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FIVE-YEAR STRATEGIC PLAN FOR THE TEXAS ACCELERATED PAVEMENT TEST CENTER (TXAPT)

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Project 5-1924: Implementation of a Fixed Site for the TxMLS

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FIVE-YEAR STRATEGIC PLAN FOR TxAPT
As Of August 2002; Revised February 2004

EXECUTIVE SUMMARY

This document is a draft 5-Year Strategic Plan for the Texas Accelerated Pavement Test (TxAPT) Center as of August 31, 2002. This document describes a plan for work to be completed by the TxAPT and partners under the direction of TxDOT. TxDOT funds this work primarily on an annual basis.

The contract and program organization should allow for leveraging of TxDOT resources and research results to obtain results and assistance from other sources where available. The long-term vision is to improve TxDOT pavement technology so that TxDOT can more efficiently complete its mission and meet the needs of the public.

The Texas Accelerated Pavement Test Center (TxAPT) is a joint venture between the Center for Transportation Research, The University of Texas at Austin and the Texas Department of Transportation. It has been created to provide a fixed facility where the Texas Mobile Load Simulator (MLS) can be operated to further pavement technology. The priorities for testing and funding will be approved by RMC-1.

The equipment will also maintain its capability for use as a mobile test facility, but the work described in this Long-Term Goals document primarily deals with the use of the equipment at the TxAPT Center in Austin, Texas.

This document outlines the general background goals of TxAPT and provides a description of potential work that can be carried out at the Center. This document will need to be updated at regular intervals as new information becomes available.

The current operating plan for TxAPT is that it will be operated as a completely "open shop"; that is, any research agency selected by TxDOT can carry out research at the facility.

While TxAPT staff will outline various research projects that we feel are appropriate and high priorities, it is clearly understood that all funding and research decisions are currently planned to be made by RMC-1 and the ROC of TxDOT with technical input and recommendations from TxAPT staff and the TxDOT Pavement TAP.

In this document, we attempt to outline general plans and goals for the TxAPT Center. Previously, the MLS has been used to do performance prediction testing for various pavement sections. It is possible that the equipment can more effectively be used for individual section validation, specific investigations, and ultimate proof testing.

The work described in this TxAPT Strategic Plan is designed to assist TxDOT in meeting the following needs:

- provide TxDOT with an ongoing and improving technical resource for testing pavements,
- address immediate needs facing TxDOT with regard to pavement technology policy decisions, and needs for new solutions to immediate problems,
- continue to develop new technology that has the potential for large payoffs in the longer-term, and
- facilitate implementation of new pavement technology, and aid in the evaluation of existing technology, and
- develop solutions for statewide problems.

All work performed to address the immediate needs of TxDOT are intended to also provide information and technology to complete longer term research goals that will have large payoffs

for TxDOT in the future. Two key principles in the TxAPT mission are to avoid duplicating work done by other researchers, and to incorporate useful results, methods, and knowledge from outside TxDOT wherever possible.

Research Services outlined in this Strategic Plan include:

- Assisting RMC-1 in the development of a Program for Pavement Research, involving APT.
- Building and maintaining a Pavement APT Research Database.
- Providing pavement technology advice to TxDOT as requested.
- Special Forensic Investigations of pavement performance, as requested.
- Implementation Projects for technologies under evaluation by TxDOT.

It is recommended that the sponsors review this document in the near future and that discussions and resolution of questions be incorporated in future updates of this document.

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AS OF AUGUST 2002

This document is a draft 5-Year Strategic Plan for the Texas Accelerated Pavement Test (TxAPT) Center as of August 31, 2002. It describes a plan for work to be completed by the TxAPT and partners under the direction of TxDOT. TxDOT funds this work primarily on an annual basis.

The contract and program organization should allow for leveraging of TxDOT resources and research results to obtain results and assistance from other sources where available.

A background document is needed, based in part on this 5-Year Strategic Plan, describing the long-term vision for development of TxDOT pavement technology through partnered pavement research. The long-term vision is to improve TxDOT pavement technology so that TxDOT can more efficiently complete its mission "to provide safe, effective and efficient movement of people and goods." and meet the needs of the public.

This Strategic Plan is intended to provide a basic description of the work which can be performed at TxAPT over the next 5 years. This Strategic Plan describes work past the termination of the current research contract, which could be continued under subsequent contracts. This Strategic Plan will need to be updated at regular intervals as significant information is discovered or becomes available.

Detailed test plans will need to be prepared for each Research Goal and Project. Each Research Goal may change somewhat as detailed test plans are developed based on additional information, changes in available resources, and any changes in the priorities of TxDOT. The objectives of each Research Goal should not change without a review process by RMC-1 and the Pavement TAP.

1.0 DESCRIPTION OF TXAPT

The Texas Accelerated Pavement Test Center (TxAPT) is a 5-year joint venture between the Center for Transportation Research, The University of Texas at Austin and the Texas Department of Transportation. It has been set up to provide a fixed facility where the Texas Mobile Load Simulator (MLS) can be operated. Here-to-fore, the MLS has been used on normal highways to evaluate pavement performance. The equipment has been moved to PRC (Pickle Research Campus) to test selected pavement sections which will be constructed under close construction specifications and control. The priority of testing and funding will be approved by RMC-1.

The equipment will also maintain its capability for use as a mobile test facility, but the work in this Long-Term Goals document primarily deals with the use of the equipment at the TxAPT Center in Austin, Texas.

