Appendix E

Summary of Bridge and Pavement Program Minimum Standards Compliance

Section 515.17 of the Final Rule for developing a Transportation Asset Management Plan (TAMP) identifies the documentation requirements for pavement and bridge management system used for developing and implementing asset management plans.

Bridge and pavement management systems shall include, at a minimum, documented procedures for:

1. ***Collecting, processing, storing, and updating inventory and condition data for all NHS pavement and bridge assets.***
2. ***Forecasting deterioration for all NHS pavement and bridge assets;***
3. ***Determining the benefit-cost over the life cycle of assets to evaluate alternative actions (including no action decisions), for managing the condition of NHS pavement and bridge assets;***
4. ***Identify short- and long-term budget needs for managing the condition of all NHS pavement and bridge assets;***
5. ***Determining the strategies for identifying potential NHS pavement and bridge projects that maximize overall program benefits within the financial constraints; and***
6. ***Recommending programs and implementing schedules to manage the condition of NHS pavement and bridge assets within policy and budget constraints.***

The following summaries were provided by the ODOT Bridge and Pavement Units to document existing procedures for the agency's bridge and pavement management systems

ODOT Bridge Program Management System Summary

• **Collecting, processing, storing, and updating inventory and condition data for all NHS bridge assets**	*Monitoring bridge conditions and associated inspection activities falls under the responsibility of the Bridge Section, specifically the Bridge Operations and Standards and Bridge Program units. Bridge inspection guidance is provided in the following documents:* 1. *Bridge Inspection Coding Guide* 2. *Bridge Inspection Program Manual* 3. *Bridge Inspector's Reference Manual* *Bridge inspections are conducted at regular intervals, usually every two years. Inspection data is collected by certified bridge inspectors employed by ODOT and by consultants and is stored in the AASHTOWare Bridge Management software (BrM). A compilation of data is reported annually to the Federal Highway Administration.* *ODOT follows the National Bridge Inspection Standards (NBIS),which are federal regulations establishing requirements for inspection procedures, frequency of inspections, qualifications of personnel, inspection reports, and preparation and maintenance of a State Bridge Inventory. The NBIS apply to all structures defined as bridges located on all public roads. By meeting the requirements of the NBIS satisfies the requirement to collect, process, store, and update the inventory and condition data for all NHS bridge assets.*
• **Forecasting deterioration for all NHS bridge assets**	*ODOT is fortunate to have over 20 years of condition data for many of the NHS bridges stored in BrM to aid in condition forecasting and bridge management. Currently, condition projections are made using deterioration models developed internally based on trends of the condition ratings over the period of the records.*
• **Determining the benefit-cost over the life cycle of assets to evaluate alternative actions (including no action decisions), for managing the condition of NHS bridge assets**	*Not currently being done as part of asset management. Alternative actions are evaluated by first cost and estimated increase in service life during the preliminary design stage.*
• **Identify short- and long-term budget needs for managing the condition of all NHS bridge**	*ODOT has prepared program level models that predict the condition of bridges as represented in ODOT and national performance measures that consider various levels of funding to help inform the budget setting process.*

assets	
• **Determining the strategies for identifying potential NHS bridge projects that maximize overall program benefits within the financial constraints**	*The Bridge Program follows ODOT Highway Management Team established criteria for identifying priority bridges and optimizing bridge program funds. The strategies are listed below:* • *Ensure the protection of high value coastal, historic and major river crossings and border structures.* • *Use Practical Design and fund only basic bridge rehabilitations and rare replacements.* • *Focus bridge program funding on bridge work only.* • *Give priority to maintaining Fix-It corridor bridges which incorporate the highest priority freight corridors (OTIA III, Stages 1-3).* • *Continue to maximize bridge preventive maintenance (PM) treatments to extend the service life of the deck and other structural components using Major Bridge Maintenance (MBM) funding.* • *Leverage other programs where possible to do additional bridge preservation on the system, E.g. pavements program.* • *Continue use of bridge inspection, health monitoring and improved deterioration prediction methods to anticipate future bridge conditions.* • *Ready additional bridge shelf projects in anticipation of program savings and/or new funding opportunities.*
• **Recommending programs and implementing schedules to manage the condition of NHS bridge assets within policy and budget constraints**	*Future analyses will be done using the updated version of BrM (5.2.3) scheduled to be implemented at ODOT in early 2018. The new software includes enhanced deterioration modeling and project/program analyses to assist in program optimization including life cycle planning and short and long-term budget needs for alternative programs. ODOT will be developing processes and documentation around bridge planning as the new software is implemented.*

