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A PROCEDURAL DOCUMENT DESCRIBING THE PROCESS OF DEVELOPING THE 4-YEAR PLAN

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*TxDOT Project 5-9035-01: Pilot Implementation of a Web-based GIS System to
Provide Information for Pavement Maintenance
Decision-Making*

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ABSTRACT

The Texas Department of Transportation (TxDOT) is responsible for a vast managed pavement network: 79,991 centerline miles of highways and 49,829 bridges. Rider 55 of the appropriations bill for TxDOT requires that prior to the beginning of each fiscal year, the department provide the Legislative Budget Board and the Governor with a detailed plan for the use of these funds. This plan should include, but is not limited to, a district-by-district analysis of pavement score targets and how proposed maintenance spending will impact pavement scores in each District. To fulfill this requirement, TxDOT and its Districts develop the 4-year pavement management plans and update the plans every year. The plans are used to predict the future conditions of pavements and analyze the impact of the appropriated funding on the conditions of the pavements. To support the TxDOT Districts in developing the 4-year pavement management plans, this report presents a procedural process to guide the Districts in plan development.

INTRODUCTION

The Texas Department of Transportation (TxDOT) maintains a large network of highway pavements. Effective management of the required maintenance in order to preserve pavement assets with a limited budget has always been a challenge. In addition, Rider 55 TxDOT's appropriations bill requires that prior to each fiscal year the department provide the Legislative Budget Board and the Governor with a detailed plan for the use of these funds. The plan should include, but is not limited to, a district-by-district analysis of pavement score targets and how proposed maintenance spending will impact pavement scores in each District. To fulfill this requirement, TxDOT and its Districts develop the 4-year pavement management plans (PMP) and update the plans every year. The goals of the plans are to

- Develop a comprehensive and uniform PMP that is roadway specific to the greatest extent possible, and is fiscally constrained.
- Generate Pavement Condition Projections based on a financially constrained plan that can be reported in compliance with Rider 55 of the 2012–2013 Appropriations.
- Assure maintenance resources are directed toward pavement operations and roadway-related work.
- Provide a reporting mechanism for District Engineers, Administration, and the Commission to utilize in briefing elected officials.
- Allow Districts and regions to appropriately allocate resources through long-term planning in order to accomplish the plan.

The 4-year PMP provides TxDOT with a mechanism to predict pavement conditions based on a specified funding level and project-specific plan. The resulting report consists of the summary of the number of lane miles that each District plans to treat as Preventive Maintenance (PM), Light (LRhb), Medium (MRhb), or Heavy Rehabilitation (HRhb), and the impact that those treatments are predicted to have on the pavement conditions. The primary components of the plans include the following:

- The financial constraint for all categories of funding for FY 2012–15 was identified from finance revenue projections and utilized to plan the projects.
- Projects for the FY 2012–15 planned lettings were identified in P6 and considered for impact on pavement condition.
- All maintenance expenditures (Strategy 105/144) were captured in the PMP system, taking into account all routine and preventive maintenance work.

In addition to Category 1 – Preventive Maintenance and Rehabilitation (CAT 1) funding, each District developed their 4-year expenditure projections based on anticipated maintenance budgets. Certain expenses are fixed and are part of doing business, such as overhead and operational expenses. The roadside expenditures continue to be evaluated in order to find the balance with expectations. Traffic operational expenses are well established in order to maintain existing systems (Intelligent Transportation Systems [ITS], signals, illumination, etc.). The pavement maintenance expenditures include both in-house state force work and routine maintenance contracts.

Procedures for 4-Year Pavement Management Plan Development

As briefly discussed earlier, the 4-Year PMPs for the 25 Districts each contain a list of pavement projects identified for maintenance or rehabilitation treatments in the current and three future Fiscal Years. The procedures used by the Districts to develop the 4-Year Plans could vary significantly because of local conditions (metro/urban or rural District); availability of archived pavement layer and treatment history data; use of network-level deflection testing; retirement of experienced TxDOT personnel; and reductions in personnel resources in each District. To maximize best use of limited resources, it is recommended that the 4-Year Plan be developed and updated by the Districts each year through a rigorous process that involves three major steps as shown in Figure 1.