This document outlines the general goals of TxAPT and provides a description of potential research that can be done at the Center. This document will need to be updated at regular intervals as required. We particularly will need to update it after review by the Operating Advisory Group (OAG) and the sponsors. It will also need to be updated after the completion of the pilot test study, which will define the capabilities of the equipment and the facility in many ways currently undefined.

The current plan for TxAPT is that it will be operated as a completely "open shop"; that is, any research agency selected by TxDOT can carry out research at the facility with the support and oversight of TxAPT staff. The staff of TxAPT will support the individual research projects with data collection and standard operating procedures. In each case a complete research plan and operating plan for the equipment will be written and used to control the individual testing program. A final written "test plan" will be prepared and agreed upon by TxAPT, TxDOT and the research agency for each test and no deviations from that plan will be allowed unless modifications are agreed upon by all parties. An assigned Test Engineer, or "Test Master" will control each test plan.

While TxAPT staff will outline various research projects that are felt to be appropriate and will address high priorities, it should be clearly understood that all funding and research decisions are currently planned to be made by RMC-1 and the ROC of TxDOT with technical input and recommendations from TxAPT staff and the TxDOT Pavement TAP.

In this document we attempt to outline a general plan and general goals which should be setup for operating TxAPT.

Previously, the MLS has been used to do performance prediction testing for various pavement sections. It is entirely possible that the equipment can more effectively be used for individual validation, specific investigations, and ultimate proof testing.

Ultimately it will be required to define the broader data needs for best utilization of the MLS equipment. Obviously, the MLS will have a finite life so every effort should be made to minimize test time or the number of applications which need to be applied in any individual test. As the MLS is operated at the TxAPT Center, the anticipated life and functional characteristics will become better understood. This information will be critical to the revision of this document, as it will have direct implications on the types and duration of tests that can be successfully conducted in the future.

1.1 Long-Term Vision for TxDOT Accelerated Pavement Testing

A background document is needed describing the long-term vision for development of TxDOT pavement technology through pavement research. This responsibility generally resides with the RMC-1. The work included in this Strategic Plan for TxAPT should support TxDOTs Mission and Vision statements for Pavement Research. The long-term vision is to improve TxDOT pavement technology so that TxDOT can more efficiently complete its mission and meet the needs of the public. A "Vision" document could help provide an overview of the long-term vision for TxDOT pavement technology, as well as define details regarding specific elements of such a plan including TxAPT.

The work described in this APT Strategic Plan, if carried out, is designed to meet the following needs of TxDOT:

- support a TxDOT plan for improving technical resources for pavements,
- help address immediate needs TxDOT is facing with regards to pavement technology policy decisions, and needs for new solutions to immediate problems,
- continue to develop new technology that has the potential for large payoffs in the longer-term period of five to ten years, and
- facilitate implementation of new pavement technology, and to aid in the evaluation of existing technology.

All work performed to address the immediate needs that TxDOT faces should also provide information and technology to complete longer-term research goals that will have large payoffs for TxDOT in the future.

Two key principles of the TxAPT Mission are to avoid duplicating work done by other researchers, and to incorporate useful results, methods, and knowledge developed from outside sources wherever and whenever practical. The work described in this Strategic Plan is designed to maximize the application of these principles. Some of the proposed new work addresses problems identified at a Research Problem Statement Workshop held in Austin, October 21, 2001 by TxDOT and the Center for Transportation Research (CTR) and presented in section 3.0 herein. Detailed work plans have been, or will be developed by other TxDOT researchers for many of the Research Goals and Implementation Projects.

1.2 Outline of Work Included in the Agreement

The work described in this Strategic Plan includes Research Services (including Implementation Projects), and proposed new Research Goals and Implementation Projects. Summary

descriptions of Research Services and Research Areas are included in Sections 2 and 3, of this document. Detailed work plans will be developed for many of the Research Goals and Implementation Projects, when, and if, directed by RMC-1.

Research Services for TxDOT that could be supported by TxAPT include the following:

- support of a Program for Pavement Research for TxDOT using the MLS and involving other universities,
- continued building and maintenance of the APT Pavement Research Database,
- provision of pavement technology advice to TxDOT as needed,
- Special Forensic Investigations of pavement performance, including testing and assistance with the analysis of results as requested.
- Implementation Projects for technologies under evaluation by TxDOT. This work could help with test plans, experiment design, specification development, construction, sampling, laboratory testing, instrumentation, monitoring, and analysis of results.

1.3 What is Partnered Pavement Research?

A good model for review by TxDOT in setting up a broader pavement research program involving TxAPT has been outlined by Caltrans as part of its Partnered Pavement Research Program. A partial description of that program is outlined below for ready reference. While TxDOT is different from Caltrans, it is possible to benefit from the same approach. As a matter of fact, TxDOT is a member along with Caltrans of a multi-state pavement research program, including Texas, Minnesota, Washington and California.

To maximize the use of Caltrans pavement research funding, Caltrans has provided resources for a Partnered Pavement Research Center (PPRC), including partners for each research goal. Potential partners are identified based on two criteria:

1) they have pavement needs that are covered partly or fully in the Caltrans research goal, and
2) they have an ability to provide resources that contribute towards completion of the research goal or increase the benefits obtained from the research goal.

Resources that partners provide can include funding to augment Caltrans funding, results from research they are funding, materials, data, staff, pavement test sections, equipment instrumentation, testing services, knowledge, or implementation. The mechanisms that permit partnering will vary. In many cases, it is desirable to partner without contractual agreements. In other cases, risk and financial and legal obligations will require a contract which would be set up through direct contracts with the University of California (UC), with UC as contractor or contracting organization.

