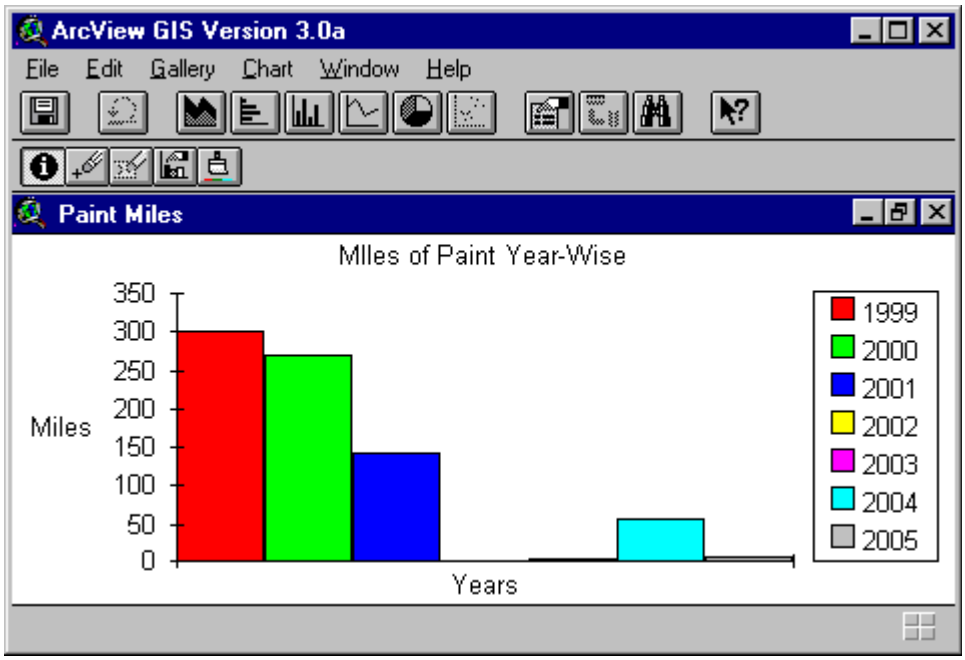


Figure 15. Graphic Display of the Miles of Paint Applied by Year.

Figure 15 is a graphic of the miles of paint planned for application by year. The values have been computed from the database, and the results are shown in the form of a bar chart.

Figure 16 is a graphic displaying the power of GIS to relate data from disparate databases and perform an analysis. Here the single dashed lines are pavements scheduled for painting in the year 2000. The double lines are pavements scheduled for treatment during years 2001 and 2002. The overlap of these lines show pavements which will be treated within two years after striping.

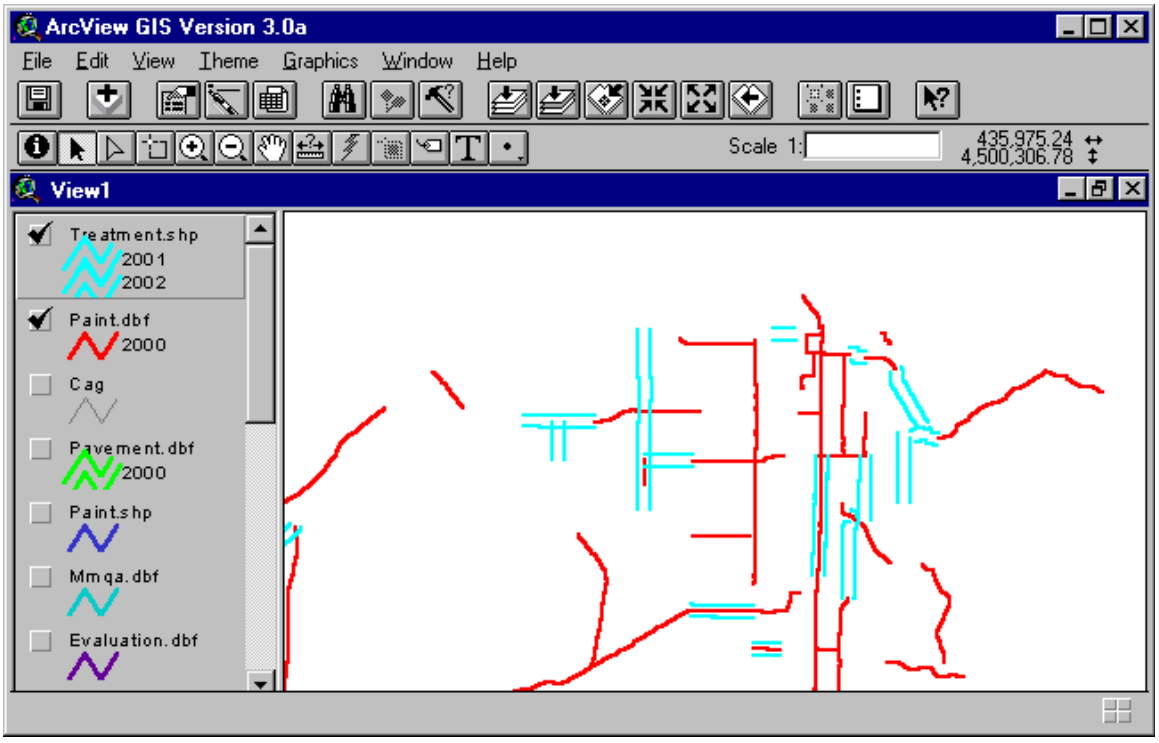


Figure 16. GIS Display of Pavement Overlays and Pavement Striping.

MAINTENANCE MANAGEMENT QUALITY ASSURANCE EXAMPLE

Introduction

Each Region and Station is responsible for assessing the quality of its roads. This Maintenance Management Quality Assurance (MMQA) process is accomplished by randomly selecting segments of roads, visually inspecting the segments, and grading the results on a scorecard. The scorecard is divided into 10 groups:

1) snow removal
2) hard surface maintenance
3) non-hard surface maintenance
4) roadside maintenance
5) vegetation control
6) drainage and slope repair
7) major structure maintenance
8) traffic services
9) supervision, training, and support maintenance
10) rest area maintenance

Each group contains several activities. Performance measures are specified for each activity. Scoring is accomplished by rating the performance measure for each activity on a scale from Av(high) to F (low). A complete list of groups, activities, and performance measures is presented in Appendix C.

UDOT developed a Quatro Pro spreadsheet to help station personal conduct scoring in the field. The spreadsheet generates random numbers for selecting road segments, and provides dialog boxes for scoring each activity.

Region 2 added columns to their Pavement Preservation spreadsheet in an attempt to consolidate Pavement Preservation, Paint Preservation, and Maintenance Management Quality Assurance into a unified software suite that could be used by the regions.

The objective of this part of the project was to demonstrate an alternative to the spreadsheet, and to present some of its advantages including interaction with Geographic Information Systems (GIS).

Database Approach

The dialogue boxes of MMQA data can easily be replicated in dBase using standard tools. Figure 17 is the highest level dialog box showing the general information and the randomly selected route segments in the spreadsheet. The main advantages of dBase files over spreadsheets are as follows:

Accessability to Data

The dbase files can easily be linked with ArcView GIS. Numerical data can be viewed in two dimensions. A two-dimensional picture gives a detailed overview of the data which can be useful to the people in the field. The database format reduces the time and effort needed to generate a geographical display showing the spacial distribution of the scorecard values. Figure 18 shows the region on the standard state highway reference system.

Analysis of Sata Made Easy

With the two dimensional/route map available in ArcView, the data can be analyzed further, which will give a detailed output. Any type of analysis can be made on the data and any number of additional attributes can be linked with the data available. For example, the attribute length of route can be added to make the tables more self-explanatory. Also one can make an analysis such as which part of the county has maximum traffic or which part of routes require MMQA treatment and so on. These analyses make the data more useful and efficient. This also could save some time and effort of the site

engineers who go out to collect the data which can be evaluated on the desk by conducting analysis in ArcView. Some of the analysis done on MMQA is shown in Figures 19 through 22.

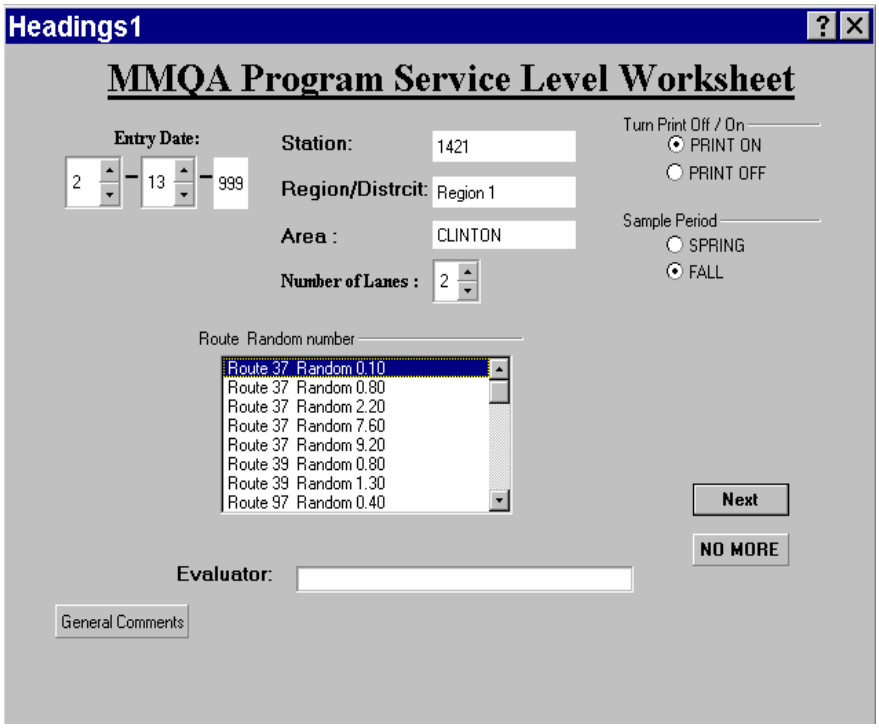


Figure 17. Dialog Box Showing Randomly Selected Route Segments

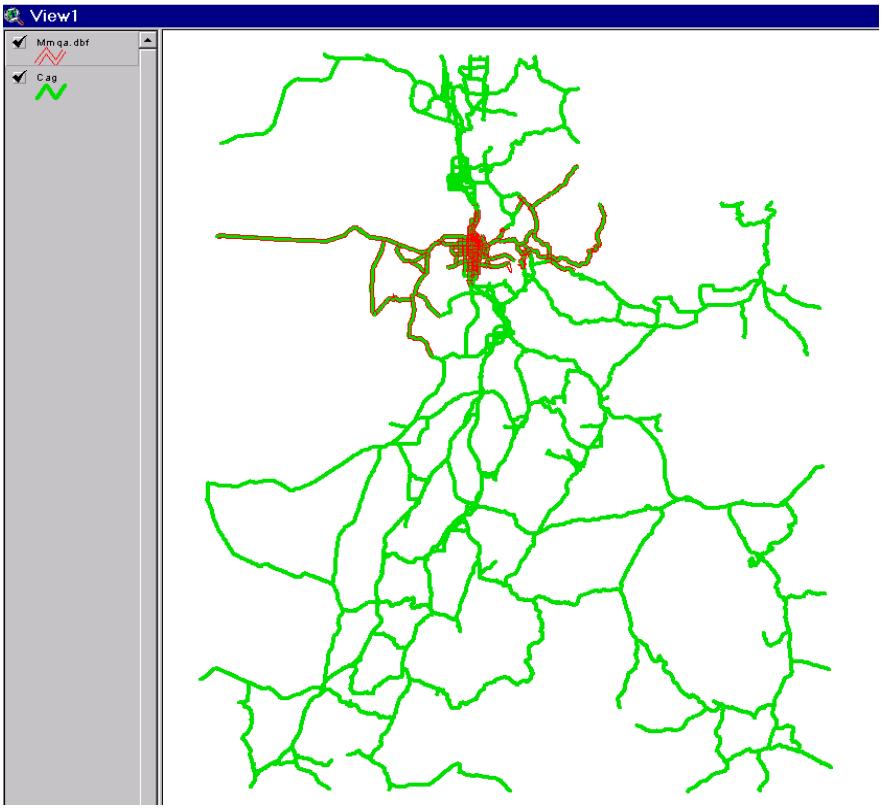


Figure 18. Sites for MMQA Data for Region 2.