ODOT Pavement Program Management System Summary

• **Collecting, processing, storing, and updating inventory and condition data for all NHS pavement assets**	*Inventory data for the entire NHS, both state and local, is managed and maintained by the Roadway Inventory and Classification Services (RICS) Unit in ODOT's Transportation Development Division. Inventory data is stored in the corporate "TransInfo" data base including elements such as highway name and numbering, Linear Reference System (LRS) identification, jurisdiction, NHS status, functional classification, mileage, number of lanes, and structure type. These data elements are collected and updated regularly by TDD staff in accordance with standard operating procedures for all of the NHS including the local system. Pavement specific data such as surface type and condition data for pavement asset management and HPMS reporting is the responsibility of the Pavement Services Unit within the ODOT's Highway Division. The Pavement Services Unit maintains this data in the Pavement Management database.* *Pavement condition data for all Interstate and NHS routes on both state and local jurisdiction are collected by a single data collection vendor, under contract with ODOT, to ensure the data obtained is consistent and accurate. Interstate conditions are collected annually and the remaining systems are collected every two years. Data collection is performed in accordance with the ODOT Pavement Data Collection Manual, the HPMS Field Manual, and applicable AASHTO standards and is subjected to quality control / quality assurance procedures in accordance with ODOT's Pavement Data Quality Management Plan. A final copy of all 0.10 mile pavement data is archived and stored in the Pavement Management database and is used to create the HPMS pavement dataset which is processed and formatted in accordance with HPMS requirements.*
• **Forecasting deterioration for all NHS pavement assets**	*Oregon has collected pavement distress and roughness data on state jurisdiction Interstate and NHS highways for over 20 years. ODOT's PMS uses a 0 to 100 scale Overall Condition Index based on quantity and severity of distress to categorize and report pavement condition and to manage the system. More information is available in ODOT's Pavement Condition Report. Deterioration models using ODOT's Pavement Condition methodology are considered most appropriate for network pavement management activities and are the primary means for analyzing and managing highway pavement conditions on the state highway system including the NHS. Forecast pavement conditions for each pavement management section are used to determine pavement needs, evaluate funding scenarios, trigger pavement preservation and rehabilitation projects, and determine regional funding allocations. The forecasting takes committed (e.g. programmed) projects that have an impact on pavement conditions into account.*