All research performed as part of the Partnered Pavement Research Program must have partners within Caltrans to interact with the researchers during the research work, such as Materials, Design, Maintenance, Construction, Traffic, Districts, or line functions (for example, Materials Engineers, or Maintenance Engineers), to facilitate implementation of the research. All research is communicated to the Office of Pavement Standards (OPS), and primarily through OPS, to the Pavement Steering Committee (PSC). Coordination and communication across all Caltrans groups is provided. Partners are also sought from organizations outside of Caltrans, including local agencies, contracting and materials industry groups, individual contractors and producers, other state DOTs, other universities in and out of California, and other national and international organizations.

Currently, Caltrans uses the HVS accelerated pavement test program as a cornerstone for their Partnered Pavement Research. In effect, the Caltrans Partnered Pavement Research Program carries out the research which in TxDOT is currently monitored by RMC-1, the Pavement TAP, and which TxAPT, CTR and other research agencies in Texas carry out.

This 5-year Global Plan does not attempt to outline the breadth of coordination that is carried out by the California Partnered Pavement Research Program. However in order to make it as complete

as possible, we are outlining a broad range of research plans with the full knowledge that TxAPT will fit into these plans only as desired by TxDOT and as approved by RMC-1.

1.4 Selection Process for New Goals and Implementation Studies

The TxDOT Pavement Research Management Committee (RMC-1) holds the ultimate authority for selecting research work to be performed by the pavement research teams in Texas.

The selection process for the new research goals and implementation projects consists of the following tasks:

1) Summarize and synthesize feedback from interaction with TAP-1 and other TxDOT headquarters and district staff regarding the most important pavement issues requiring new research. Wherever possible include disparate problems identified by different sources into comprehensive experimental objectives and plans. Relate research needs identified through this process to the overall goals of TxDOT to improve the following aspects of transportation:
    - Reliability
    - Performance
    - Flexibility
    - Efficiency
    - Safety
2) This program could be supported by review of:
    a. national pavement research programs such as those of the National Cooperative Highway Research Program, US Army Corps of Engineers, Federal Aviation Administration and Federal Highway Administration,

b. international programs such as those of the European Community, the South African national and provincial programs, and the Australian Road Research Board, and

c. state programs, particularly those of the partner states in the State Pavement Technology Consortium (SPTC).

To avoid duplication, identify where calibration or verification is required for TxDOT and identify potential partners. Identify how short-term research needs fit into the long-term vision for TxDOT pavement technology.

3) Develop a preliminary scope, schedule and resource requirements needed for each new Research Goal, and identify needed resources within the TxDOT research program. Identify potential partnerships and additional resources that might be obtained from other agencies.

1.5 Scope of this Strategic Plan

This Strategic Plan is intended to provide a basic description of the work to be performed by the TxAPT for the TxDOT Pavement Research Program over the next five years. This Strategic Plan includes work past the end of the current termination of the research contract which will be continued if there is funding for subsequent contracts. This Strategic Plan will need to be updated regularly.

Detailed test plans should be prepared for each research goal. Each research goal may change somewhat when the test plans are developed, based on additional information, changes in available resources, and any changes in the needs of TxDOT. The objectives of any research goal should not change without a review process by TxDOT.

2.0 RESEARCH SERVICES

A wide variety of research can be undertaken using the MLS facility at the TxAPT. It has been stipulated by the TxDOT Administration that pavement research carried out with the MLS will address statewide pavement issues that have high visibility and high payoff potential.

A pilot study has been funded as the first operational test for the newly refurbished MLS. The research goal of the pilot study is to demonstrate damage caused by heavy trucks on relatively thin pavements. Useful qualitative results will be produced but the primary purpose of the first test section is to debug the fixed operation of the new MLS at the APT Center. The debugging process in the pilot study will enable TxAPT staff to:

- Evaluate the operation characteristics of the refurbished MLS.
- Evaluate new instrumentation and equipment.
- Develop standard operating procedures.
- Establish test plan development guidelines and protocols.
- Determine the operational reliability of the MLS.
- Finalize data handling and processing procedures and data QA/QC protocols.
- Collect data to evaluate the impact of HB2060 on Texas' Farm-to-Market road network.

To date, the most complete review of potential research to be carried at TxAPT was done in a brainstorming meeting on October 22, 2001 at the Center for Transportation Research. The meeting was attended by eleven people from TxDOT and five people from individual research agencies, including Texas A&M and the Center for Transportation Research. More than 30 research projects were identified in that meeting. All are statewide issues which make them a candidate project for testing by the TxAPT Center. These ideas were prioritized and the results are present in three groups, A, B and C. Group A ideas include the most critical in highest payoff items as judged by the group. Groups B and C are of less importance and are defined separately.

This list of potential projects currently serves as a list of long-term goals for TxAPT. It will be discussed with the OAG in an October 2002 meeting, and the list of potential projects should be presented to the Pavement TAP, RMC-1 and any other interested RMC's. It is intended to have a proposed prioritized list to present to the RMC for their review and potential funding in early 2003.

Since the Pavement TAP reviews potential pavement research, formulates a priority list and presents it to the RMC-1 for approval, it seems essential that the TAP be made aware of the TxAPT capabilities and how it can be integrated into the approved Pavement Research Program.