In Step I, Network-Level Project Screening, Districts analyze Pavement Management Information System (PMIS) data, which is collected on over 90% of the TxDOT roadbed mileage each year. The combination of ongoing construction project work zones, accidents, and very heavy traffic in metro Districts makes data collection on 100% of the state pavement network impossible. The PMIS data includes distress data collected between September and December by contract raters. In addition, automated ride quality and rutting information is collected using TxDOT profiler/rutbar vans. TxDOT CST-PAV conducts QC/QA evaluations of the manual distress, ride quality, and rutting information to ensure accuracy and completeness. The data is then stored in the PMIS database for use by administration, Districts, and the divisions for pavement management applications, Legislative Budget Board Rider 55 expenditure requirements, and to meet federal requirements including the Highway Performance Monitoring System (HPMS) annual report. In addition, PMIS data is combined with visual maintenance condition survey information to prepare annual Maintenance Division reports and to identify and program routine maintenance activities such as crack sealing, pothole repairs, and similar work.

The PMIS database contains pavement distress and condition information for the current and previous fiscal years to 1993. This historical record of pavement distress, ride, and condition performance provides essential data and information needed to evaluate condition trends and for use in developing improved analysis models and condition forecasting tools. The data for each 0.5-mile PMIS rating section is supplemented with information obtained from the TxDOT Texas Reference Marker (TRM) database, including traffic volumes and loads, posted speed limit, and other factors. This information is used to compute the Pavement Distress, Ride Quality, and Condition Scores on each PMIS rating section and to calculate the percentage of pavements in “Good” or better condition at the District and statewide levels. Network-level Skid data is also collected and stored in the PMIS database, but is not included in the PMIS Condition Scores because safety-related issues are analyzed and prioritized using different procedures.