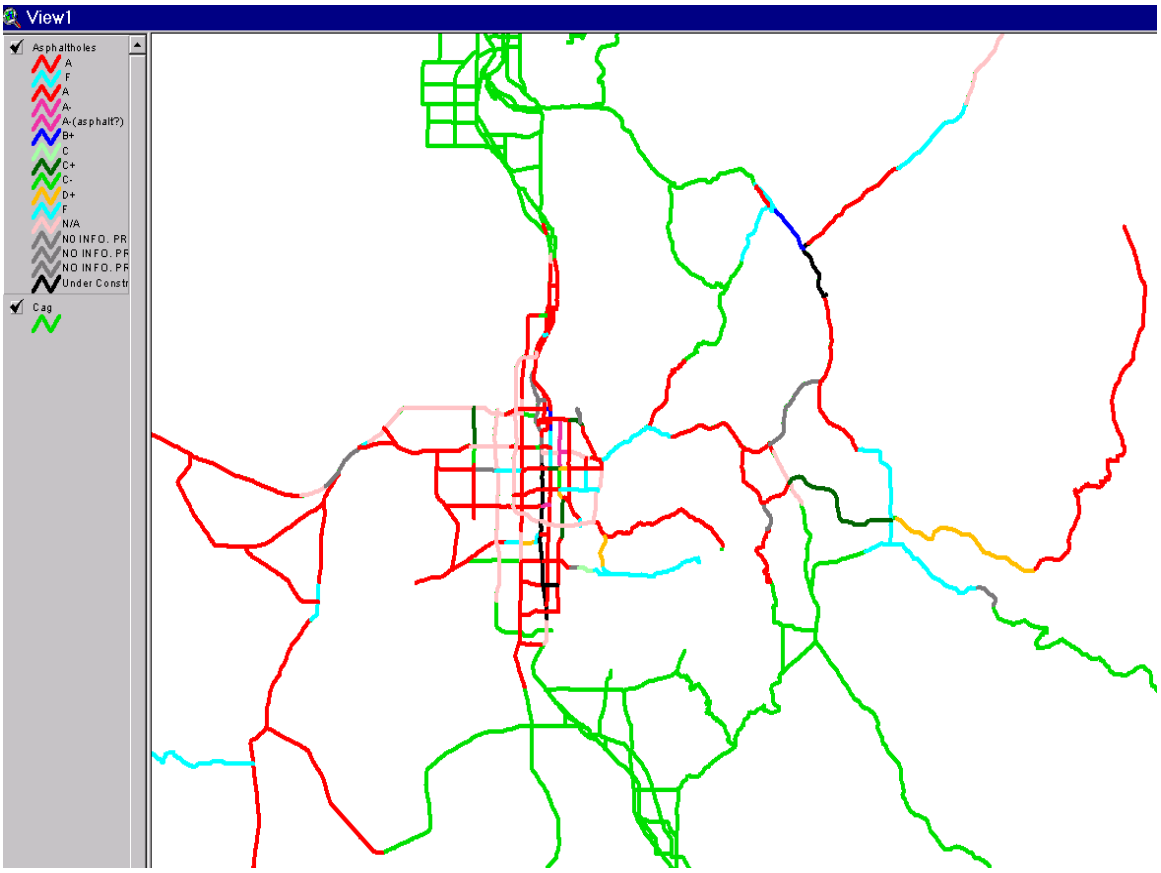


Figure 19. Display of MMQA Data Field "Asphaltholes".

Figure 19 shows ratings for the MMQA parameter "Asphaltholes" on the State Highway Route map. This type of information is useful for prioritizing and scheduling. Figure 20 shows information from Figure 19 plus a character (A through F, or N/A) representation of the score for the respective route segment.

Figure 21 shows similar data for the MMQA parameter "Concreteholes" plotted as bars.

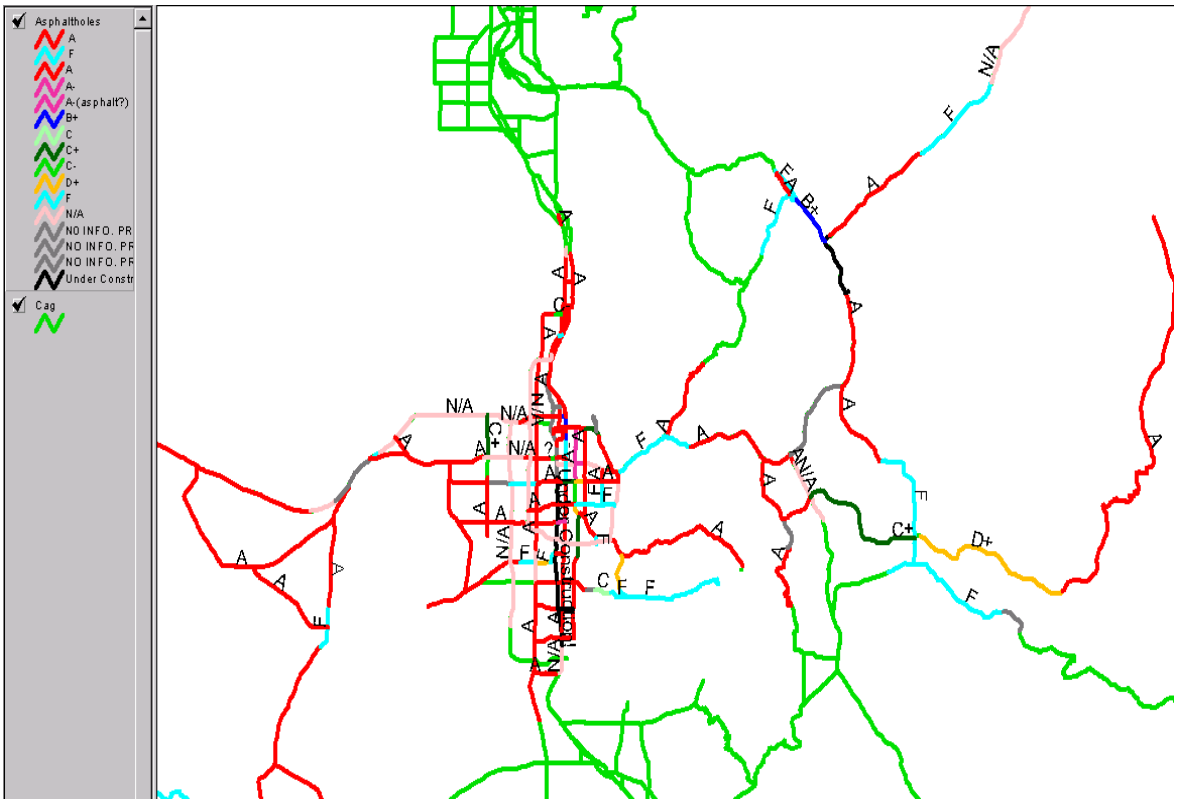


Figure 20. Display of MMQA Data Field "Asphaltholes" Showing Character Score.

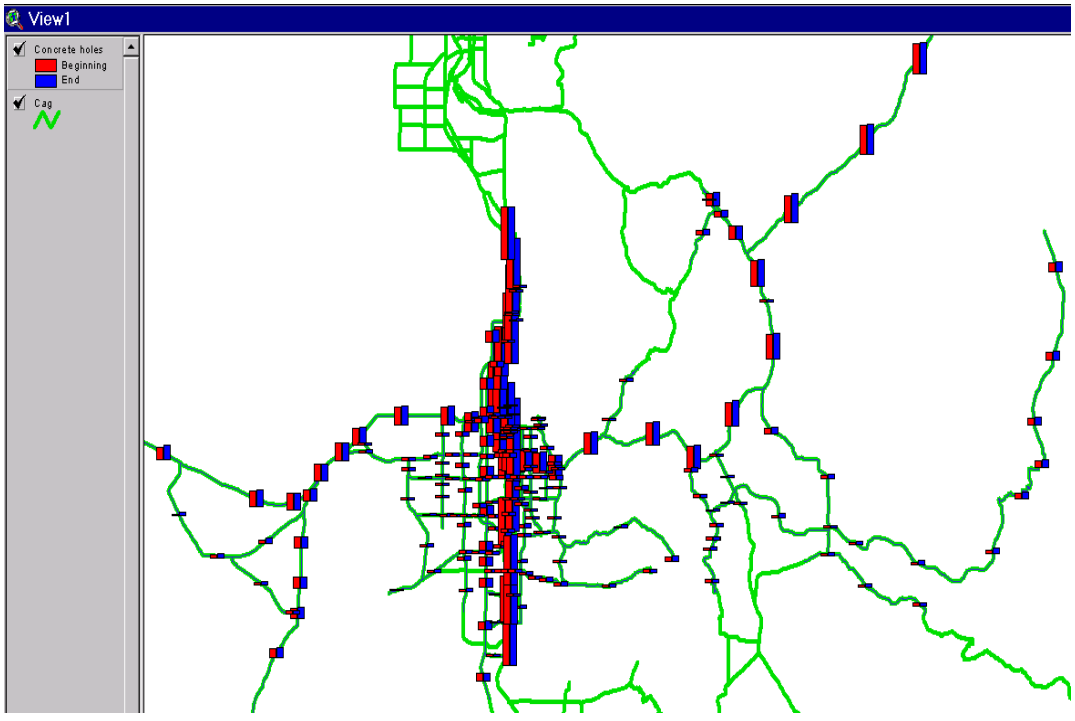


Figure 21. Display of MMQA Data Field "Concreteholes".

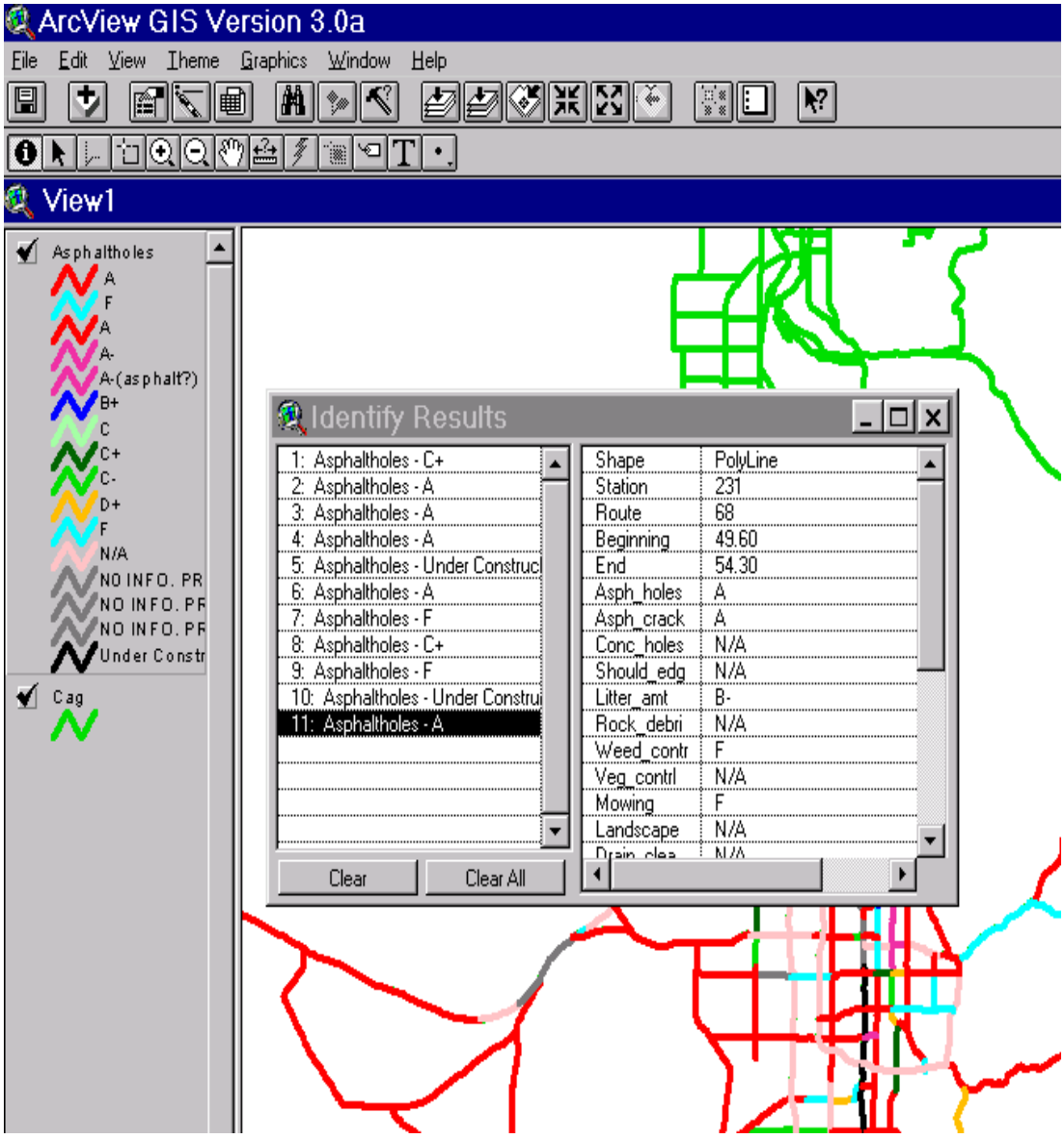


Figure 22. Table of Attributes Displayed by the Identity Tool.

Data Queries

The simplest way to access data is to use the GIS Identity Tool. As shown in Figure 22, the identity tool in ArcView gives all the attribute information on screen for any route selected. Again this is an efficient and handy tool for the site engineers.

The query tool is the main tool used to answer most of the questions during analysis. For example in Figure 23 and 24, with the help of this tool one can find a particular route or all MMQA treatments required in a particular year. Multiple queries using Boolean values, like “and,” “or,” “>,” “<,” etc; can be used where more than one attributes is to be used to find an accurate solution.