2.1 Development of Accelerated Pavement Research Program

Many accelerated pavement test efforts exist around the world as stand-alone activities with independent programs and independent funding provided by their agencies. Examples are the Federal Highway Administration program in Washington, DC and the CSIR program in South Africa. Other programs exist in the States of Louisiana, Florida and elsewhere.

A different model is used in California. The Caltrans APT effort has fostered a Partnered Pavement Research Program, which integrates all pavement research within Caltrans and with many partners outside Caltrans. Of all the efforts we have looked at, Caltrans seems to be the most successful and now has two full-time Heavy Vehicle Simulator (HVS) machines operating in the State of California, with a budget of $5 million per year. Although the APT program in California represents only a portion of their annual $5 million pavement research program, it has become the focal point for pavement research in California because of the heightened awareness it brings to pavement research throughout the state and the beneficial payoffs resulting from its high profile operation. In this respect, it filled a void which existed there 10 years ago.

The construction of the Mobile Load Simulator (MLS) was authorized and accomplished by TxDOT in 1988-1990 with special funding from the TxDOT Administration and with four major goals

in mind. These goals are covered in section 4 herein and serve as a focal point for review of TxAPT testing goals. Now that the TxAPT Center has been funded for FY2003, these former goals should be reviewed with Pavement TAP, RMC, ROC, and the TxDOT Administration. Ideally an integrated set of goals will be formulated through RMC-1 and the ROC.

As envisioned by TxDOT Administration, TxAPT was formed to codify accelerated pavement testing in TxDOT. Currently it is not a stand-alone program, but is integrated to the total pavement research program by RTI and RMC 1. Rather TxAPT is a tool for pavement research funded through the Pavement RMC-1 and coordinated by RTI to address priority pavement research issues important to the State of Texas. Future tasks can be separately funded projects identified in the Long-Term Pavement Research Program, special administrative projects to investigate critical statewide concerns involving the legislature or a tool to validate results and concepts produced in other research projects or obtained from outside sources.

This "Goals" document is written on the basis of the most recently stated plan of the TxDOT Construction Division and RTI; that is, funding will be accomplished through the normal pavement research programs. With this approach, the TxAPT staff is very careful to interact regularly with the Pavement TAP and RMC-1, which integrates the program with RTI. This draft 5-Year Strategic Plan has been developed with that approach in mind. It will be presented to the sponsors for discussion and has been a key subject on the agenda for the next TxAPT OAG meeting. Input from the sponsors and the OAG should be integrated into the revised document.

We should then receive from the TAP and RMC-1 feedback on their priorities and needs for accelerated pavement testing, as well as funding expectations. This will be an interactive process in which we will share with them our testing capabilities and our estimates of high payoff accelerated testing projects and they will review these and feedback to us their high priority concerns and needs based on TAP and RMC-1 deliberations.

To the degree possible, it will be desirable for the RMC to deal with funding expectations in order that appropriate funding can be associated with appropriate priority projects. With this information on priority needs and potential available funding expectations, a new program can be reformulated with preliminary funding associated with individual priority projects. Hopefully a 2-3 year horizon of expected funding and projected projects could be outlined. However by maintaining full communications and coordination, TxAPT can most effectively support pavement research efforts within TxDOT.

2.2 Pavement Research Database

2.2.1 Background

The production of reports, and other research products at the successful completion of a Research Goal captures the immediate results and benefits of the research. However, data produced from multiple research goals collected over time can be combined to enhance results in the future and could produce unexpected bonus results. Ideas may be developed at a later time that can be tested against the data, and models can be developed from the data that were not included in the original research.

However, data quickly becomes difficult to access and understand at the completion of a project if it is not organized and stored in a database within a short period of time. This occurs because the human memories of data location and meaning are lost with time, and storage media can potentially deteriorate with age. TxAPT should have an integrated Pavement Research Database for APT data and developed as part of the contract in 2002-2003 and maintained in subsequent years.

2.2.2 Objectives

This work will involve development of database structures for all types of MLS test data that will be collected, and the entry of all data produced during testing into the database. It should also include the development of improved access and analysis procedures to make better use of the data, including the development of data queries, downloading procedures, and reporting features.

Work on this research service also includes improving access to the TxAPT pavement research database by TxAPT staff, TxDOT personnel and other interested researchers. This will require an interface with the partially completed Web-based database developed by Dr. Fred Hugo for TxDOT in 2000-2001, if it is finalized. During the past 5 years (1995-2000), data from MLS has been loaded into a variety of data files using Access and other programs. Routines have been written to reduce raw data and summarize data. Existing data needs to be loaded into a comprehensive database, which provides greater query functions and the ability to handle larger volumes of data. Tasks to be carried out include:

- load existing data into a new comprehensive database format,
- evaluate and upgrade the available data queries,
- develop a system to provide web access to the database by TxDOT researchers,
- once access is improved, provide technology transfer to inform potential users of the contents of the database and how to access them.

2.2.3 Expected Benefits

The expected benefits of continued building of the Pavement Research Database include:

- Preservation of results, and raw and processed data, that TxDOT has invested considerable funds in obtaining.
- Continued easy access to data by TxDOT and other researchers.

- Ability to perform systematic searches of the database for results relevant to later projects and problems.
- Ability to re-evaluate results from multiple projects to obtain additional and unexpected (bonus) research results.
- Support for users of the database.
- Incorporation of all new data developed as part of the TxAPT through development of new data structures, and organization of the new data into the database.
- Technology transfer to TxDOT regarding the contents and use of the database.