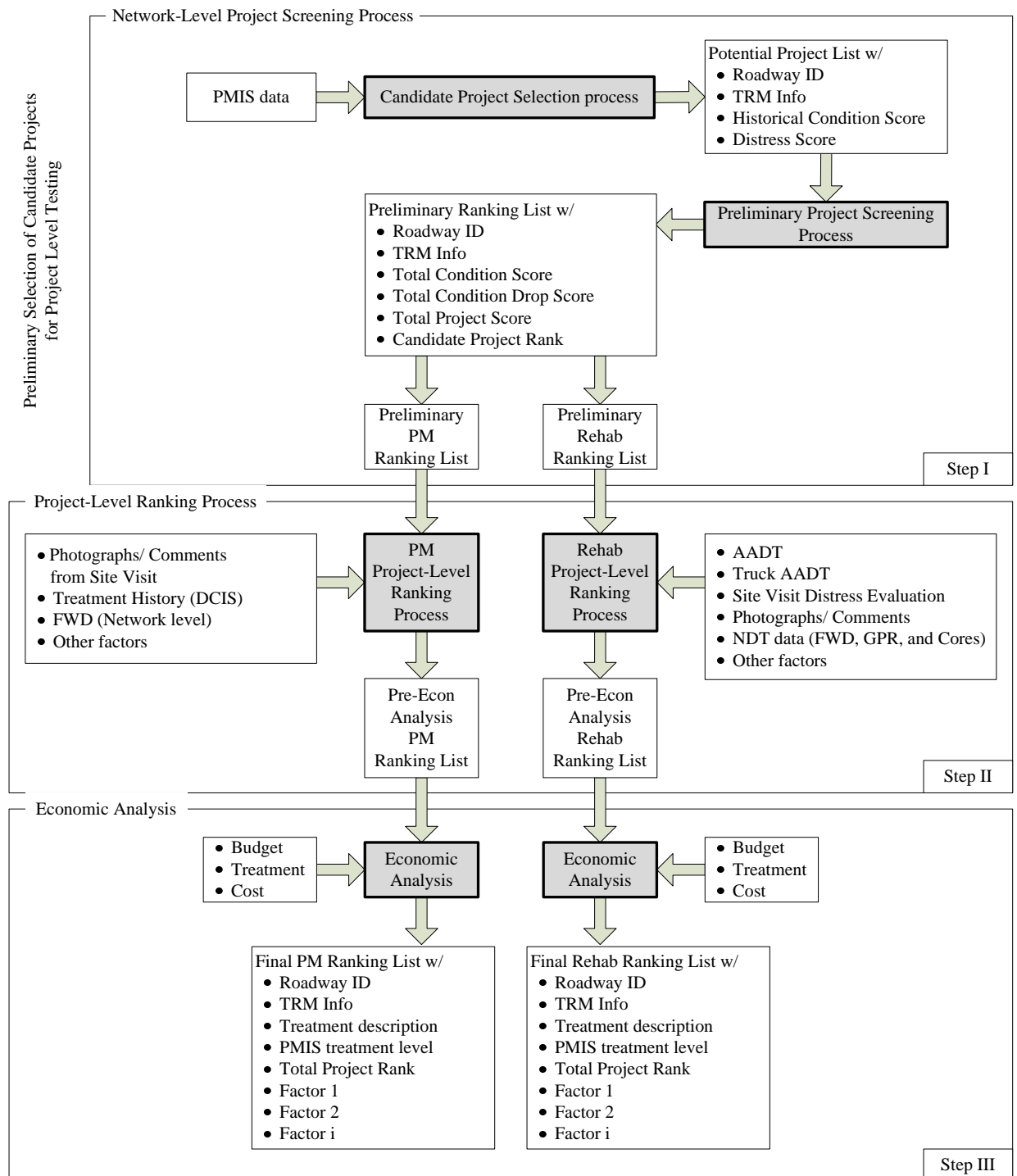


Figure 1. Recommended 4-Year PMP Development Process

Candidate projects are identified using the PMIS data and various data analysis, mapping, and reporting tools. A list of prioritized, candidate projects is identified by the District pavement engineer, area engineers, and maintenance supervisors based on PMIS data, field visits to candidate project sites, and additional information about local conditions. The additional information includes safety investigations and the potential increased pavement life consumption due to impacts of heavy truck operations associated with the energy and construction industries, agriculture, local land development, and NAFTA trade. The candidate list of projects is reviewed and prioritized by the District Engineer and members of his/her management team, including maintenance, construction, operations, traffic, safety, planning, and design. The District also coordinates planned projects with metropolitan planning organizations, counties, and cities. Projects are then programmed and assigned to either the current or a future plan year depending on safety issues and crash history, traffic volumes, anticipated pavement deterioration rates, available funding, and District/statewide condition score goals. Pavement needs always exceed available pavement maintenance budgets. This requires that more thorough project-level assessments and a benefit/cost analysis is conducted for each planned project as outlined in Steps II and III.

In **Step II, Project-Level Ranking Process**, projects in the early years of the plan are selected for detailed project-level field investigation and testing. TxDOT non-destruction testing equipment—including the falling weight deflectometer (FWD), ground penetrating radar (GPR), profiler/rutbar vans, pavement coring, geotechnical investigations, material sampling, laboratory testing, and other means—is obtained to determine the cause(s) of the distresses. This information is also used to help define the final project limits and to identify potential treatment strategies, including lower cost routine or preventive maintenance or more expensive light, medium, or heavy rehabilitation. A lower cost, light preventive maintenance treatment (such as a seal coat) improves skid resistance and can extend pavement life, but does not improve pavement structural conditions. Rehabilitation treatments involve more extensive work, which may involve construction of the thick ACP overlay, removal and replacement of pavement layers, or complete reconstruction of the pavement. The project-level investigation also helps determine whether a project can be delayed or requires immediate attention.

In **Step III, Economic Analysis**, a benefit/cost analysis is performed to determine the relationships between treating selected projects in relation to the increased costs and loss of condition if a project is delayed. Budget constraints are a primary factor in determining the best strategy for maintaining and potentially improving pavement condition scores while addressing immediate concerns associated with safety, public input, and other factors.