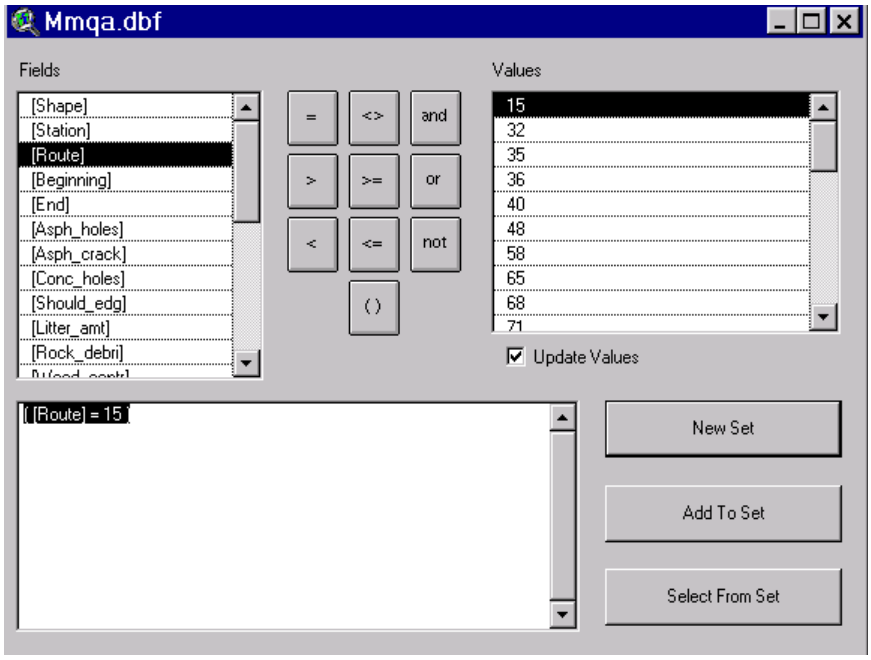
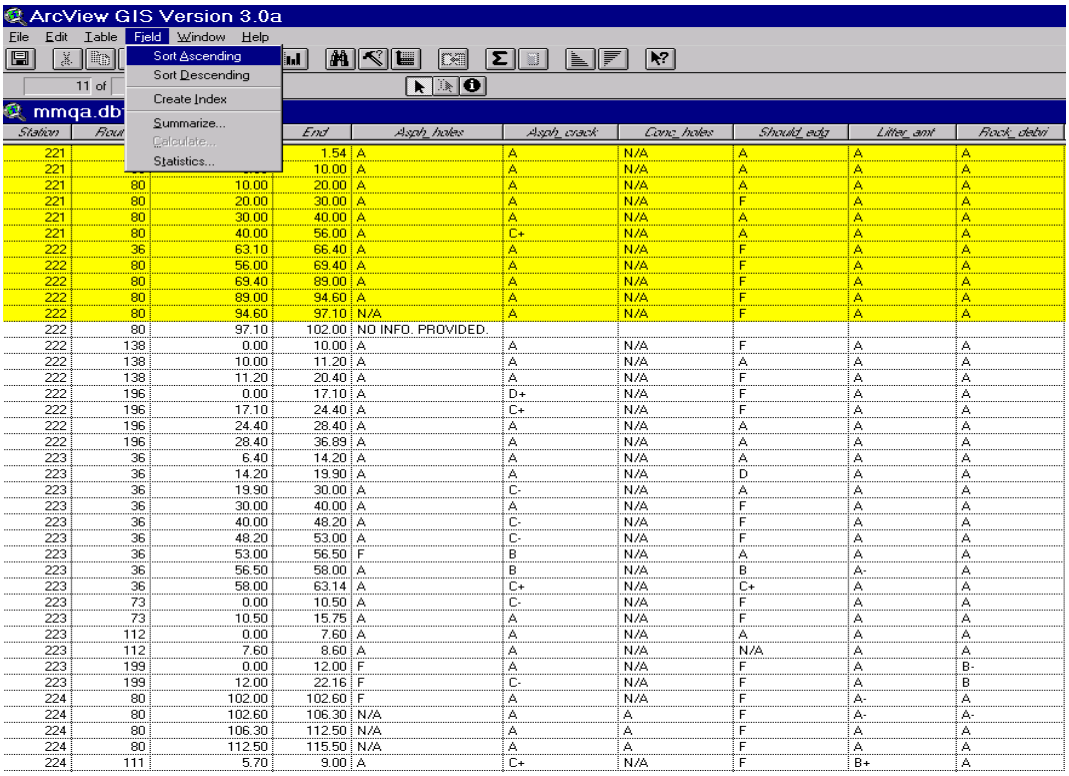


Figure 23. Multiple Query Tool.

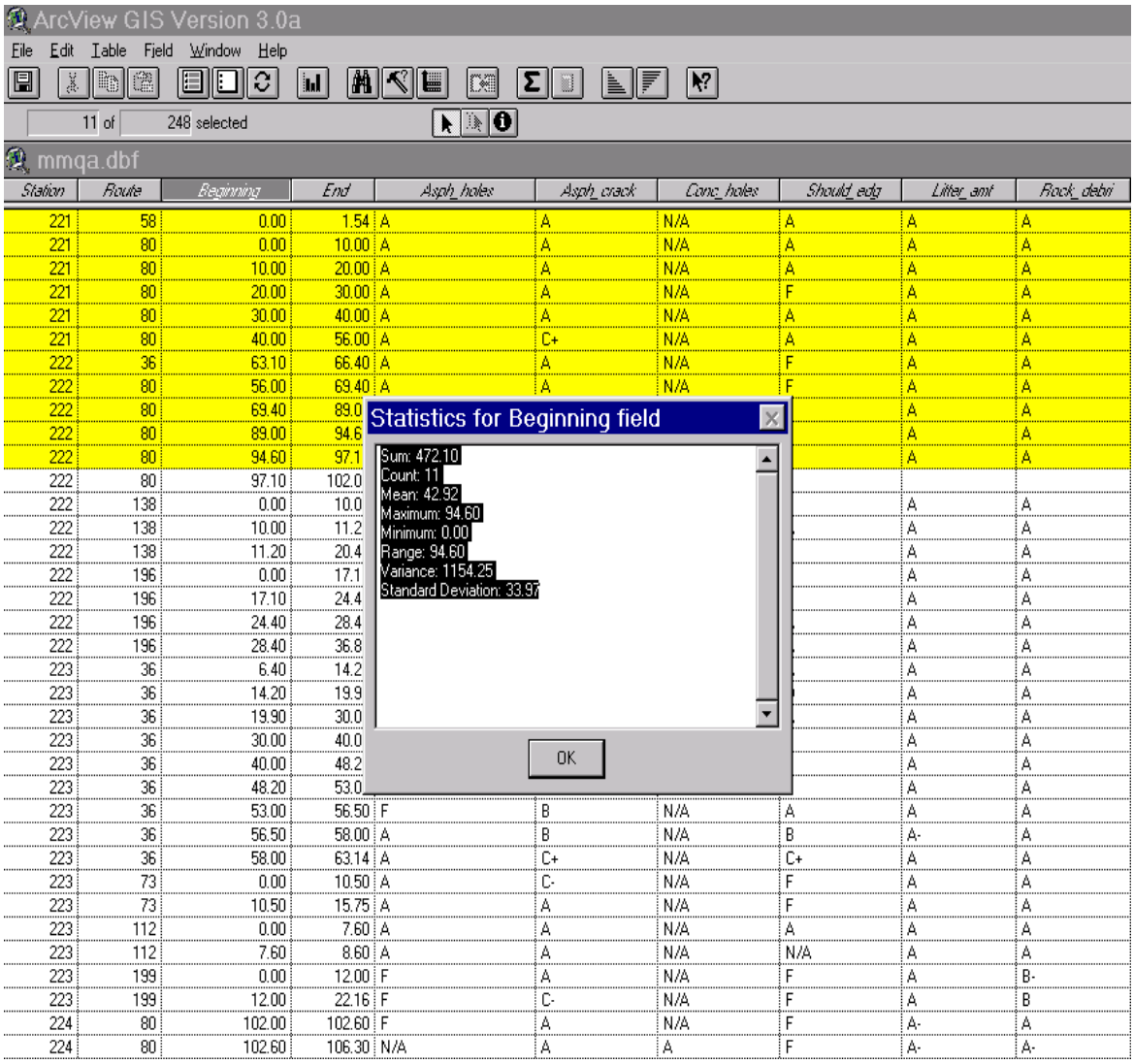


Station	Rout		End	Asph_holes	Asph_crack	Conc_holes	Should_edg	Litter_amt	Rock_debri
221			1.54	A	A	N/A	A	A	A
221			10.00	A	A	N/A	A	A	A
221	80	10.00	20.00	A	A	N/A	A	A	A
221	80	20.00	30.00	A	A	N/A	F	A	A
221	80	30.00	40.00	A	A	N/A	A	A	A
221	80	40.00	56.00	A	C+	N/A	A	A	A
222	36	63.10	66.40	A	A	N/A	F	A	A
222	80	56.00	69.40	A	A	N/A	F	A	A
222	80	69.40	89.00	A	A	N/A	F	A	A
222	80	89.00	94.60	A	A	N/A	F	A	A
222	80	94.60	97.10	N/A	A	N/A	F	A	A
222	80	97.10	102.00	NO INFO. PROVIDED.					
222	138	0.00	10.00	A	A	N/A	F	A	A
222	138	10.00	11.20	A	A	N/A	A	A	A
222	138	11.20	20.40	A	A	N/A	F	A	A
222	196	0.00	17.10	A	D+	N/A	F	A	A
222	196	17.10	24.40	A	C+	N/A	F	A	A
222	196	24.40	28.40	A	A	N/A	A	A	A
222	196	28.40	36.89	A	A	N/A	A	A	A
223	36	6.40	14.20	A	A	N/A	A	A	A
223	36	14.20	19.90	A	A	N/A	D	A	A
223	36	19.90	30.00	A	C-	N/A	A	A	A
223	36	30.00	40.00	A	A	N/A	F	A	A
223	36	40.00	48.20	A	C-	N/A	F	A	A
223	36	48.20	53.00	A	C-	N/A	F	A	A
223	36	53.00	56.50	F	B	N/A	A	A	A
223	36	56.50	58.00	A	B	N/A	B	A-	A
223	36	58.00	63.14	A	C+	N/A	C+	A	A
223	73	0.00	10.50	A	C-	N/A	F	A	A
223	73	10.50	15.75	A	A	N/A	F	A	A
223	112	0.00	7.60	A	A	N/A	A	A	A
223	112	7.60	8.60	A	A	N/A	N/A	A	A
223	199	0.00	12.00	F	A	N/A	F	A	B-
223	199	12.00	22.16	F	C-	N/A	F	A	B
224	80	102.00	102.60	F	A	N/A	F	A-	A
224	80	102.60	106.30	N/A	A	A	F	A-	A-
224	80	106.30	112.50	N/A	A	A	F	A	A
224	80	112.50	115.50	N/A	A	A	F	A	A
224	111	5.70	9.00	A	C+	N/A	F	B+	A

Figure 24. Display of Query Results.

Statistics

Statistics of the data are essential for most planning studies. With the database front end or a GIS like ArcView, tools are readily available to calculate statistical parameters such as standard deviation, mean, sum, count, maximum value, minimum value, variation, etc. Figure 25 shows the sum, count, mean, maximum, minimum, range, variance, and standard deviation for the shaded data.



Station	Route	Beginning	End	Asph_holes	Asph_crack	Conc_holes	Should_edg	Litter_amt	Rock_debri
221	58	0.00	1.54	A	A	N/A	A	A	A
221	80	0.00	10.00	A	A	N/A	A	A	A
221	80	10.00	20.00	A	A	N/A	A	A	A
221	80	20.00	30.00	A	A	N/A	F	A	A
221	80	30.00	40.00	A	A	N/A	A	A	A
221	80	40.00	56.00	A	C+	N/A	A	A	A
222	36	63.10	66.40	A	A	N/A	F	A	A
222	80	56.00	69.40	A	A	N/A	F	A	A
222	80	69.40	89.0					A	A
222	80	89.00	94.6					A	A
222	80	94.60	97.1					A	A
222	80	97.10	102.0						
222	138	0.00	10.0					A	A
222	138	10.00	11.2					A	A
222	138	11.20	20.4					A	A
222	196	0.00	17.1					A	A
222	196	17.10	24.4					A	A
222	196	24.40	28.4					A	A
222	196	28.40	36.8					A	A
223	36	6.40	14.2					A	A
223	36	14.20	19.9					A	A
223	36	19.90	30.0					A	A
223	36	30.00	40.0					A	A
223	36	40.00	48.2					A	A
223	36	48.20	53.0					A	A
223	36	53.00	56.50	F	B	N/A	A	A	A
223	36	56.50	58.00	A	B	N/A	B	A-	A
223	36	58.00	63.14	A	C+	N/A	C+	A	A
223	73	0.00	10.50	A	C-	N/A	F	A	A
223	73	10.50	15.75	A	A	N/A	F	A	A
223	112	0.00	7.60	A	A	N/A	A	A	A
223	112	7.60	8.60	A	A	N/A	N/A	A	A
223	199	0.00	12.00	F	A	N/A	F	A	B-
223	199	12.00	22.16	F	C-	N/A	F	A	B
224	80	102.00	102.60	F	A	N/A	F	A-	A
224	80	102.60	106.30	N/A	A	A	F	A-	A-

Figure 25. Statistical Summary for Selected MMQA Data

CONCLUSIONS

The pavement inventory and scheduling needs assessment at the regional level provided the information for developing a computer-based tool that could be applied at the local level. The needs at headquarters for aggregating the data were accommodated by exposing the regional data in standard (.dbf) formats.

A variety of development tools were considered for the project including: Borland Delphi, Microsoft Visual Basic, Sybase PowerBuilder, and Symantec Visual Cafe. Each of these tools has its strong and weak points. After careful consideration, Delphi was selected. We judged that it provides satisfactory connectivity for enterprise as well as local back-ends, it provides a powerful development language (object Pascal) for engineering algorithms, and it provides an exceptionally good Integrated Developers Environment (IDE).

The Pavement Preservation Prototype consists of three coordinated sections: Pavement Treatments, Paint Treatments, and Maintenance Management Quality Assurance. Each section was provided with a customized Graphical User Interface (GUI) in conjunction with a standard database back-end. The GUIs were designed to resemble as closely as possible the forms that were currently in use in order to reduce the impact of switching to a new system.

Because the data were converted and exposed in a standard format, straight forward ArcView GIS analyses could be applied. Examples are provided for each of the three prototype sections demonstrating the advantages of standardizing regional data and applying GIS for analysis and visual displays.