2.2.4 Potential Partners or Users

Potential partners or users for this work include organizations performing research of interest to TxDOT and organizations that are interested in APT work being performed. Current potential partners include the State Pavement Technology Consortium (including California, Washington State, Minnesota, and Texas DOT), the Army Corps of Engineers Waterways Experiment Station and the Army Corps of Engineers Cold Regions Laboratory. Other interested agencies could potentially include Florida DOT, Louisiana DOT, the Australia Road Research Board, and other APT Centers desiring to share data and data structures.

An NCHRP Project regarding accelerated pavement testing (APT) database structures has recently been completed and results will be evaluated for incorporation in the database structure.

2.3 Provision of Pavement Technology Advice to TxDOT, As Needed

Benefits from the development of improved pavement technology can only be obtained if it is widely distributed and implemented. Three primary means of dissemination of pavement technology

information have been identified, in addition to the implementation projects and special forensic investigations:

1) participation in meetings, discussions, and presentations,
2) technology scanning, and
3) technology transfer.

2.3.1 Meetings, Discussions and Presentations

This work consists of:

- Participation in meetings at the request of TxDOT by TxAPT members and other experts whose travel expenses and fees can be paid through the research contract,
- Preparation of presentations on specific items, or overviews of recent results from TxAPT and related industry meetings, symposiums, conferences and workshops, and
- Telephone consultation with TxDOT regarding pavement technology research.

2.3.2 Technology Scanning

This work could consist of attending conferences, workshops, symposiums, and other meetings to obtain information needed by TxAPT to improve pavement technology. This work requires a clear and comprehensive understanding of TxDOT needs so that technology in use outside of Texas can be evaluated for its applicability to Texas problems and conditions, and synthesized into usable recommendations. This work also includes incorporation of technology scanning results into the research being performed for TxDOT and/or direct distribution to TxDOT.

2.3.3 Technology Transfer

This work could consist of development of technology transfer materials and their transmission to TxDOT contractors and others. The objective is to transfer the results of research in a usable form to pavement technologists and managers. The traditional means of technology transfer include

production of report, presentations, classes, symposiums, conferences and workshops. In addition to these means of technology transfer, the TxAPT and their partners could investigate other technology transfer formats, including:

- Short memorandums (tentatively titled "Pavement Notes") that provide brief descriptions and summaries of results of research work, condensed from one or more reports,
- Web-based self-paced learning (distance learning),
- Internet distribution of results, and
- Distribution of results in non-paper media such as CDs.

2.4 Special Forensic Studies

Special forensic investigations are short-term research oriented investigations of pavement condition or performance. For a limited number of cases, TxAPT could assist in forensic investigations where some special expertise or equipment will aid in successful identification of the failure mechanism or evaluation of pavement condition or performance.

The results of these Special Forensic Studies would also provide case histories that could provide validation and calibration data for new pavement technology being developed as part of the research program. Only those studies approved by our sponsors would be undertaken.

3.0 RESEARCH TASKS APPLICABLE TO APT TESTING AS SYNTHESIZED BY PRELIMINARY APT PLANNING GROUP, OCTOBER 22, 2001

3.1 Topics With Highest Priority and Payoff (Group A)

3.1.1 Determine the Impact of HB 2060 Permits on Texas Load-Zoned Roadways

In HB 2060 the Texas legislature modified the current limitations on permits for load zone roads. These higher allowable load permits for special loads can be very damaging to the thin pavements constructed on our farm to market system. It will be important to observe the impact of heavier loads and this can be done rapidly with TxAPT. It would be necessary to build a thin section similar to those currently used in south Texas, perhaps 1 1/2" surface on 6" of base. We would test one subsection using say, 12 kip axle loads (24 kip tandem loads). Another subsection would be tested with heavier axle loads. It would be necessary to compare the performance based on cracking, rutting, roughness, residual deflection and material property changes during the test. The results will produce results, which can be presented to the Texas Legislature, if TxDOT desires.

This topic has been selected as the pilot study to be carried out with the MLS at TxAPT. It has been funded at a total of $200,000 to begin in January 2003 with funding for fiscal year 2003 of $120,000, and the balance to come from fiscal year 2004.

3.1.2 Evaluate and Calibrate AASHTO Design Guide for Selected Designs

A great deal of energy and money is going into the development of a new AASHTO pavement design guide based on mechanistic principles. This guide should be available for evaluation by TxDOT in early 2003, however it will be necessary to evaluate and calibrate the method for Texas conditions. It is not clear yet how this project might be undertaken, except that by running repeated

loading with MLS it would be possible to calibrate some of the mechanistic fatigue models used in the 2002 Guide. Additional subtopics for this potential project are outlined below. It is expected that work with the TxAPT OAG and with groups in TxDOT will result in an expansion of this topic in the next update of this 5-year Global Plan.

3.1.3 Determine the Impact of New Truck Tire Load Enforcement Legislation.

The Legislature has passed legislation that removes former limits on the amount of load that could be applied per inch of tire on Texas highways. This former law was used by the Texas Highway Patrol to control and enforce load limits by limiting the number of pounds of load that could be applied per inch of tire width.

Lacking this control, it is conceivable that truckers could use excessively high loads on narrow tires, thus increasing problems with rutting and other pavement damage. This project is also linked to the effect of high tire pressures on pavement performance.

TxDOT, as well as other states is continually faced with trying to evaluate the destructive effects of higher tire pressures. All performance models are based on the AASHO Road Test results carried out in 1958-60 using 80-90 psi tires. Although some theoretical work has been done, there has been no field validation of this work. In 1999-2000, a CTR Research Project #1713-3 was carried out to produce revised effects of tire pressures in the 115-120 psi range.