Pavement Condition and Needs Analysis Process for 4-Year Pavement Management Plans

The condition analysis of existing pavements for the 4-year plans is based on historical data from PMIS and the 4-year plans submitted by the TxDOT Districts. Using the PMIS data, proposed treatment strategies in the 4-year plans, and the calibrated pavement deterioration analysis system developed by the Center for Transportation Research (CTR) at The University of Texas at Austin, the “Good” or better percentage of the pavement network for the base year is first calculated. Then the change in “Good” or better percentage resulted from pavement

deterioration from the base year to a future year is computed. The predicted condition (in terms of ride and distress) of a pavement section for a future year due to pavement deterioration, when combined with the gain from a treatment (if any) proposed in the 4-year plans, yields the future condition of the pavement section.

The base-year “Good” or better percentage is compared with a pre-defined scenario goal to obtain the difference between the base-year “Good” or better percentage and the defined goal to reach for the pavement network. This difference can then be used to determine the maintenance and rehabilitation (M&R) projects required for the base year. Finally, combining unit cost information with the required M&R projects produces the base-year pavement needs in dollars. This process continues as a loop for the whole analysis period from the base year to the ending year of the analysis period, yielding the pavement needs for each individual year and the total pavement needs for the analysis period. The overall analysis procedure is illustrated in Figure 2.

Following are some basic assumptions for the pavement condition and needs analysis: 1) only state-maintained highways are considered; 2) toll-roads, such as the Trans-Texas Corridor, are self-sustainable; 3) costs include not only the pavement materials but also other costs that are required to deliver the pavement as a completed project; 4) truck size and weight remain unchanged over the analysis period; 5) a PM, LRhb, or MRhb project improves conditions the same fiscal year as programmed in the 4-year plan; HRhb projects are assumed to take longer to complete and do not improve pavement conditions until 1 year after the programmed year; 6) the PMIS rules for condition score improvement are used to determine the impact of each treatment on the forecast condition scores. The PMIS rules for treatment condition score improvements include the following:

- a. PM treatments reset Distress Score to 95 and improve Ride Score by 0.5 Serviceability Index Units;
- b. Light Rehabilitation treatments reset Distress Score to 100 and improve the ride score by 1.5 Serviceability Index units;
- c. Medium and Heavy Rehabilitation treatments both have the same impact on pavement Conditions. Both treatment types reset Distress Score to 100 and reset Ride Score to 4.8.

It should be noted that the forecast of future pavement conditions is based on the list of planned projects from the 4-year plans submitted to UT/CTR for analysis. Differences between the forecast condition scores and actual scores calculated in the following year can be influenced by various factors, including changes in planned project lettings and completions:

- a. The actual improvement in Ride Score associated with different treatment levels can introduce variations between the forecast condition improvements and improvements actually achieved at the project and network levels.
- b. The UT/CTR forecast condition scores are based on project treatment types and the completion year shown in the 4-year plans. Acceleration or delay of planned project completions or changes in project scope can introduce variations between the forecast and actual condition scores.

- c. Variations in the planned and actual number of miles of treatments completed can introduce variations between forecast and actual condition scores. Short-term changes in construction letting costs might result in either more or fewer lane-miles of pavement treatments than originally planned.

- d. Routine or preventive maintenance treatments may provide a short-term improvement in pavement conditions by covering distresses that cannot be seen by a PMIS visual rater.

These thin treatments do not address deep pavement problems that may result in shortened maintenance treatment life and accelerated reduction in network conditions in future years. However, a District may consciously decide to apply a thin PM treatment as a temporary solution until a more expensive rehabilitation can be programmed.

- e. Differences in how Districts assign the four network-level definitions of Preventive Maintenance, Light, Medium, and Heavy Rehabilitation treatments to a project may occur considering the much larger variety and greater complexity of project-level treatment strategies. These differences can introduce variations in the amount of condition score improvement assigned to a project during the condition score forecast analysis and improvements actually achieved in the field.