	Pavement deterioration models use a family curve approach as described in Section 5.4 to 5.6 of the AASHTO Pavement Management Guide. The family curves are based on pavement type (e.g. asphalt, concrete), most recent wearing course and thickness, and traffic volume. The family curve is shifted to fit the most recent observed conditions to estimate the remaining number of years in fair or better condition for each pavement management section. Age based models and rutting models are also applied to the pavement management sections and the results are compared and the model with the lowest remaining number of years in fair or better condition is used for forecasting condition. The age-based models are based on the pavement design life or the best estimate of treatment life and primarily govern in the early years after a treatment is applied before there is adequate condition data to determine a reliable deterioration rate. After a few years of deterioration are reflected in conditions, the shifted family curve model is used. On routes which routinely see high wear and winter damage resulting from chain and studded tire wear, the rutting models typically govern.
• **Determining the benefit-cost over the life cycle of assets to evaluate alternative actions (including no action decisions), for managing the condition of NHS pavement assets**	*The goal of the ODOT pavement preservation program is to keep highways in the best condition possible with available funding, by taking a life-cycle cost approach to preservation and maintenance. A variety of treatment options are available in the 'toolbox' to maintain pavements on the NHS. The treatments range from maintenance activities such as crack sealing and minor patching to full reconstruction. Pavement condition, traffic level, cost, service life, risk, and other factors are all considered to determine the most appropriate treatment on a given highway section.* *The Pavement Management System tracks pavement conditions as well as treatment history on state highways to evaluate the effect of these treatments on condition and service life. Cost data from pavement preservation projects are also tracked so that service life versus cost comparisons can be made between different treatment options. Pavement project and work type selection includes a cost effectiveness component in the selection criteria in the form of dollars per lane mile-year ($/LM-year). This parameter is utilized as a benefit-cost measure and is proportional to a more traditional benefit-cost calculation using area under the performance curve; the lower the $/LM-year parameter, the higher the benefit-cost. Project selection also considers route classification, traffic level, and speed. Each of these factors impacts the benefit side of the equation when pavement projects are selected. Projects on higher classification routes and where traffic volumes and speeds are relatively higher impact more users and provide more benefit than less critical locations. This is accounted for in preservation program funding allocations and project selection through the use of appropriate weighting factors.* *Alternative treatment strategies can be compared using life cycle cost analysis (LCCA). Chapter 7 of the ODOT Pavement Design Guide provides LCCA guidance. The treatment strategies, timing, and cost should be as realistic as possible based on actual pavement management data. Both alternatives should provide similar levels of service (e.g. remain in "fair" or better condition) throughout the analysis period so that both alternatives have similar benefits. The analysis period should be of sufficient length to capture resurfacing/rehabilitation for both alternatives (a minimum of 30 years is suggested) and both alternatives should include salvage value at the end of the analysis period. Comparisons should be based on equivalent uniform annual cost (EUAC). A sensitivity analysis to the LCCA inputs should be conducted to evaluate inputs used.*
• **Identify short- and long-term budget needs for managing the condition of all NHS pavement assets**	*There are no specific definitions of short-term and long-term included in § 515.17. The Performance Measure rule which complements the TAMP rule use a 4-year time horizon for performance targets and measures. This timeline is consistent with the approved STIP but is shorter than the STIP development planning horizon which has a lag of about 6 to 8 years between data collection and project delivery. The TAMP financial plan requires a minimum time horizon of 10 years. This matches ODOT's standard PMS practice which uses an analysis period that goes one STIP cycle beyond the programming period to better capture long-term trends and needs. For example, the 2021-2024 programming cycle which began in 2017 used data collected in 2016 to estimate pavement conditions and budget needs out to 2026. Although project selection and programming only go out to 2024, the budget needs in the outer years helps identify longer range issues that may require adjustments to future programs. ODOT's Chip Seal subprogram in the Fix-It Preservation program and the Maintenance pavement programs use a timeline of about 2 to 3 years between data and delivery. Once again, for these subprograms, standard ODOT PMS practice is to use the shorter time horizon for project selection and go one cycle beyond for planning and long-term budgeting purposes.* *Budget needs estimates are determined at the network level by evaluating the treatment needs and costs for each pavement management section and summing up the results for the entire NHS network. Within the PMS, highway jurisdiction, route classification, traffic level, geography and climate, urban/rural, construction history, age, forecasted pavement condition, treatment cost and service life are the primary decision tree factors in determining the treatment required for each PMS section. At the network level, treatments are typically assigned using treatment categories rather than specific treatments and planning*