It is possible with TxAPT to compare the performance of pavements using 80 psi and 120 psi tires. It would be necessary to set up a pavement test section using standard pavement thicknesses in Texas, to run one or two subsections using 80-psi tires up to one million applications, and then to compare the rate of progression of deterioration on one or two other subsections using 120-psi tires. It would be important to compare cracking, rutting, change in residual deflection material properties and roughness under the two tire pressures.

3.2 Topics With High Priority and Payoff (Group B)

3.2.1 Determine Fatigue Resistance of Rut Resistant Mixes

Texas is currently constructing new, more rut resistant asphalt concrete mixes; based somewhat on Superpave technology. It is important to determine whether these new mixes, which are more expensive than old mixes, actually provide an improvement in rut resistance and whether or not they are as fatigue resistance as the old mixes. It would be unfortunate to exchange rutting improvements for decreases in fatigue resistance. The pavement will fail no matter which one of these distress factors governs. It will be possible to compare these two factors by building a pavement section with a moderate to strong base and to place on the section one half of the length with old mix and one half of the length of the total section with a rut resistance mix. One or two comparison tests of the MLS would be run on the old mix and one on the new mix. The rutting of the two mixes will be compared along with fatigue cracking, roughness, residual deflection and change in material properties. This can also be combined with problem statement #3.2.2, by placing the two types of mixes on two types of bases; normal performing and high performing flexible bases. (This combination would require two years and at least $400k but is worth considering by the RMC.)

3.2.2 Evaluate High Performance Flexible Bases

Texas is currently building new high performance flexible crushed stone bases. These bases are more expensive because they have a tighter specification than old bases and it is important to determine whether or not the resulting performance is worth the additional cost. It is possible to make this comparison quickly using TxAPT. It will be necessary to build a section, where the total length is 1/2 high performance base and the other half is constructed with some typical regular base. Two test sites on each base would then be trafficked by the MLS using an appropriate traffic load. Possibly an 18 kip load for the first site and a 24 kip load for the second site, for example. The results of the

performance of the two sections based on cracking, rutting, roughness, residual deflection and material property changes could be compared to determine the benefit of the high performance flex bases. The performance prediction models could then be compared against the cost factors and a cost benefit relationship could be determined. This could be combined with a test to Evaluate Rut Resistant Mixes where four sections could be built with both high performing bases and regular performing bases and half of the mix on each of those two bases could be old mix and half rut resistance mix. In this way, a 2x2-test factorial could be compared.

3.2.3 Determine Cost Benefits of PG Binder and Modifier

As a part of the Superpave program, PG gradings of asphalt cements has been instituted. In order to meet these PG gradings it is sometimes necessary to add modifiers. The cost of obtaining these new AC gradings is often higher than using traditional asphalt cements, although there has been some work as a part of the SHRP program to show the benefits of PG binders and modifiers, little work has been done to compare the cost of these binders in practice against the benefits, thus producing a cost benefit relationship versus standard binders. It would be possible to setup a research project using the MLS at the TxAPT to study this problem and to estimate cost/benefit relationships.

3.3 Topics with Medium Priority and Payoff (Group C)

The topics listed in group C of this category are both Portland Cement Concrete (PCC) projects. One of the major problems to be faced by TxAPT Center is to get the most benefit from the MLS after it is refurbished. In effect, the total benefits of TxAPT will derive not only from the benefit to be gained from running the tests, but the relative cost of running the tests in terms of the life of the equipment itself. Generally, Portland Cement Concrete pavements are longer lived than some asphalt concretes pavements. In this case, it is possible that testing of such PCC sections will require many

more applications of the MLS. Ultimately this decision is a policy decision which must be dealt with by RMC-1 and the TxDOT Administration. We will continue to update recommendations on these topics.

3.3.1 Determine the Effectiveness of PFC-CRCP

In the past several years, there have been a number of problems associated with skid resistance on concrete pavements. There has also been some concern about providing an asphalt surface layer over CRCP to provide a quieter and smoother ride. Several sources have proposed the use of porous friction courses for this purpose, yet TxDOT has very little experience in the effectiveness of these materials. It was suggested in the planning group meeting that an experiment be run to examine the effectiveness of PFC over CRCP.

3.3.2 Determine the Impacts of Concrete Curing Time on Pavement Performance

Many studies have been undertaken in recent years relating pavement curing time to pavement performance. A major research project is going on at TxDOT related to design and performance of concrete pavements. Researchers making use of the TxAPT Center could verify the results of that study.

4.0 PREVIOUSLY APPROVED PRIORITY CATEGORIES OF TxDOT ADMINISTRATION

When MLS was first placed in service, the TxDOT Administration outlined four major categories of research as priorities. These categories are:

1. Quantify Overload Damage
2. Evaluate Truck Tire Pavement Interactions
3. Develop New Design and Rehabilitation Methods
4. Evaluate Innovative Pavement Materials and Technology

These are four broad categories which cover all of the topics listed in Section 3.0 in the three priority topics. As part of this planning session, these topics were used to elicit other potential testing projects from the group, based on their individual experience and knowledge of TxDOTs needs.