APPENDIX A

DATABASE TECHNICAL DETAILS

GENERAL DATABASE

Field name	Type
STATION	Number
ROUTE	Number
BEGIN_MP	Number
END_MP	Number
LOCATION	Char
ADT_1997	Number
SURF_AREA	Number
LAST_CONST	Char
ROAD_CLASS	Char
STIP	Char
LANE_MILES	Number

PAVEMENT DATABASE

Field name	Type
STATION	Number
ROUTE	Number
BEGIN_MP	Number
END_MP	Number
LST_TRE_TY	Char
LST_TRE_YR	Number
SCD_TRE_TY	Char
SCD_TRE_YR	Number
PLN_TRE_TY	Char
PLN_TRE_YR	Number
LANE_MILES	Char

PAINT DATABASE

Field name	Type
STATION	Number
ROUTE	Number
BEGIN_MP	Number
END_MP	Number
LST_PT_TYP	Char
LST_PT_YR	Number
SCD_PT_TYP	Char
SCD_PT_YR	Number
ACT_PT_TYP	Char
ACT_PT_YR	Number
LANE_MILES	Char

EVALUATION DATABASE

Field name	Type
STATION	Nmber
ROUTE	Number
BEGIN_MP	Number
END_MP	Number
EVALUATION	Char
CRACK_IND	Number
IRI	Number
RUT_DEPTH	Number
SKID_NUMBER	Number
COMMENTS	Char

MMQA DATABASE

Field name	Type
STATION	Number
ROUTE	Number
BEGIN_MP	Number
END_MP	Number
ASPH_HOLES	Char
ASPH_CRACK	Char
CONC_HOLES	Char
SHOULD_EDG	Char
LITTER_AMT	Char
ROCK_DEBRI	Char
WEED_CONTR	Char
VEG_CONTRL	Char
MOWING	Char
LANDSCAPE	Char
DRAIN_CLEA	Char
DRAIN_INLE	Char
SLOPE_RE	Char
BRIDG_DECK	Char
BRIDG_STRU	Char
BRIDG_JOIN	Char
PAVE_STRIP	Char

PAVE_SYMBO	Char
SIGNS	Char
DELINEATOR	Char
GUARDRAIL	Char
H/W_LIGHT	Char
SIGN_REPA	Char
SWEEPING	Char
GUTER_ISLAND	Char

APPENDIX B

USER'S GUIDE

USER'S GUIDE TO THE PAVEMENT DATA INTERFACE PROGRAM

Introduction

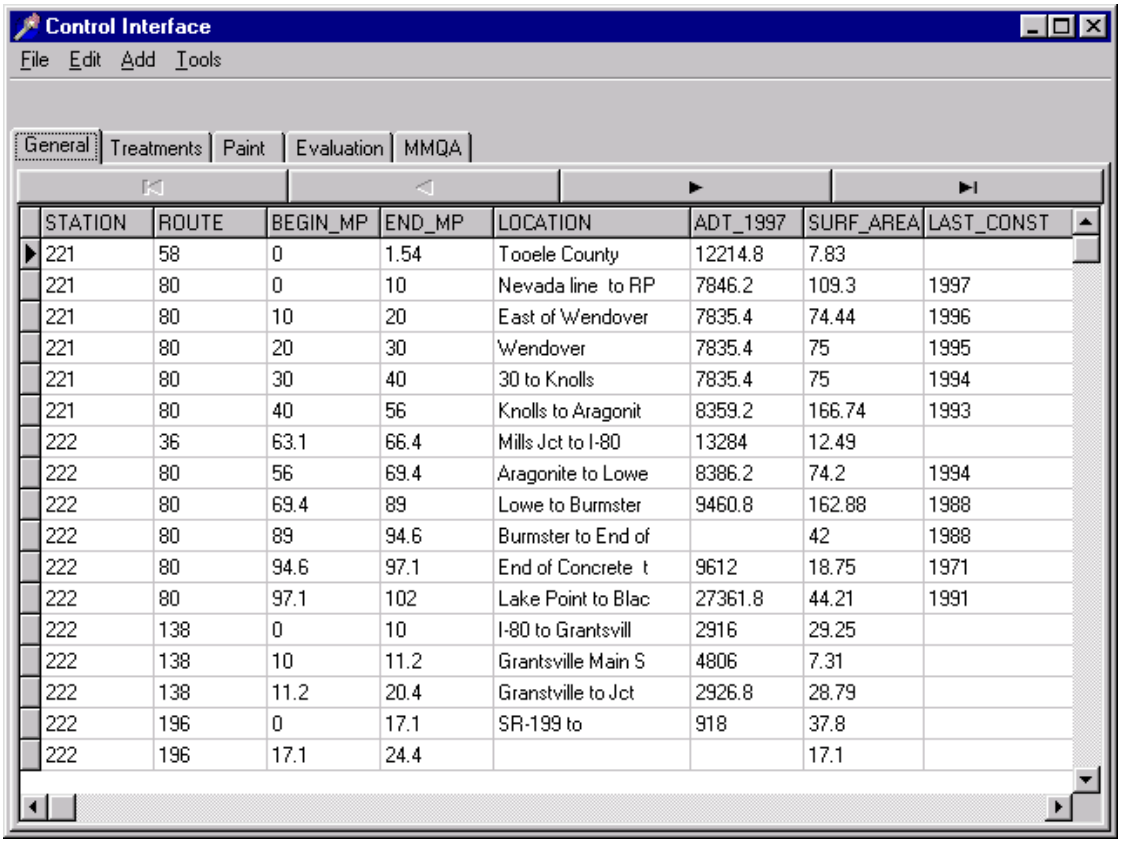
The Pavement data interface program is an efficient tool for the collection, analysis and retrieval of data. It consists of several components that are tailor made to suit the current requirements of UDOT pavement data management.

The program has been modeled after the Quattro-pro spreadsheet programs that are currently being used. While mirroring the ease-of-use of a spreadsheet, this program has additional advantages. The database structure developed is used to perform repeated tasks such as querying and sorting with ease. A GIS tool such as ArcView can access the tables stored in this program. This provides a real time spatial representation of the pavement data.

Salient Features

The first command to be executed on running the program is the **File > Open** menu. This leads the user to the directories on the machine. The user needs to select the correct path the database resides in and click on any of the tables.

The opening screen shot shows the five different databases which can then be viewed individually by clicking on the tabs.



STATION	ROUTE	BEGIN_MP	END_MP	LOCATION	ADT_1997	SURF_AREA	LAST_CONST
221	58	0	1.54	Tooele County	12214.8	7.83	
221	80	0	10	Nevada line to RP	7846.2	109.3	1997
221	80	10	20	East of Wendover	7835.4	74.44	1996
221	80	20	30	Wendover	7835.4	75	1995
221	80	30	40	30 to Knolls	7835.4	75	1994
221	80	40	56	Knolls to Aragonit	8359.2	166.74	1993
222	36	63.1	66.4	Mills Jct to I-80	13284	12.49	
222	80	56	69.4	Aragonite to Lowe	8386.2	74.2	1994
222	80	69.4	89	Lowe to Burmster	9460.8	162.88	1988
222	80	89	94.6	Burmster to End of		42	1988
222	80	94.6	97.1	End of Concrete t	9612	18.75	1971
222	80	97.1	102	Lake Point to Blac	27361.8	44.21	1991
222	138	0	10	I-80 to Grantsvill	2916	29.25	
222	138	10	11.2	Grantsville Main S	4806	7.31	
222	138	11.2	20.4	Granstville to Jct	2926.8	28.79	
222	196	0	17.1	SR-199 to	918	37.8	
222	196	17.1	24.4			17.1	

A navigator tool has been provided which allows convenient access to each of the rows in the database. The buttons have the following functionality.

 Moves the cursor to the first row

 Moves to the prior row

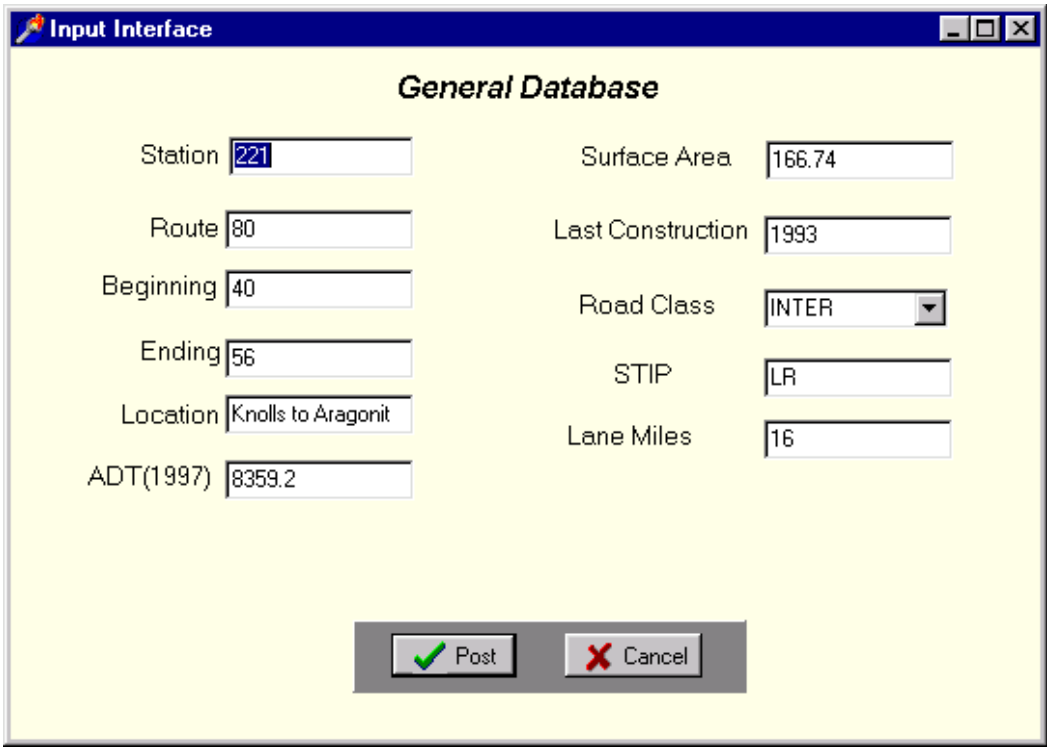
 Moves to the next row.

 Moves the cursor to the last row.

The **File > Print** command prints the table being viewed.

The **File > Close** command exits the program.

The Edit menu brings up a new dialog box which is used to update the databases. The values of the fields of the row pointed by the cursor are seen in the dialog boxes. A typical dialog box would resemble the following screen shot.


Input Interface
General Database
Station
221
Route
80
Beginning
40
Ending
56
Location
Knolls to Aragonit
ADT(1997)
8359.2
Surface Area
166.74
Last Construction
1993
Road Class
INTER
STIP
LR
Lane Miles
16
Post
Cancel

Once the requisite changes have been made, the user has a choice of posting the changes or canceling them.

The following occurs when the ‘Post’ button is clicked

(a) The record in the main table gets updates with changes made in the dialog box.

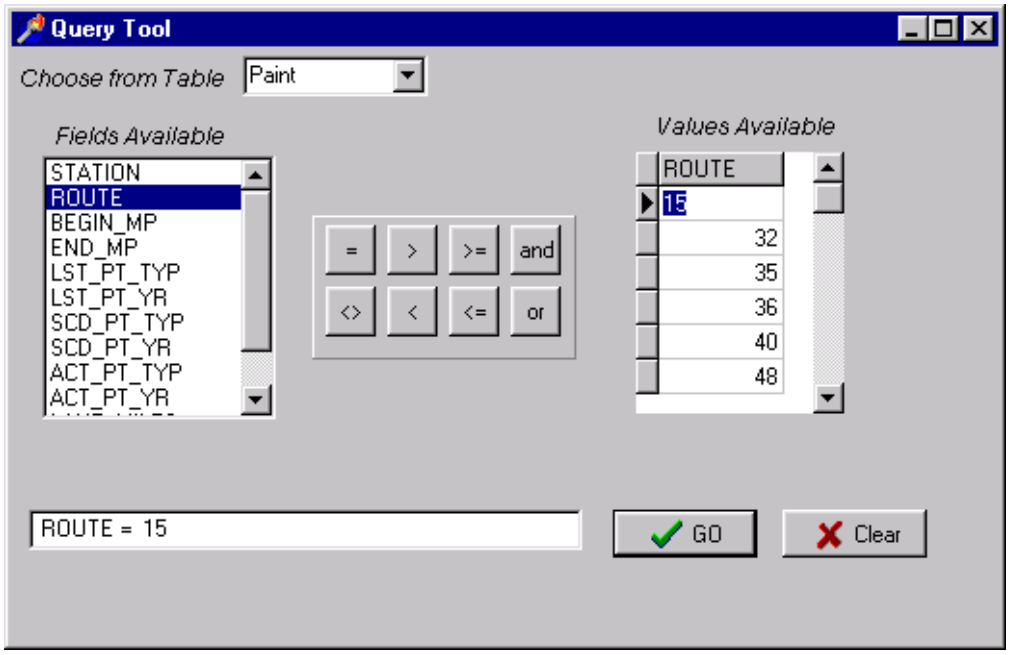
(b) The changed record gets archived in a separate archive table.

This two-step approach to updates ensures that a record of all changes made is maintained.

The **Add** menu items work similar to the Edit menu items with the difference that the Add commands are invoked when adding a new road segment. A dialog box similar to the edit dialog pops up which can be populated with the new values.

The **Tools > Archives** command enables one to view the archived tables. A print option is also included. Navigation tools have been provided to move through the database. Additionally a tool to delete records has also been provided to clean up the archived table.

The **Tools > Queries** tool allows one to query the database. Complex queries are supported by this program using the ‘and’ or ‘or’clauses. This tool brings up the following screen.



The following sequence of commands has to be followed to query the database.

(a) The table to be queried should be chosen in the drop-down box. In this example, we have chosen the 'Paint' table.

(b) The fields available for the table chosen show up as a list on the left-hand side. The user double-clicks the field to be queried.

(c) The user single-clicks the operand to set the query.