	level cost estimates are determined from unit cost data for pavement projects typically on the basis of dollars per lane mile. More refined project level treatment and cost estimates are developed during scoping for priority sections (e.g. 150% list). Lane-mile weighted average unit cost factors appropriate for treatment type, route (interstate/non-interstate), urban/rural, and region are inflated to the year the treatment is to be applied. *Most of the NHS mileage is state highway jurisdiction and only approximately 6 percent is on the local NHS system. Since the local NHS system is such a small part of the overall system and pavement management decisions on the local NHS highway system are not under ODOT's control, total NHS needs are estimated by analyzing NHS state highways and adding an appropriate increase factor for the local NHS system. Since much of the local NHS is in urban locations where resurfacing costs are higher, even though the local NHS is only 6% of the mileage, in terms of resurfacing cost, it represents about 8% of the total overall NHS funding need.* *A check on long-term needs can be made using the FHWA's quick checkup tool on their pavement preservation website. For the Interstate and NHS highway system, approximately 12,100 lane mile-years of life is lost due to deterioration annually. For long-term pavement health, an equivalent number of 12,100 lane mile-years of pavement repair work must be put back into the system to offset this deterioration. This is best accomplished by programming an appropriate mix of preventive pavement maintenance, preservation and rehabilitation projects.* *Annual rehabilitation and resurfacing mileage needs for the NHS highway network can be approximated by dividing the number of lane miles by the typical life span of resurfacing and rehabilitation treatments and factoring in maintenance treatments to extend life where appropriate. The NHS highway network has a mix of different pavement types with different pavement condition levels, treatments required, and different life spans. Based on Pavement Management data, treatment cycles and appropriate treatments unit costs to maintain a sustainable "steady state" program can be determined to estimate annual needs.* *About 92% of the NHS highway network is asphalt surfaced. Resurfacing or rehabilitation treatments on asphalt surfaced pavements last about 10 to 20 years before another one is required, depending on traffic, environmental conditions, resurfacing thickness, and maintenance practices. Seal coat treatments such as chip seals can extend the resurface interval to 25 years or more on some low and moderate traffic asphalt surfaced roads by providing a barrier against the harmful effects of moisture, aging, and traffic. Some asphalt surfaced pavements are too damaged to cost effectively rehabilitate and must be reconstructed. The remaining 8% of the NHS highway network is concrete pavement which typically needs resurfacing or replacement after 30 to 50 years of service.*
• **Determining the strategies for identifying potential NHS pavement projects that maximize overall program benefits within the financial constraints**	*For state highways, the pavement strategy uses a tiered approach to prioritize highway routes and also includes dedicated funding programs for the most cost-effective maintenance treatments, preservation resurfacing and rehabilitation, and reactive pavement patching.* *State highway pavement conditions are prioritized by state highway classification into four levels, 1) Interstate highways are the highest priority, have the highest condition targets, and the highest level of investment, 2) Fix-It priority routes like US-97, OR-58, or US-26 are the next highest priority, followed by 3) remaining State level NHS routes like US-101, followed by 4) Region and district level routes like OR 99E or OR 214.* *Since it is more cost effective over the long run to do low cost thin resurfacing and seal treatments on pavements with only minor deterioration than to employ a "worst first" approach, dedicated funding subprograms are provided to preventive maintenance and seal coat projects in both the STIP and Maintenance budgets based on needs as determined by PMS analysis.* *Pavement Management decision trees are used to determine candidate project lists for all pavement seal coat, resurfacing and rehabilitation projects. By policy, the state highway network is broken up by traffic volume and truck traffic loading so that the Interstate and most of the NHS pavement projects are delivered with STIP funds through the Fix-It Preservation Program while projects on lower traffic volumes state highways are delivered with Maintenance funds. As explained in the Budget Needs section above, a decision tree process is used to estimate treatment needs and costs. Because there are differing design standards and delivery options for the STIP and Maintenance programs, there are separate decision tree processes for each subnetwork.* *The PMS seal coat decision trees use age and forecasted pavement conditions to determine chip seal and microsurfacing needs within the appropriate analysis period. The decision tree is used to initially time the treatment and then packaging and bundling opportunities are explored when developing project lists. A revolving 4-6 year planning horizon is used where project selections are made about 2 to 3 years ahead of treatment and program funds are budgeted for the next cycle based on likely candidates from the PMS.*