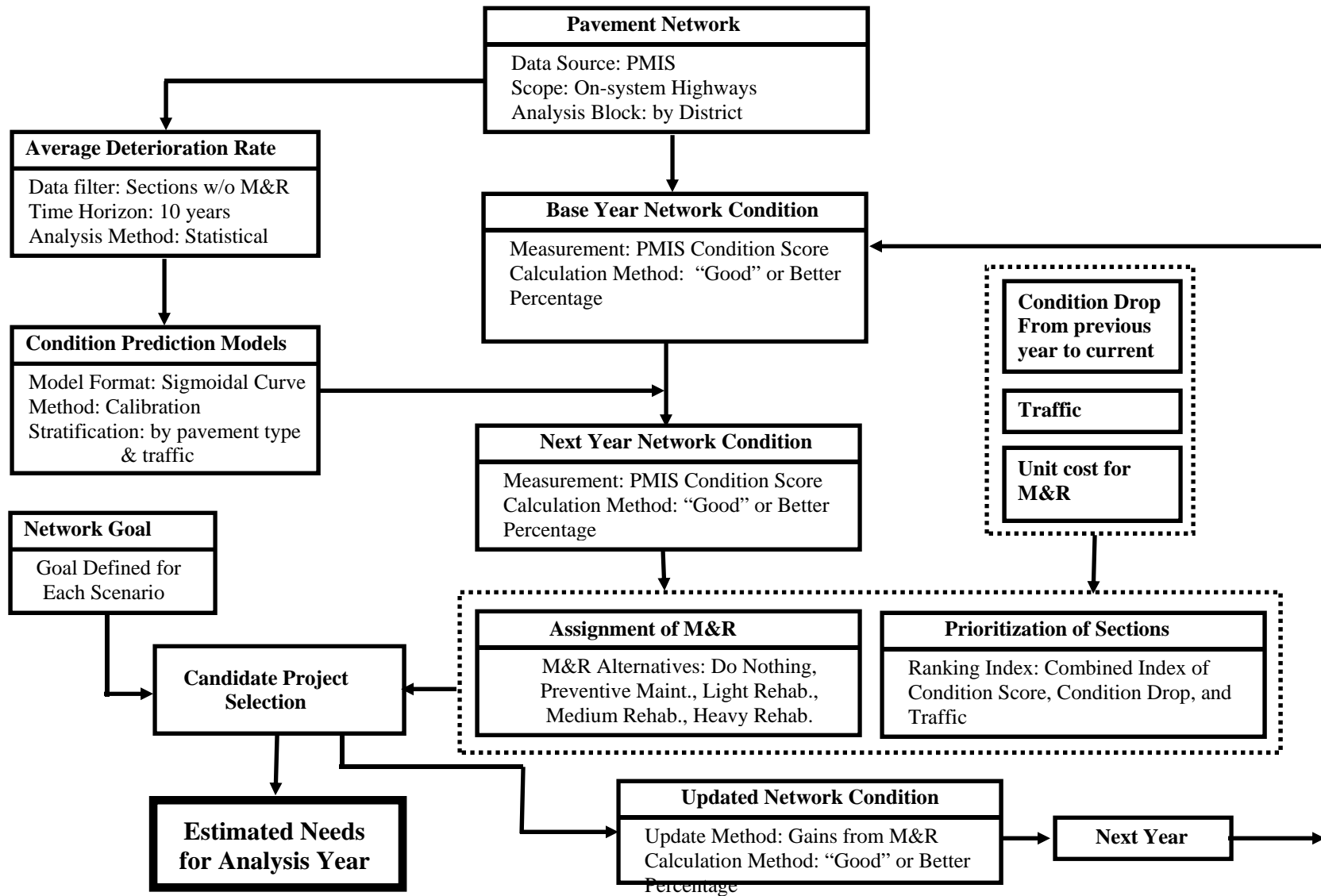


Figure 2. Methodological Framework for the Condition and Needs Analysis of Existing Pavements