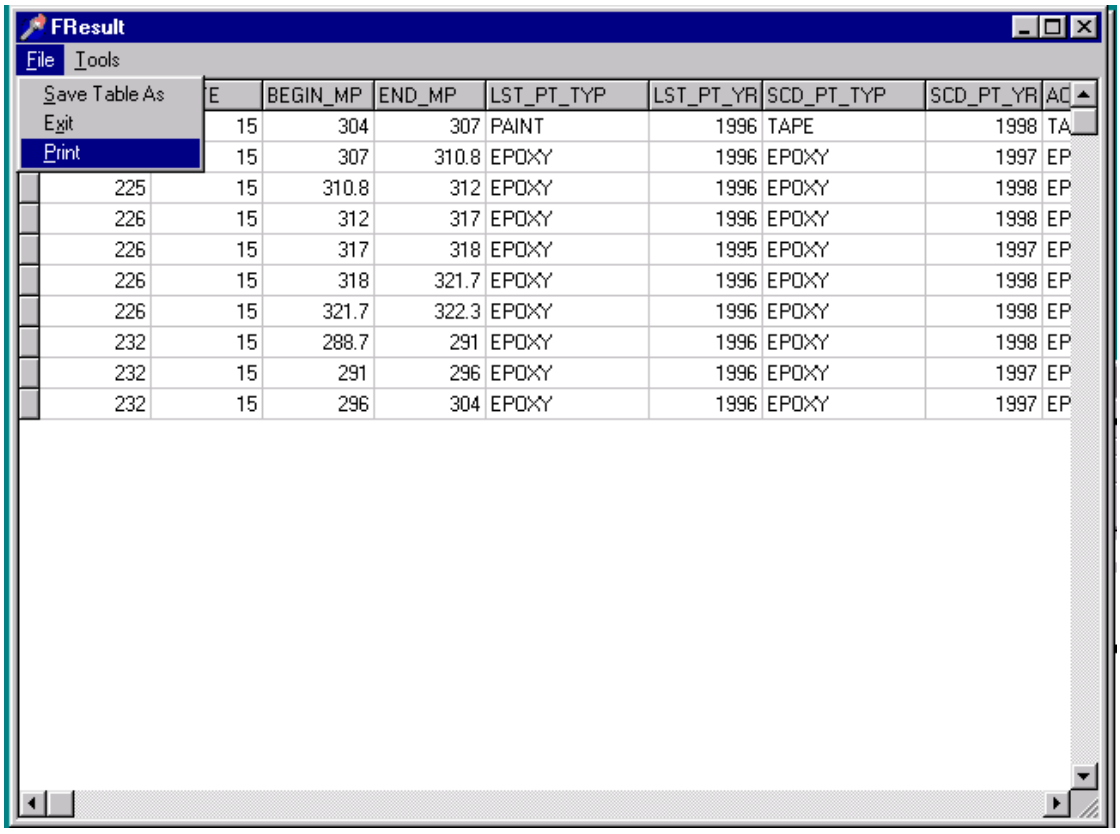
(d) A list of values available is displayed as a list in the right-hand side. The user double-clicks on the value he needs selected.

(e) The query as chosen appears on a box below the lists (in the example here; "Route =15").

(f) Clicking on the 'Go' button brings up the query results.

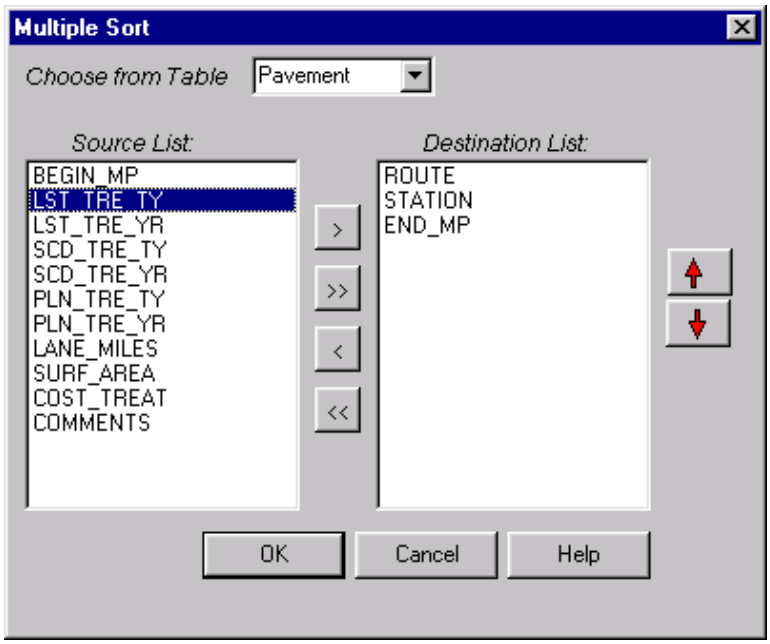
(g) Clicking on the 'Clear' button resets the query.

The results of a query can be printed or saved as a new table as shown in the next screen shot.



	E	BEGIN_MP	END_MP	LST_PT_TYP	LST_PT_YR	SCD_PT_TYP	SCD_PT_YR	AC
	15	304	307	PAINT	1996	TAPE	1998	TA
	15	307	310.8	EPOXY	1996	EPOXY	1997	EP
225	15	310.8	312	EPOXY	1996	EPOXY	1998	EP
226	15	312	317	EPOXY	1996	EPOXY	1998	EP
226	15	317	318	EPOXY	1995	EPOXY	1997	EP
226	15	318	321.7	EPOXY	1996	EPOXY	1998	EP
226	15	321.7	322.3	EPOXY	1996	EPOXY	1998	EP
232	15	288.7	291	EPOXY	1996	EPOXY	1998	EP
232	15	291	296	EPOXY	1996	EPOXY	1997	EP
232	15	296	304	EPOXY	1996	EPOXY	1997	EP

The **Tools > Sort** command is used for multiple sorts on the database. The screen looks like the following graphic.



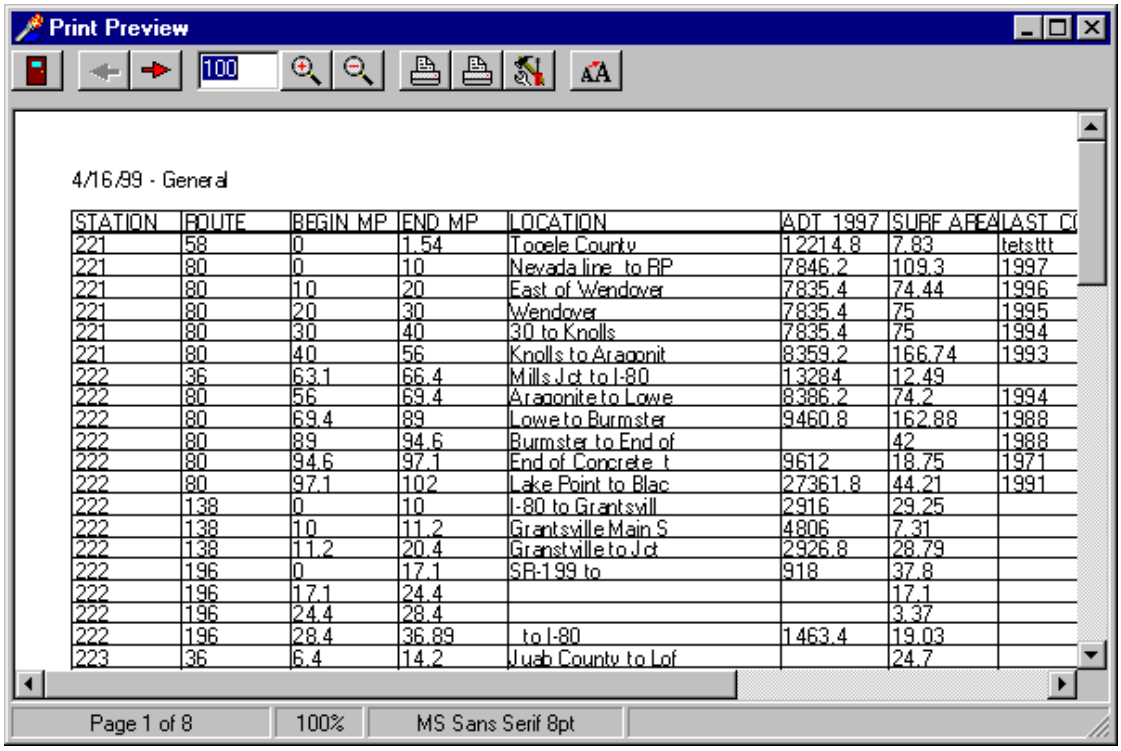
The following steps are to be followed:

(a) The table, which needs to be sorted, is chosen first.

(b) The source list details all the available fields. Using the right arrow (>), the destination list can be populated in the order of precedence. The up and down arrows can also be used to determine the sort order. The double-right arrow (>>) can be used to transfer the entire source list to the destination.

(c) The 'OK' button gives the sorted table which can be printed and saved as a new table.

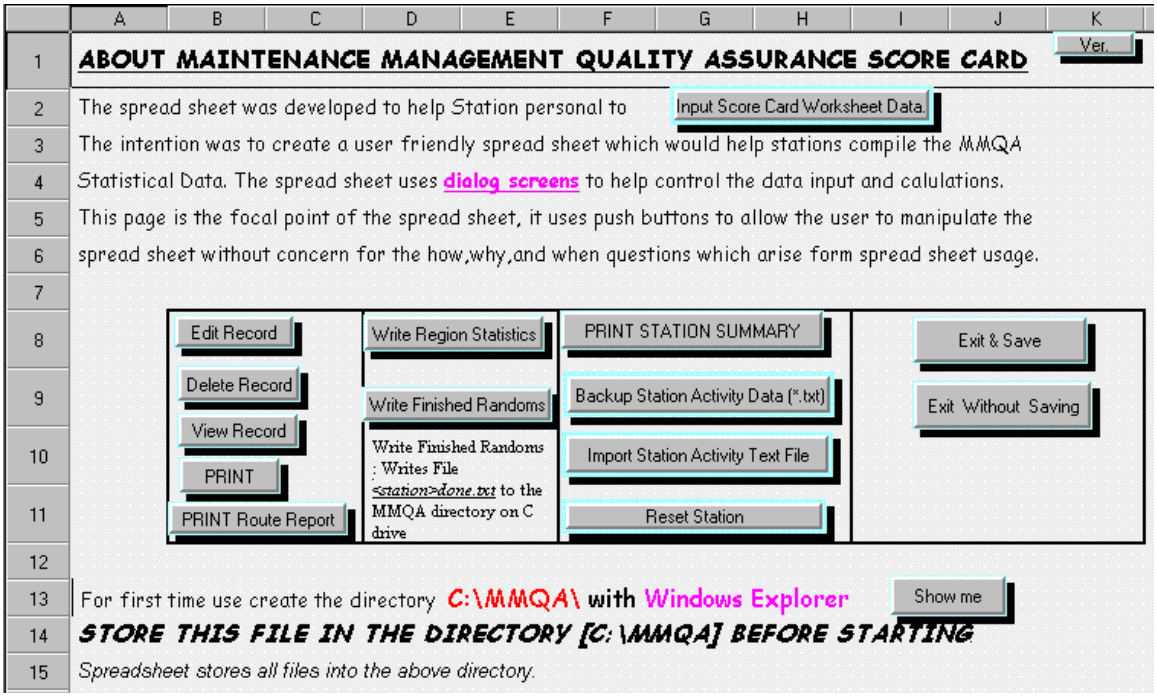
The Print command on all these screens lead to the following dialog box.

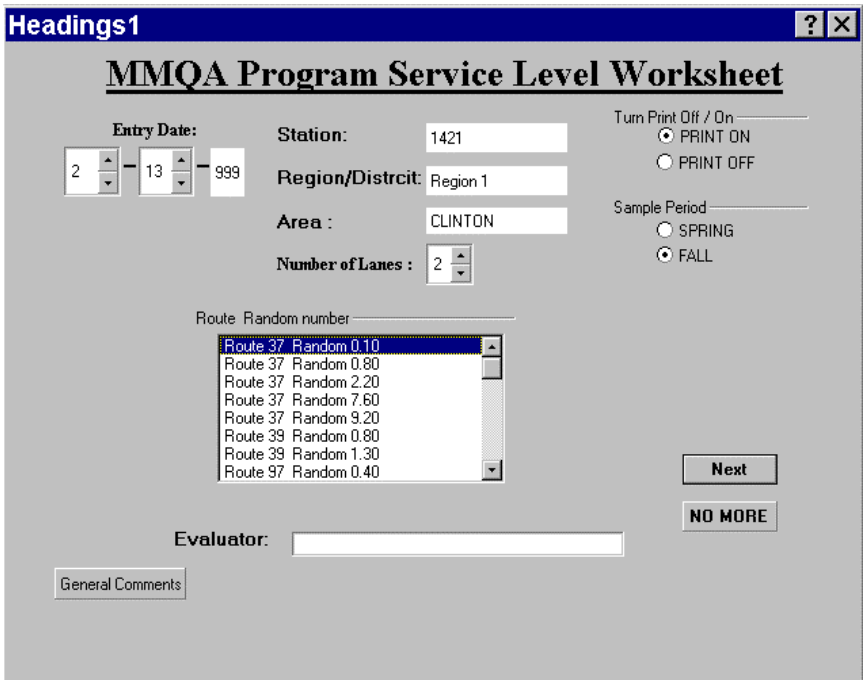


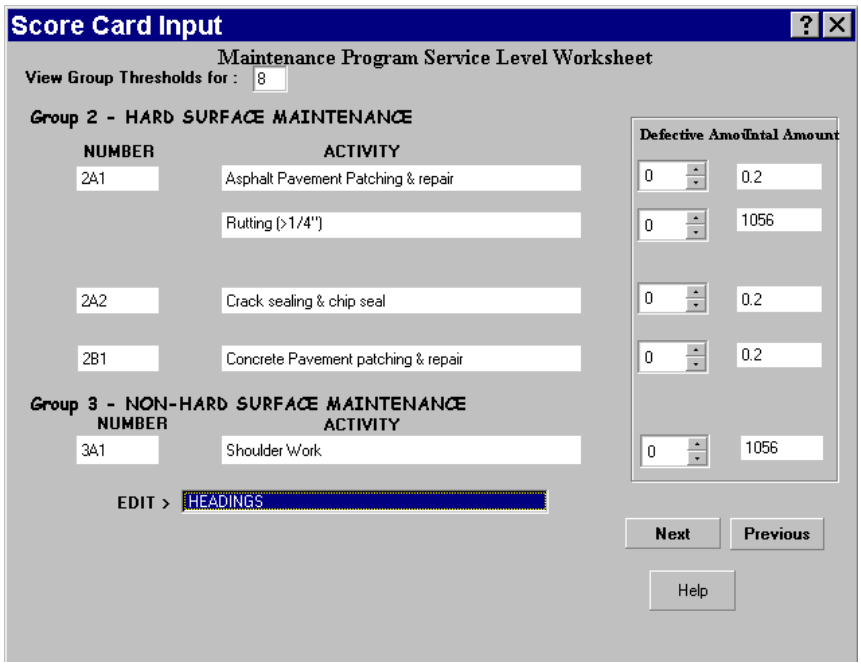
The print tool contains standard features such as zooming the preview, setting up the paper size and properties such as landscape and portrait. All these dialogues are in the standard windows format.