Listed below are many of the topics that were put forth in that discussion. These topics will be preserved and will serve as input into the next round of review for priority testing with MLS. It will also be very important to obtain related priorities from the Pavement TAP since this priority listing is background information which is furnished to the RMC-1 (Pavements). Since funding for our individual pavement research projects in TxAPT must be approved by RMC-1, it is critically important that the input from the TxAPT supervising group be provided to the Pavement TAP and RMC-1 so that congruent priorities can be established.

The highest priority items have been discussed in the previous section and the items listed here are not listed in any particular order of priority. In general, these topics cover small tasks as well as some very large tasks. The amount of energy that each would require from TxAPT varies enormously, and individual TxDOT research projects and research plans will be extracted from this list and other sources in the next 12 months.

4.1 Quantifying Overload Damage Due to Heavy Trucks

4.1.1 Determine an overload damage relationship to improve corridor impact analysis

One of the main issues facing the TxDOT Administration is to clearly demonstrate to the legislature the damaging effects of higher axle loads on typical Texas pavements. By running the MLS over instrumented pavements, it will be possible to measure pavement response under a wide range of loading conditions. By conducting tests at different wheel load levels, the impact of load on pavement life can be determined. Both the load and response data can be used to calibrate pavement performance models, which can then be used to generate defensible statewide estimates of the cost impact of overloaded vehicles.

4.1.2 Evaluate the Impact of HB 2060 Permits on Texas Load-Zoned Roadways

This project has been selected for evaluation in the pilot study of TxAPT. Preliminary qualitative results on this subject will be made available to the TxDOT Administration in December 2003.

4.1.3 Validate the AASHTO 2002 Axle Load Spectrum Concept

The new AASHTO Pavement Design Guide, termed the 2002 Guide, will probably be made available to TxDOT for evaluation in 2003. A new concept of evaluating axles in a wide variety of spectra of environmental and load categories will be presented in this new method. Currently load equivalencies are used. TxAPT may be able to assist in evaluating this new concept.

4.2 Evaluate Truck-Tire-Pavement Interaction

Listed in this category are seven topics which have been offered for consideration from various groups within TxDOT. The names of the topics presented below are self-explanatory in general. In

these cases, no descriptive material has been added. In the case of the first and last topics, descriptive material is helpful and has been included.

4.2.1 Determine the Impact of New Truck Tire Load Enforcement Legislation

During the last legislative session, the pounds per inch of tire width' requirement was eliminated from the Texas Traffic Laws. DPS troopers will compare actual truck tire load to the recommended tire load printed on the tire by the Manufacturer to ensure compliance. This may allow truckers to use any tire pressure they desire. This legislation may increase the tendency to use higher tire pressure and cause excess damage to pavements.

4.2.2 Evaluate 18-kip Equivalency Factors

4.2.3 Look at Relationship Between Tire Load, Pressure and Contact Area

4.2.4 Evaluate Damage Due to Different Suspension Designs

4.2.5 Quantify Damage from Dynamic Loads Due to Rough Pavements

4.2.6 What is the Benefit of a Super-Smooth Pavement Relative to Dynamic Load?

4.2.7 Evaluate Current Ride Spec Bonuses Based on Higher Vehicle Operating Costs

Ride specifications as a part of performance-based specifications have been reviewed and used to some degree in TxDOT. Calculations for related bonuses and penalties have been based on extended pavement life based on higher levels of riding quality and, initial Pavement Serviceability Index (PSI). To date the calculations have not considered user cost which can be very large and could increase the benefits of higher ride quality specifications.

4.3 Develop New Design and Rehabilitation Methods

In this category, nineteen subtopics have been offered by various TxDOT sources. Several of these are expanded below where additional information is needed. In the others, the topic title is satisfactory to define the needs at the current level. In subsequent reviews, those topics which are defined as highest priority will be further expanded.

4.3.1 Determine the Ability of Premium Base Materials to Withstand Heavier Axle Loads

Designing base thickness to accommodate more and heavier trucks is a major concern for TxDOT. Little information is available on the long-term design strengths of flexible and stabilized base materials. The MLS test program can provide data to evaluate the adequacy of current pavement design procedures, as well as calibrate the mechanistic procedures currently under development. Another concern is the need to evaluate the economic benefits of using higher-cost premium materials rather than locally available materials. At the conclusion of the test program, pavement life cycle cost calculations need to be undertaken to determine if the higher cost materials can be justified in terms of either longer life or thinner layer requirements.

4.3.2 Improving and Calibrating Pavement Prediction Models

The MLS test program provides TxDOT with a good opportunity to evaluate how well laboratory test results and performance prediction models can estimate field performance. As a minimum, the field NDT and laboratory test programs could provide input for the following pavement design and performance prediction models:

- FPS 19 (TxDOTs current flexible pavement design procedure)
- VESYS 5 (FHWAs performance prediction model)
- AASHTO 2002

- Finite Element Analysis

4.3.3 Evaluate the Performance of Rich-Bottom Mixes

4.3.4 Evaluate the Fatigue Resistance of Rut-Resistant Mixes

4.3.5 Evaluate Surface Energy Concepts to Assess Moisture Damage

4.3.6 How Long Do We Need to Cure Concrete Pavement?

Four days of curing are now required. Is it possible to get by with 2 days? Will the concrete lose its tining? What is the actual strength requirement? Is curing method a factor in PCC performance? What is the impact of the fast-track concrete pavement methods?