	The funding levels for chip seal are set to allow all projects with a good chance of success and return on investment as determined by LCCA to be programmed. *STIP Fix-It resurfacing projects are prioritized by a cost effectiveness weighting factor in terms of $/LM-year. Total vehicle and truck traffic volumes, risk of treatment delay to maintenance and repair cost, pavement program manager priority, and regional priority are also accounted for in project prioritization through the use of weighting factors. The prioritization process is used to hone down the candidate list to a list which is approximately 150% of the available budget (e.g. 150% list).* *The following guiding principles are considered when making decisions about allocating pavement dollars and selecting projects.* • *Prioritize pavement condition by route classification, from a state level perspective.* • *Provide consistent, stable, and adequately funded allocations to preventive maintenance and seal coat treatments.* • *Prioritize treatments and projects which provide higher pavement service life for funds expended (e.g. $/lane mile-year).* • *Prioritize projects where poor pavement surface condition poses an increased safety risk.* • *Favor projects with higher speeds and higher traffic volumes where user costs are more negatively impacted by rough road conditions.* • *Favor projects requiring significant maintenance expense to save on maintenance costs.* • *Distribute projects across all parts of the state to balance pavement conditions geographically.* • *If substantial increases in pavement funds become available, allocate a portion to rehabilitate urban and lower volume highways that are in poor to very poor condition to help reduce deferred backlog.*
• **Recommending programs and implementing schedules to manage the condition of NHS pavement assets within policy and budget constraints**	*Pavement Management System data and analyses are integrated into ODOT's pavement strategy, which is overseen by an interdisciplinary Pavement Committee steering team that includes state pavement representation, traffic/roadway, construction, region and area managers, and maintenance. This steering team meets regularly and sets the overall strategy and policy direction for the pavement programs based on Pavement Management analysis. The team manages the financial plans for the Interstate preservation program, the HB2017 funded preservation program, and the chip seal program, and also determines funding allocations to the interstate and regional paving and chip seal programs.* *Overall funding levels for ODOT's Fix-It Preservation program are established each STIP update cycle, typically every 2 to 3 years, at ODOT's executive level and are informed by the PMS which forecasts the impacts of different investment levels on pavement conditions. Program funds are then allocated to the Interstate, regional NHS and non-NHS state highway resurfacing, and chip seal subprograms using PMS data and analysis.* *Interstate – Interstate highways are the highest priority in ODOT's pavement investment strategy and the funding allocation is set before any other subprogram by running a 10 year analysis (typically one STIP cycle beyond the one being planned) of interstate treatment needs and conditions and setting funding levels to maintain pavement long-term conditions above 95% "fair" or better using ODOT's condition measure which also assures compliance with the National performance measure of no more than 5% poor Generally, one-third to one-half of total program funds are allocated to Interstate preservation projects. Stand-alone interstate sign replacement projects funded at $2 million per year to do sign replacement projects on a corridor approach so that replacement occurs on a recurring cyclical basis. Another $3 million per year goes to the Major Interstate Maintenance (MIM) subprogram for local pavement repair projects on the Interstate. The intent of MIM is to do maintenance work beyond what normal crew patching budget can cover that will prolong the life of the pavement and maximize the time interval before a larger scale interstate preservation project becomes necessary. The ideal project would be one where there are relatively small sections of poor pavement within a section of relatively good pavement where fixing the small section of poor would extend the life of the entire section. MIM projects are selected from a District solicitation / Headquarters field review / Pavement Committee approval process.* *NHS State Highways – Most NHS state highways are funded from the Fix-It Preservation Program although projects on some lower volume NHS state highways are funded from the Maintenance program. For both programs, the PMS seal coat decision tree is applied to forecasted pavement conditions to determine chip seal and microsurfacing projects within the appropriate analysis period. Funding levels for the Fix-It Chip Seal subprogram have historically been roughly $5 million per year while the Maintenance Low Volume program historically adds another $2 to $3 million annually on lower volume NHS state highways. Remaining program funds are allocated to the state highway system for pavement resurfacing projects using an allocation formula that forecasts pavement conditions in each region one STIP cycle ahead (typically 8 to 10 years from data collection) and compares them to target levels by state highway*

	classification. From this, funding needs to reach target levels in each region are determined and the resulting percentages are pro-rated to funds available. *Pavement Management data and analysis are also incorporated into the Maintenance program budgeting process every biennium. Within the Maintenance budget there are two dedicated pavement funding line items – Low Volume and Pave Patch. Funding levels and district allocations for both of these programs are established each biennium (2 year cycle) within Maintenance as part of their normal budgeting process and are informed by PMS data. The Low Volume Program is budgeted to hold pavement conditions on low volume state highways with mostly chip seals and patching. Budget levels are periodically adjusted based on pavement condition trends. Funds are allocated to the districts in proportion to lane-miles. Starting with the 19-21 biennium, the budget was increased by about 15% to apply resurfacing overlays to priority locations with extensive deterioration and/or high risk of failure. The Maintenance Leadership Team selects the locations for resurfacing based on recommendations from Pavement Management. The overall budget for Pave Patch is informed by the PMS by monitoring historic and forecast pavement conditions, and adjusting as needed. The Pave Patch district splits are based on a formula incorporating lane miles, pavement condition, and traffic level.* *Local NHS – Although local NHS inventory and conditions are included in ODOT's PMS and budget needs for local NHS projects can be reasonably estimated, ODOT does not identify potential projects on the local NHS. Pavement management and project selection on the local NHS falls under the responsibility of each local agency with NHS routes under their jurisdiction. The HB2017 transportation bill now requires all local agencies to report pavement conditions on all federal aid highways under their jurisdiction to receive state funding. This reporting requirement was newly implemented in 2019. Over time, this information should allow strengthened ties to local system PMS management strategies on the NHS.*