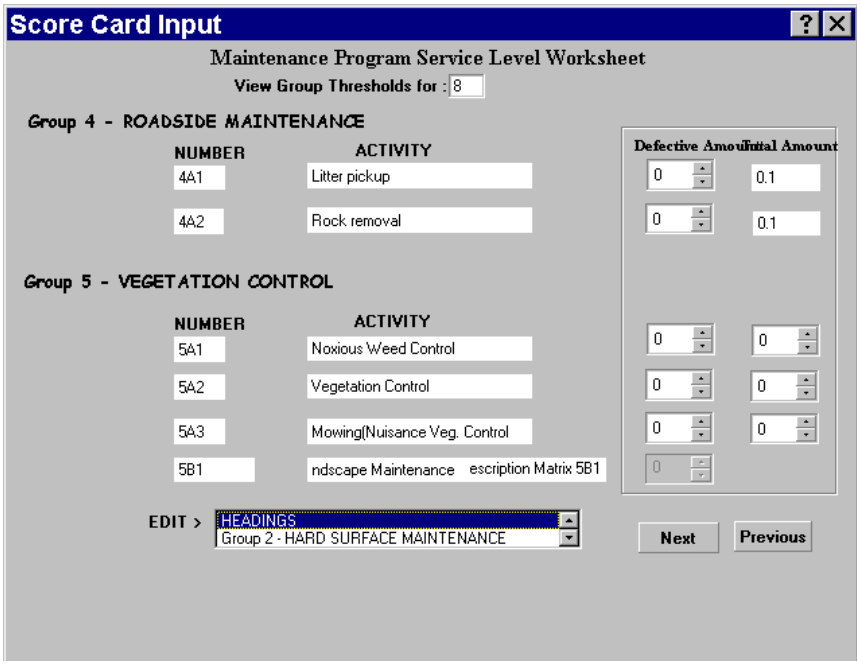
APPENDIX C

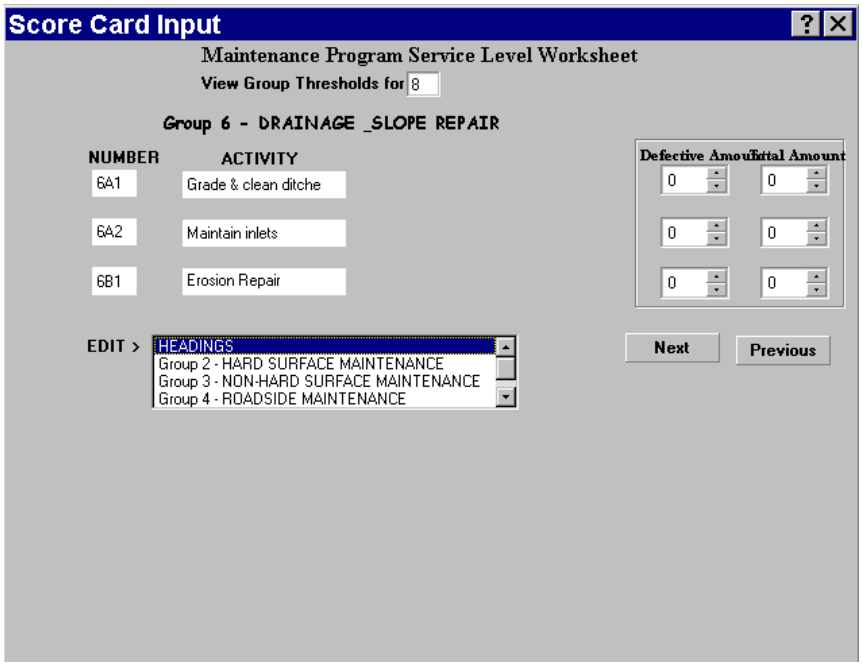
MMQA DATA DESCRIPTIONS

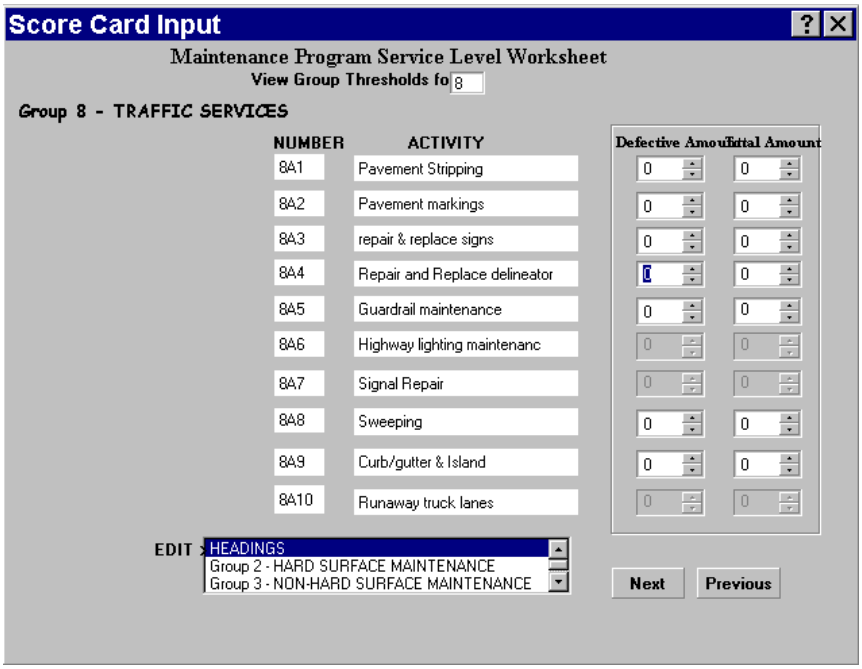

ABOUT MAINTENANCE MANAGEMENT QUALITY ASSURANCE SCORE CARD
Ver.
The spread sheet was developed to help Station personal to
Input Score Card Worksheet Data.
The intention was to create a user friendly spread sheet which would help stations compile the MMQA
Statistical Data. The spread sheet uses dialog screens to help control the data input and calulations.
This page is the focal point of the spread sheet, it uses push buttons to allow the user to manipulate the
spread sheet without concern for the how,why,and when questions which arise form spread sheet usage.
Edit Record
Delete Record
View Record
PRINT
PRINT Route Report
Write Region Statistics
Write Finished Randoms
Write Finished Randoms : Writes File <station>done.txt to the MMQA directory on C drive
PRINT STATION SUMMARY
Backup Station Activity Data (*.txt)
Import Station Activity Text File
Reset Station
Exit & Save
Exit Without Saving
For first time use create the directory C:\MMQA\ with Windows Explorer
Show me
STORE THIS FILE IN THE DIRECTORY [C:\MMQA] BEFORE STARTING
Spreadsheet stores all files into the above directory.


Headings1
MMQA Program Service Level Worksheet
Entry Date:
2
13
999
Station:
1421
Region/Distrcit:
Region 1
Area :
CLINTON
Number of Lanes :
2
Turn Print Off / On
PRINT ON
PRINT OFF
Sample Period
SPRING
FALL
Route Random number
Route 37 Random 0.10
Route 37 Random 0.80
Route 37 Random 2.20
Route 37 Random 7.60
Route 37 Random 9.20
Route 39 Random 0.80
Route 39 Random 1.30
Route 97 Random 0.40
Next
NO MORE
Evaluator:
General Comments


Score Card Input
Maintenance Program Service Level Worksheet
View Group Thresholds for : 8
Group 2 - HARD SURFACE MAINTENANCE
NUMBER
ACTIVITY
Defective Amou
Intal Amount
2A1
Asphalt Pavement Patching & repair
0
0.2
Rutting (>1/4")
0
1056
2A2
Crack sealing & chip seal
0
0.2
2B1
Concrete Pavement patching & repair
0
0.2
Group 3 - NON-HARD SURFACE MAINTENANCE
NUMBER
ACTIVITY
3A1
Shoulder Work
0
1056
EDIT >
HEADINGS
Next
Previous
Help


Score Card Input
Maintenance Program Service Level Worksheet
View Group Thresholds for : 8
Group 4 - ROADSIDE MAINTENANCE
NUMBER
ACTIVITY
Defective Amou
Intal Amount
4A1
Litter pickup
0
0.1
4A2
Rock removal
0
0.1
Group 5 - VEGETATION CONTROL
NUMBER
ACTIVITY
5A1
Noxious Weed Control
0
0
5A2
Vegetation Control
0
0
5A3
Mowing(Nuisance Veg. Control
0
0
5B1
ndscape Maintenance escription Matrix 5B1
0
EDIT >
HEADINGS
Group 2 - HARD SURFACE MAINTENANCE
Next
Previous


Score Card Input
Maintenance Program Service Level Worksheet
View Group Thresholds for 8
Group 6 - DRAINAGE _SLOPE REPAIR
NUMBER
ACTIVITY
Defective Amou
ttal Amount
6A1
Grade & clean ditche
6A2
Maintain inlets
6B1
Erosion Repair
EDIT >
HEADINGS
Group 2 - HARD SURFACE MAINTENANCE
Group 3 - NON-HARD SURFACE MAINTENANCE
Group 4 - ROADSIDE MAINTENANCE
Next
Previous


Score Card Input
Maintenance Program Service Level Worksheet
View Group Thresholds fo 8
Group 8 - TRAFFIC SERVICES
NUMBER
ACTIVITY
Defective Amou
ttal Amount
8A1
Pavement Stripping
8A2
Pavement markings
8A3
repair & replace signs
8A4
Repair and Replace delineator
8A5
Guardrail maintenance
8A6
Highway lighting maintenanc
8A7
Signal Repair
8A8
Sweeping
8A9
Curb/gutter & Island
8A10
Runaway truck lanes
EDIT >
HEADINGS
Group 2 - HARD SURFACE MAINTENANCE
Group 3 - NON-HARD SURFACE MAINTENANCE
Next
Previous

SCORE CARD:A1

MMQA Program Service Level Worksheet

Date..: 02/13/99 **Route :** 37 **Entry Dat** 02/13/99

Region: 1 **No. of Lanes :** 2

Area..: CLINTON

Station: 1421 **Mile MarkerBegi** 0.10 **MM Ending :** 0.20

Segment length(mi) = 0.10

NUMBER	ACTIVITY	CONDITION RATING	LOS	LOS #	Defective Amount	Units	Total Amount	Units
Group 2 - HARD SURFACE MAINTENANCE								
2A1	Asphalt Pavement Patching & repair (Potholes/Ruts)	0.00	LOS A	1.4		# of potholes	0.2	# lanes*0.10
	Rutting (>1/4")	0.00%	LOS A+	1.0		Lin. Ft.	1056	# lanes*528
2A2	Crack sealing & chip seal	0.00	LOS A+	1.3		Lin. Ft.	0.2	# lanes*0.10
2B1	Concrete Pavement patching & repair (cracks/joints)	0.00	LOS A+	1.3		Lin. Ft. spalled area	0.2	# lanes*0.10
Group 3 - NON-HARD SURFACE MAINTENANCE								
3A1	Shoulder Work	0.00%	LOS A	1.5		Lin. Ft.	1056	2*528
Group 4 - ROADSIDE MAINTENANCE								
4A1	Litter pickup	0.00	LOS A+	1.1		# of objects	0.10	CL mi.
4A2	Rock removal	0.00	LOS A+	1.1		# of Objects	0.10	CL mi.
Group 5 - VEGETATION CONTROL								
5A1	Noxious Weed Control	-1.00%	LOS N/A	1.0		Lin. Ft.		Lin. Ft.
5A2	Vegetation Control	-1.0	LOS N/A	1.5		Lin. Ft.		Lin. Ft.
5A3	Mowing(Nuisance Veg. Control)	-1.0%	LOS N/A	1.0		Lin. Ft.		Lin. Ft.
5B1	Landscape Maintenance	0	LOS N/A	1.0	See condition description matrix 5B1			
Group 6 - DRAINAGE & SLOPE REPAIR								
6A1	Grade & clean ditches	-1.0%	LOS N/A	1.0		Lin. Ft.		Lin. Ft.
6A2	Maintain inlets	-1.0%	LOS N/A	1.0		# of inlets > 25% full		Total # of inlets
6B1	Erosion Repair	-0.2	LOS N/A	1.0		Lin Ft.		Lin. ft.
Group 8 - TRAFFIC SERVICES								
8A1	Pavement Striping	-1.00%	LOS N/A	1.1		Lin. Ft.		Lin. Ft.
8A2	Pavement markings	-1.00%	LOS N/A	1.1		# of ...		Total # of ..
8A3	repair & replace signs	-1.00%	LOS N/A	1.1		# of ...		Total # of ..
8A4	Repair and Replace delineators	-1.00%	LOS N/A	1.1		# of ...		Total # of ..
8A5	Guardrail maintenance	-1.00%	LOS N/A	1.0		Lin. Ft.		Lin. Ft.
8A6	Highway lighting maintenance	-1.00%	LOS N/A	1.0		# of ...		Total # of ..
8A7	Signal Repair	-0.01	LOS N/A	1.5		# of Callouts		# of years
8A8	Sweeping	-1.00%	LOS N/A	1.0		Lin. Ft.		Lin. Ft.
8A9	Curb/gutter & Island	-1.00%	LOS N/A	1.3		Lin. Ft.		Lin. Ft.
8A10	Runaway truck lanes	-1.00%	LOS N/A	1.0				
Group 10 - REST AREA MAINTENANCE								
10A1	rest area maintenance	-1		1.0	See Condition Description Matrix 10A1			