4.3.7 Evaluate Patching Materials

4.3.8 Effect of Tining on Long-Term Performance

4.3.9 Field Validation of Porous Friction Course/CRCP Pavement System

4.3.10 Evaluate the Development of Reflective Cracking and Possible Cures

4.3.11 Expand AASHTO 2002 to Provide a Means for Designing Thin Pavements (use results from HB2060 study)

4.3.12 Evaluate Impact on Performance of Incremental Changes in Thickness (9" vs. 10" of PCC, etc.)

4.3.13 Evaluate and Determine How to Construct "Model" Pavements to Represent Thicker Pavements

4.3.14 Review Commission's Report and Tie to Goals

4.3.15 Evaluate Specialized Designs for 125,000-lb Truck Corridors

4.3.16 Validate/Evaluate Overload Design Models Which Could be Used for Corridor Studies

4.3.17 Develop Optimum Rehab Methods for Load-Zoned Roads Including Low Cost Solutions and In-Place Cement Treatments

4.3.18 Modified Triaxial Design Method is Conservative, but Under What Conditions?

4.3.19 Evaluate Base Design Using Locally-Available Materials in Subbase, and Premium Materials in a Thinner Base

4.4 Evaluate Innovative Pavement Materials and Technology

Eight topics have been offered by TxDOT representatives, which are considered relatively high priority in this category. In general, the topics are self-explanatory and no additional descriptions are needed at this point. In subsequent reviews where additional priorities are considered, more details will be developed.

4.4.1 Determine Optimum Applications for Reinforcement Fabric and the Impact of Fabric on Base Design Thickness

4.4.2 Determine Cost Benefits of PG Binders, and Modifiers

- Is there a performance benefit associated with higher-grade PG binders?
- Are there specific modifiers that would give superior performance as compared to premium PG binders?

4.4.3 Evaluate the Benefit and Design Considerations Related to Geogrids

- Can base thickness be reduced if geogrids are used?
- Do geogrids provide any benefit?
- Rigid grids vs. flexible grids
- Vendor may need to help pay for testing their product

4.4.4 Evaluate traffic Marketing Materials

- Glass bead index; higher index means a softer bead, which wears down
- Bridging effects
- Materials affected by environment

- May provide good comparison of wear characteristics for different types of beads
- Pavement markers are breaking recently. Is it because of poor quality, or other factors?

4.4.5 Evaluate Performance of Permeable Friction Courses as Compared to:

- CMHB
- SMA
- Superpave mixes
- High-performance mixes
- Dense-graded mixes

4.4.6 Evaluate High-Performance Bases Using the MLS

- Current study 4358 will develop specifications with various material characteristics
- JMF grading

4.4.7 Field Validation of "Selected" Liquid Stabilizers Determined from 4240

- Compare to other stabilizing methods (such as using select material) from a structural perspective
- Water ingress needed

4.4.8 Evaluate Selected Recycled Materials

5.0 VALIDATION OF OTHER RESEARCH RESULTS AND CONCEPTS

One important use of the MLS is as a tool to validate the results of other research and analytical concepts. In the past, new ideas have been put forth either from an individual research project, or from outside vendors to test a new material or to calculate a new pavement response or performance life, based on new materials, new design methods, or both. Many times these new ideas have been integrated into pavement construction, or rehabilitation projects with little or no results produced, either because the implementation was not properly documented and followed up, or more importantly perhaps because the results of any change required several years to actually be observed.

Using MLS in properly designed experiments at the TxAPT Center, it would be possible to verify new concepts, materials and ideas in a more uniform fashion and more quickly. This is one of the approaches that have been used in Caltrans with their Accelerated Pavement Test facility. It has already been suggested by Dr. Claros that the TxAPT be used to validate the concepts of integrating FPS 19 and Texas Triaxial Design Methods. A major research project is currently being funded at Texas A&M-UT/El Paso on this subject. With proper integration, an early project for TxAPT could be to validate some of these design methods.

Major work is also going on to provide high quality bases for Texas asphalt pavements. It could be possible to validate very early the improved performance which might be obtained from enhanced quality specifications for bases. It would then be possible to perform a benefit/cost analysis to ascertain the value of using the high quality base materials.

Much work is being done in Texas and nationally on performance-based specifications. In order to validate a performance-based specification and understand its value, it is necessary to be able to specify appropriate levels of performance and to insure that they have been achieved by the pavement contractor. TxAPT can be used as a tool to validate these performance-based specifications to provide more performance information on which to base appropriate specifications and which to

quantify the financial ramifications (bonuses or penalties) associated with the ability of the contractor to both meet or exceed the specification or their failure to do so.

6.0 SUMMARY

This document outlines many key elements of a 5-Year Strategic Plan for the Texas Accelerated Pavement Test Center. It relies on information presented by TxDOT sponsors in formulating the initial proposals and first year contract. It also incorporates information obtained related to the original funding and development of the Mobile Load Simulator and its subsequent rehabilitation. Using this and background information from other accelerated pavement test centers, the draft plan presented here has been developed for discussion and consideration. It outlines a number of key issues which need serious consideration. In the past, TxDOT Administration has defined some of the key research issues.

Under current plans, all research conducted at the TxAPT Center will be integrated for funding through the Pavement RMC. Clear policy guidance from the sponsors is needed, along with good coordination and communications amongst the various elements of the program to insure optimum success. Work by the TxAPT staff and Advisory Groups to date, strongly indicate that successful accelerated pavement testing can be accomplished with the rehabilitated MLS and that by proper coordination, funding and vigorous activity by the related groups, significant results can be produced to assist TxDOT in fulfilling its mission of providing improved highway transportation to the State of Texas.

It is recommended that the sponsors review this document carefully in the near future and that discussions be held to resolve critical questions.