Evaluator

Comments:

SCORE CARD | GRP 1 Threshold | GRP 2 Threshold | GRP 3 Threshold | GRP 4 Threshold | GRP 5 Threshold | GRP 6 Thresh

Group Center	
-1	N/A
0	A+
1	A+
1.33	A+
1.34	A
1.67	A
1.68	A-
2	A-
2.01	B+
2.34	B+
2.35	B
2.67	B
2.68	B-
3	B-
3.01	C+
3.34	C+
3.35	C
3.67	C
3.68	C-
4	C-
4.01	D+
4.34	D+
4.35	D
4.67	D
4.68	D-
5	D-
5.01	F+
5.34	F+
5.35	F
5.67	F
5.68	F-
6	F-

CATEGORY				SERVICE LEVEL				
Group 1- SNOW REMOVAL				A	B	C	D	F
#	Activities	Condition Indicators	Performance measures	threshold	threshold	threshold	threshold	threshold
1A1	Snow and Ice Control	Timeliness of response to snow & ice on roadway, accumulation of snow on roadway, presence of traction aids (sand & deicers) when needed, pass opening and closing dates of seasonal roadways, presence of black ice .	Conformance to targeted condition goals (See Condition Description Matrix - 1A1)	1	2	3	4	5

CATEGORY				SERVICE LEVEL				
Group 2 -HARD SURFACE MAINTENANCE				A	B	C	D	F
#	Activities	Condition Indicators	Performance measures	threshold	threshold	threshold	threshold	threshold
2A1	Asphalt Pavement Patching & repair	Potholes (> 6"x6"x1")	Number of potholes/lane / mile (incl. shoulders)	0.5	8	15	23	30
		Ruts (>1")	% of rutting > 1"	5%	15%	25%	35%	45%
2A2	Crack sealing & chip seal	Cracking	Linear ft. Of pavement with unfilled [crackes/joints] / lane / mile (incl. Shoulders)	250	1313	2375	3438	4500
2B1	Concrete Pavement Patching & repair	Cracking	Linear ft. Of pavement with unfilled [crackes/joints] / lane / mile (incl. Shoulders)	250	1313	2375	3438	4500

CATEGORY				SERVICE LEVEL				
Group 3 - NON-HARD SURFACE MAINTENANCE				A	B	C	D	F
#	Activities	Condition Indicators	Performance measures	threshold	threshold	threshold	threshold	threshold
3A1	Shoulder Work (gravel ..)	Shoulder Edge drop off or erosion > 1"	% of shoulder with drop off or erosion > 1"	0%	5%	10%	15%	20%

CATEGORY				SERVICE LEVEL				
Group 4 - ROADSIDE MAINTENANCE				A	B	C	D	F
#	Activities	Condition Indicators	Performance measures	threshold	threshold	threshold	threshold	threshold
4A1	Litter pickup	Presence of litter	# of > fist size objects present / centerline mile	125	469	813	1156	1500
4A2	Rock removal	Presence of Rocks, large debris & other hazards on roadway & shoulder	# of > fist size objects present / centerline mile	125	469	813	1156	1500

CATEGORY				SERVICE LEVEL				
Group 5 - VEGETATION CONTROL				A	B	C	D	F
#	Activities	Condition Indicators	Performance measures	threshold	threshold	threshold	threshold	threshold
5A1	Noxious Weed Control	Presence of Noxious weeds	% of roadside area w/more than 1 noxious weed or Noxious weed gone to seed	2%	8%	14%	19%	25%
5A2	Vegetation Control (obstruction)	Presence of major and moderate vegetation obstructions (hazards)	Linear ft. Of major and moderate hazards per centerline mile.	0	75	150	225	300
5A3	Mowing (nuisance vegetation control)	Presence of nuisance vegetation	% of roadside area w/nuisance vegetation(weeds)	5%	11%	18%	24%	30%
5A4	Landscape Maintenance	Appearance & health of landscaped areas	Condition score (See Condition Description Matrix 4B1)	3	5	8	10	12.00

CATEGORY				SERVICE LEVEL				
Group 6 - DRAINAGE & SLOPE REPAIR				A	B	C	D	F
#	Activities	Condition Indicators	Performance measures	threshold	threshold	threshold	threshold	threshold
6A1	Grade and clean ditches	Ditches with sediment buildup, unable to carry design flow .	% of ditches > 25% full	1.5%	6%	11%	15%	20.0%
6A2	Maintain inlets	Culverts, drop inlets, & outlet channels plugged with dirt and/or debris, unable to carry design flow .	% of pipe/inlets/culverts > 25% filled	1.0%	4%	8%	11%	15.0%
6B1	Erosion Repair	Unrepaired erosion or slides encroaching on, or undermining the shoulder or travel way .	Linear ft. Of major and moderate erosion encroaching, or undermining roadway per centerline mile.	1.9%	15%	25%	35%	40.0%

CATEGORY				SERVICE LEVEL				
Group 7 - MAJOR STRUCTURE MAINTENANCE				A	B	C	D	F
#	Activities	Condition Indicators	Performance measures	threshold	threshold	threshold	threshold	threshold
7A1	Bridge Deck Repair	Unrepaired deck spalling	% of Unrepaired spalled areas	1%	4%	7%	10%	13%
	Bridge Deck Repair	Unrepaired deck spalling	size (inches) of spalls at edge of deck	1	3	5.5	8	9
7A2	Bridge Repair	Structural Deficiencies/failures ** refer to UDOT structures division	Accomplishment of identified structural deficiencies (See Condition Description Matrix - 7A2)	1.50	2.50	3.50	4.50	5.50
7A3	Bridge Cleaning	Dirty Bridge surfaces & sidwalks. Blocked Bridge drains, unfilled joints/cracks	Accomplishment of identified structural deficiencies (See Condition Description Matrix - 7A3)	1.50	2.50	3.50	4.50	5.50

CATEGORY				SERVICE LEVEL				
Group 9-SUPERVISION, TRAINING, & SUPPORT MAINTENANCE				A	B	C	D	F
#	Activities	Condition Indicators	Performance measures	threshold	threshold	threshold	threshold	threshold
9A1	Training	Employees w/ skills & knowledge required for Quality, safe efficient, customer service	% of traing hours to total work hours .					
9B1	Support Maintenance	Maintenance Radio system operated effectively, facilities operating costs reimbursed, equipment fleet non-use & downtime properly accounted for.	N/A					
9C1	Supervision	Field crew's activities properly planned & supervised .	% of supervised hrs. to total work hours .					

CATEGORY				SERVICE LEVEL				
Group 8 - TRAFFIC SERVICES				A	B	C	D	F
#	Activities	Condition Indicators	Performance measures	threshold	threshold	threshold	threshold	threshold
8A1	Pavement Striping	Worn or missing lane & edge stripes not visible at night	% of pavement striping not visible @ night	1%	6%	11%	15%	20%
8A2	Pavement markings(symbols)	Missing or defective markers(symbols)	% of Defective pavement markers (symbols)	1%	6%	11%	15%	20%
8A3	repair and replace signs	Unreadable/Damaged signs	% of Defective signs	1%	6%	11%	15%	20%
8A4	Repair and Replace delineators/Markers	Defective Delineators	% of defective delineators	1%	6%	11%	15%	20%
8A5	Guardrail maintenance	Defective guardrail	% of Defective guardrail	1%	4%	8%	11%	15%
8A6	Highway lighting maintenance	Burned out highway lights	% of highway lights not working	5%	10%	15%	20%	25%
8A7	Signal Repair **	traffic signals @ an intersection flashing, with burnt out bulbs, or with a control system malfunctioning	Number of maintenance call-outs required for this type of malfunction (call-out/year/signal)	0	1	2	3	4
8A8	Sweeping	Sand, rocks, & debris on roadway &/or shoulder	% of roadway/shoulder area with sand,rock, &/or debris	5%	16%	28%	39%	50%
8A9	Curb/gutter & Island	Defective Curb&gutter/Island	% of failed Curb/gutter or Island	2%	14%	26%	38%	50%
8A10	Runaway truck lanes			0.1	0	0	0	0.5

CATEGORY				SERVICE LEVEL				
Group 10 - REST AREA MAINTENANCE				A	B	C	D	F
#	Activities	Condition Indicators	Performance measures	threshold	threshold	threshold	threshold	threshold
10A1	rest area maintenance	Cleanliness of building. Non-functional building/utility systems (hand dryer, soap dispenser, dump station). Appearance of landscape areas, sidewalks & pavement.	Condition Score (See Condition Score Description - 10A1)	4	8	12	16	20

SNOW AND ICE CONTROL SERVICE LEVEL

Condition Description Matrix - 1A1

	Condition 1	Condition 2	Condition 3	Condition 4	
Description	Bare pavement condition maintained at all times . Traveler rarely experiences delays .	Traveler may experience some isolated delay with roads having patches of black ice, slush, or compact snow .	Traveler may experience delay and slow travel with roads having black ice, or packed snow, with only the wheel track bare .	Traveler will experience delays and slow travel with regular compact snow buildup and no bare pavement .	Road Closed

Service Level Matrix

Level of Service	A	B	C	D	F
Category 1 Highways	Condition 1	Condition 1	Condition 1	Condition 1	Condition 2
Category 2 Highways	Condition 1	Condition 1	Condition 1	Condition 2	Condition 2
Category 3 Highways	Condition 1	Condition 1	Condition 2	Condition 3	Condition 3
Category 4 Highways	Condition 2	Condition 2	Condition 3	Condition 3	Condition 4
Category 5 Highways	Condition 2	Condition 3	Condition 4	Condition 4	Condition 4
Mountain Passes	Condition 1	Condition 1	Condition 2	Condition 2	Condition 3
Seasonal Highways*	Condition 2	Condition 2	Condition 3	Condition 4	Condition 5

* Seasonal highways have a planned closure during early winter. Level of service will determine the length of the closure. LOS A has the shortest closure time, LOS F has the longest .

NOTES:

1 Conditions may vary temporarily depending on the frequency, duration & severity of snowfall events .

2 Category of highway is based on Functional Class and ADT . A highway may be raised or lowered, based on it's importan population centers, and curvature or grade of alignment .

LANDSCAPE MAINTENANCE SERVICE LEVEL

Condition Description Matrix - 5A4

	Weed Control	Plant Health	Trimming, Pruning, & Planting
Condition 1	< 5% visible weeds	Plants healthy and lush < 5% of the plants exhibit visible stress or disease 100% ground cover Lawns contain <5% visible weeds and dry spots	All plants exhibit appropriate shape and character lawns mowed and trimmed regularly 5% void in plant beds Plants have not over grown their location
Condition 2	Planting Beds with < 15% visible weeds	<15% of plants exhibiting some stress or disease ground cover has no less than 90% coverage <15% of lawn area contains visible weeds ,dry spots	No more than 15% of all plants exhibit sprouting or contain a few dead or dying branches Lawns mowed, but not trimmed regularly <15% voids in plant beds Plants have not over grown their location
Condition 3	Planting beds with > 15% visible weeds	>15% of plants exhibiting some stress or disease ground cover has less than 90% coverage >15% of lawn area contains visible weeds ,dry spots and are allowed to go dormant in the summer.	More than 15% of all plants exhibit sprouting or contain a few dead or dying branches Lawns mowed, until dormant, but not trimmed >15% voids in plant beds > 15% of plants have overgrown their location

STRUCTURAL BRIDGE REPAIR SERVICE LEVEL

Condition Description Matrix - 7A2

	Priority 1	Priority 2
Description of typical work	Work includes critical repairs such as: •replacing rotten timber components • Repair spalled concrete on piers • Repair expansion joints Address pier scour? Work should be accomplished as soon as possible, normally within one year .	Work includes non-critical & non structural repairs such as: • Correcting erosion problems around piers & abutments •remove compression seals in expansion joints • Repair damaged railings & curbs

Service Level Matrix

Service Level	A	B	C	D	F
Work to be Accomplished	All priority-1 & Priority-2 work	15% of priority-1 is deferred longer than 1 year. Priority-2 deferred as long as 3 years	30% of priority-1 is deferred longer than 1 year. Priority-2 deferred 3 years or more	50% of priority-1 is deferred longer than 1 year. Priority-2 only done when P-1 is done on a bridge	>50% of priority-1 is deferred longer than 1 year. Priority-2 may be deferred indefintely

REST AREA MAINTENANCE SERVICE LEVEL

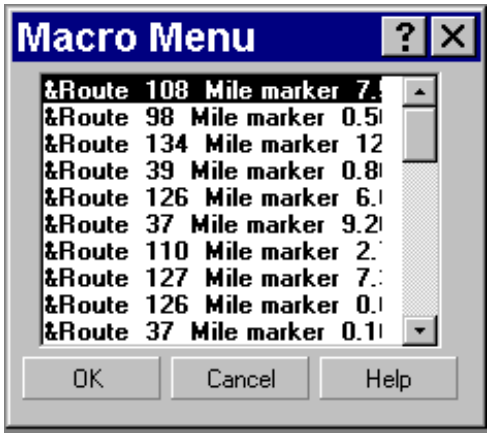
Condition Description Matrix - 10A1

	Janitorial Services	Building & utilities	Site	Operations
Condition 1	Rest rooms cleaned as necessary to meet highest standards for cleanliness. Graffiti is removed immediately. Counter tops and floors are cleaned & dried frequently. Soap & paper supplies routinely refilled during the day. Trash containers are emptied frequently.	Water & sewer systems functional & in compliance w/ regulations. Building in good repair, partitions, doors, dispensers in place without defects. Wall roof, sky lights functional & free of defects. Dump station functional.	Landscape planting healthy and lush. Lawns mowed. Sidewalks & parking areas clean & free of defects. Picnic tables clean & free of defects. Site free of noticeable litter.	All rest areas open 24 hrs. a day, 365 days a year.
Condition 2	Building cleaned routinely 2-3 times a day as required to meet a high standard for cleanliness. Graffiti is removed. Counter tops and floors are cleaned & dried. Soap & paper supplies are refilled. Trash containers are emptied during the daily routine cleaning.	Water & sewer systems functional & Building in good repair, with some defects, but functional partitions, doors, dispensers in place. Dump station functional.	Landscape planting healthy. Lawns mowed. Sidewalks & parking areas clean but exhibit some minor defects. Picnic tables clean & w/ minor defects. Minor amount of noticeable litter.	Most rest areas open 24 hours a day, 365 days a year. Selected non-interstate rest areas would be closed during low use periods, primarily during the winter months.
Condition 3	Building cleaned routinely 1-2 times a day as required to meet a minimum standard for cleanliness. Graffiti is removed. Counter tops and floors are cleaned & dried. Soap & paper supplies are refilled. Trash containers are emptied during the daily routine cleaning.	Water & sewer systems functional. Building with some surface & minor functional defects. Partitions doors may be missing, some dispensers non functional, lights out, mirrors missing. Dump station functional.	Landscape planting exhibits some stress w/ some weeds & damaged or dry branches. Lawns infrequently unmowed Sidewalks & parking areas clean w/ some noticeably defects. Picnic tables clean w/minor defects. Minor amount of noticeable litter.	All Inter state rest areas open 24 hours a day, 365 days a year. All non-interstate rest areas would be closed during low use periods, primarily during the winter months.
Condition 4	Portable toilets & paper provided only. Routinely cleaned one time a day. Trash containers are emptied during the daily routine cleaning.	Building closed because of a utility or building deficiency.	Landscape planting w/ noticeable weeds, damaged or dying branches. Lawns unmowed. Sidewalks & parking areas noticeably dirty w/ minor defects. Picnic tables need cleaning & exhibit major defects. Significant amount of noticeable litter.	All rest areas closed

Condition Total = (Janitorial Services) + (Building & utilities) + (Site) + (Operations)

Service Level	Condition Total
A	4
B	5 to 7
C	8 to 10
D	11 to 13
F	>13

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
3														
4							Randoms generated by Region 1 ... 10/14/98 ...							
5														
6		Station / Random #	1421	1422	1423	1424	1425	1426	1431	1432	1433	1435	1436	1437
7	ROUTE	1	37	26	90	60	39	65	84	13	13	23	23	16
8	REF. MArker		7.60	1.40	0.30	4.00	18.40	15.10	1.70	11.80	32.00	3.70	19.80	12.50
9	ROUTE	2	37	26	315	60	39	65	84	13	13	23	23	16
10	REF. MArker		2.20	2.60	1.00	5.20	19.20	16.60	14.90	10.30	30.30	7.70	26.50	2.60
11	ROUTE	3	37	26	13	89	39	65	84	13	13	23	23	16
12	REF. MArker		0.80	1.10	7.40	344.30	39.90	20.70	5.40	12.40	27.10	1.60	28.60	13.50
13	ROUTE	4	37	39	13	89	39	65	84	13	13	23	30	16
14	REF. MArker		0.10	3.70	6.00	337.00	40.80	9.00	4.70	18.60	22.20	8.30	111.00	19.60
15	ROUTE	5	37	39	13	89	39	65	84	13	13	23	30	16
16	REF. MArker		9.20	5.30	5.00	339.00	11.00	15.50	9.10	18.80	25.70	12.10	113.00	13.00
17	ROUTE	6	39	53	13	89	39	65	84	82	13	23	30	16
18	REF. MArker		1.30	0.90	3.20	342.40	15.00	20.90	6.00	1.30	26.80	8.00	110.20	5.90
19	ROUTE	7	39	53	13	89	39	65	84	82	30	23	30	16
20	REF. MArker		0.80	0.30	1.40	335.90	20.00	14.50	0.30	0.30	99.20	15.90	109.10	21.20
21	ROUTE	8	97	79	91	89	39	65	84	82	30	23	61	16
22	REF. MArker		1.90	4.40	7.30	340.20	22.90	13.10	3.00	2.10	102.20	0.30	2.80	24.00
23	ROUTE	9	97	79	91	106	39	65	84	83	30	91	61	16
24	REF. MArker		0.40	0.30	8.30	10.30	16.70	10.30	17.30	25.00	99.30	11.30	5.10	23.60
25	ROUTE	10	98	79	91	106	158	65	84	83	30	91	61	16
26	REF. MArker		1.30	1.10	5.20	7.90	10.30	12.50	16.20	27.80	98.90	20.60	4.20	1.90
27	ROUTE	11	98	89	91	106	158	65	84	83	30	91	89	30
28	REF. MArker		0.50	350.70	4.70	6.70	9.50	17.70	7.10	18.00	100.00	14.10	391.20	126.20
29	ROUTE	12	98	89	91	106	158	66	84	83	30	91	89	30
30	REF. MArker		2.90	357.30	1.70	7.30	8.30	11.00	19.50	26.50	103.10	17.90	372.80	122.80
31	ROUTE	13	103	89	91	109	158	66	30	83	38	91	89	30
32	REF. MArker		0.00	357.00	9.00	2.00	2.40	6.90	71.00	16.10	9.20	16.00	378.40	119.60
33	ROUTE	14	107	89	91	109	158	66	30	83	38	91	89	30
34	REF. MArker		3.80	353.50	6.20	0.10	3.70	2.50	39.40	23.40	17.60	14.00	392.80	136.90
35	ROUTE	15	108	89	89	109	158	66	30	83	38	91	89	30
36	REF. MArker		3.20	359.30	370.10	2.60	9.00	12.30	49.50	30.60	8.40	12.00	402.70	117.50
37	ROUTE	16	108	89	89	168	158	66	30	102	38	91	91	30
38	REF. MArker		11.70	346.60	366.80	0.10	11.00	8.30	22.10	16.10	2.00	22.50	44.50	120.00
39	ROUTE	17	108	104	89	168	158	66	30	102	38	101	91	30
40	REF. MArker		1.60	2.90	368.90	0.90	6.60	13.30	4.80	1.70	4.80	18.90	27.30	130.50
41	ROUTE	18	108	104	89	168	158	66	30	102	38	101	91	128.2
42	REF. MArker		6.90	1.10	365.90	0.30	11.30	8.10	25.60	8.50	12.40	14.50	37.00	30.00
43	ROUTE	19	108	203	89	193	167	66	30	102	81	101	91	132.5
44	REF. MArker		7.50	3.10	362.80	5.30	3.00	14.50	20.10	5.40	1.60	12.60	35.50	30.00
45	ROUTE	20	108	203	89	193	167	66	30	102	81	101	91	30
46	REF. MArker		8.40	2.60	371.60	0.10	4.30	9.10	73.20	6.00	2.40	14.40	33.40	141.60
47	ROUTE	21	108	203	83	193	167	66	30	102	102	101	142	39
48	REF. MArker		12.50	2.40	8.20	3.50	2.20	12.30	17.00	3.00	17.80	8.20	12.50	57.70
49	ROUTE	22	110	204	83	193	167	66	30	102	102	101	142	39
50	REF. MArker		1.30	4.80	10.60	3.00	1.60	8.30	43.60	4.80	19.70	16.60	14.30	62.30
51	ROUTE	23	110	204	83	225	167	84	30	102	102	101	142	39
52	REF. MArker		2.70	2.30	0.00	0.80	0.60	103.30	66.40	2.40	18.20	21.20	8.90	67.50
53	ROUTE	24	110	235	83	227	167	84	30	15	102	101	142	39
54	REF. MArker		0.10	0.20	7.40	0.60	5.20	105.80	32.20	377.70	18.90	19.50	2.90	45.50
55	ROUTE	25	127	235	83	232	167	84	30	15	240	165	200	39
56	REF. MArker		9.60	1.20	4.50	1.70	6.80	101.00	13.70	377.00	0.10	2.60	1.00	51.20
57	ROUTE	26	127	235	83	232	167	84	30	15	240	165	218	39
58	REF. MArker		7.30	2.00	6.80	0.00	8.70	104.80	2.30	380.40	1.00	4.40	6.00	47.20
59	ROUTE	27	134	15	83	232	167	84	30	15	15	165	218	39
60	REF. MArker		4.20	341.90	2.20	2.20	7.70	96.40	1.00	375.30	400.90	9.20	7.30	49.30
61	ROUTE	28	134	15	15	232	226	84	42	15	15	165	218	89
62	REF. MArker		2.80	344.20	366.40	0.90	1.80	99.20	2.90	378.10	393.00	6.70	2.70	410.60
63	ROUTE	29	134	15	15	15	226	84	42	84	15	165	218	89
64	REF. MArker		12.30	347.30	370.10	336.60	3.50	102.30	1.60	31.10	399.60	4.80	5.30	408.20
65	ROUTE	30	134	15	15	15	226	84	42	84	15	165	237	89
66	REF. MArker		7.9	353.30	334.20	330.80	2.30	92.90	3.60	32.60	398.90	9.60	0.40	412.90
67	ROUTE	31	126	15	15	15	226	84	42	84	15	165	237	89
68	REF. MArker		15.2	346.00	365.40	332.70	0.10	95.90	6.80	30.50	387.30	6.50	3.70	406.10
69	ROUTE	32	126	84	15	15	226	84	42	84	15	238	237	89
70	REF. MArker		0	87.00	360.90	334.90	1.10	100.40	0.80	39.80	391.00	3.80	2.40	415.80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&Route 98 Mile marker 0.5
&Route 134 Mile marker 12
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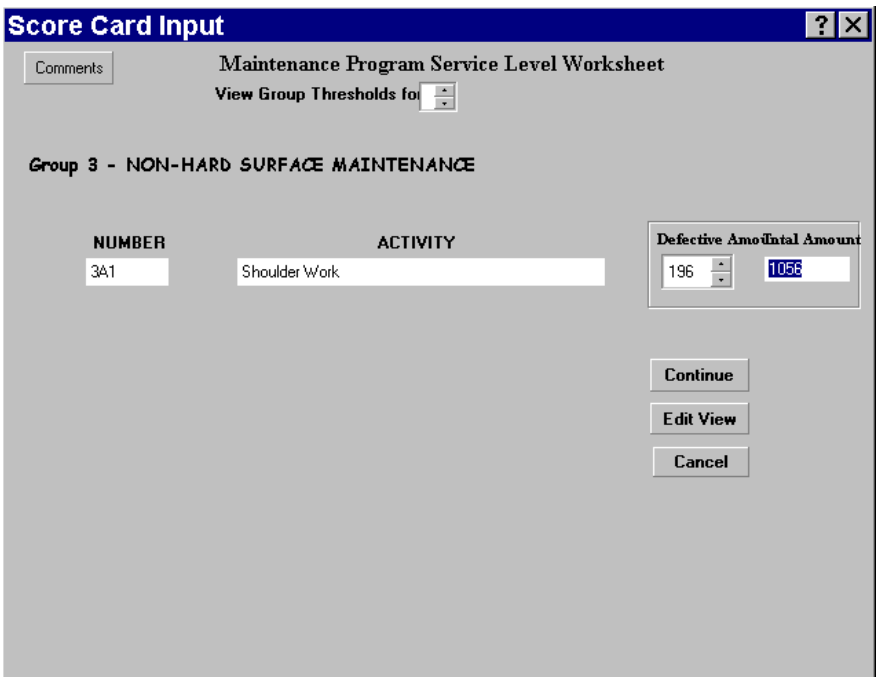
&Route 126 Mile marker 6.
&Route 37 Mile marker 9.2
&Route 110 Mile marker 2.
&Route 127 Mile marker 7.
&Route 126 Mile marker 0.
&Route 37 Mile marker 0.1
OK
Cancel
Help


Macro Menu
Group 2 - HARD SURFACE MAINTENANCE
Group 3 - NON-HARD SURFACE MAINTENANCE
Group 4 - ROADSIDE MAINTENANCE
Group 5 - VEGETATION CONTROL
Group 6 - DRAINAGE & SLOPE REPAIR
Group 8 - TRAFFIC SERVICES
Group 10 - REST AREA MAINTENANCE


Score Card Input
Comments
Maintenance Program Service Level Worksheet
View Group Thresholds fo
Group 3 - NON-HARD SURFACE MAINTENANCE
NUMBER
ACTIVITY
Defective Amo
Intal Amount
3A1
Shoulder Work
196
1056
Continue
Edit View
Cancel