TRANSPORTATION ASSET MANAGEMENT PLAN 2023

UTAH DEPARTMENT OF TRANSPORTATION

UDOT Keeping Utah Moving

2023

State of Utah

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Executive Summary

THE UTAH DEPARTMENT OF TRANSPORTATION AND ITS STAKEHOLDERS HAVE TAKEN A COLLABORATIVE APPROACH IN ESTABLISHING A TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP) THAT PROVIDES FOR THE PRESERVATION OF OUR ASSETS BASED ON ESTABLISHED PERFORMANCE MEASURES THAT ALIGN WITH OUR STRATEGIC GOALS AND ENSURE EFFICIENT USE OF TAXPAYER DOLLARS.

This TAMP presents performance and risk-based investment strategies for cost-effective management of our critical transportation system assets to remain in a state of good repair. This document includes links to UDOT's dashboard where live data is used to ensure targets are being met and investments support UDOT's Strategic Direction and infrastructure health index.

Carlos Braceras
UDOT Executive Director

UDOT Keeping Utah Moving

TAMP 2023

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UDOT has adopted the outcomes in the Utah quality of life framework as the goals for transportation planning.

Figure 1. Utah Quality of Life Framework.

Preserve infrastructure is a foundational objective for the better mobility goal in the quality of life framework and a goal within the UDOT Strategic Direction. The Utah Transportation Asset Management Plan (TAMP) establishes the processes and structure to support long-term preservation of transportation infrastructure across the state.

Objectives of the Utah Transportation Asset Management Plan (TAMP)

- Formalize a data-driven, performance-based approach for allocating transportation funds to manage pavements, bridges, traffic signals, pavement striping, and ITS devices.
- Formalize data-driven processes for managing other UDOT transportation assets.
- Incorporate asset management into the intermediate and long-range planning processes.
- Incorporate risk management into resource-allocation decisions.
- Provide a valuable asset-management tool with dynamic data connections.

UDOT TAMP Principles

- Preserve infrastructure is the foundation for the mobility and safety goals.
- Data are gathered in a cost-effective manner.
- Asset management is policy driven.
- Decisions are data-driven.
- Asset management is performance- and risk-based.

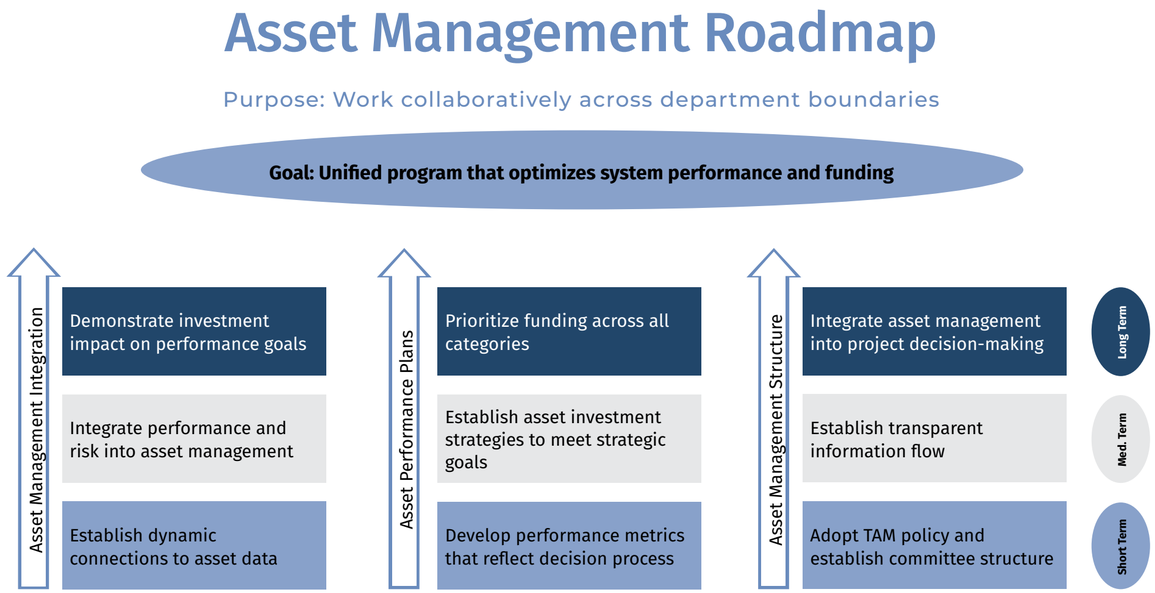
Roadmap to a Comprehensive Plan for Asset Management

To move forward as a performance-based organization and build upon UDOT's original TAMP, the roadmap has been updated to detail areas of focus and objectives for short, medium, and long-term time frames.

These three focus areas create the framework for the Utah TAMP and organizational structure. Objectives for each of the areas of focus within the roadmap are shown in Figure 2.

The UDOT vision for asset management is to work collaboratively across UDOT divisions to develop a unified program that maximizes system performance and funding and puts into place a process to quantify risks to assets in the UDOT system. The initial oversight committees identified and approved objectives for the purpose of continuous improvement of asset management within UDOT. Each of the UDOT divisions and committees are working separately and collectively to fulfill the objectives and tasks needed to complete the roadmap.

Figure 2. Asset Management Roadmap.



Asset Register

In addition to pavements and bridges, UDOT maintains registers of many roadway assets with the data from routine LiDAR scanning and in-person inventories of the state highways. These registers are used to track the quantity and some condition information of each UDOT asset. UDOT also maintains an extensive database of current unit bid item costs compiled from the advertisement of new construction projects. This database is used to establish the replacement value of the quantified assets. Additional sources of information are referenced to establish values for specialty items that are not in the database. In addition to the replacement value of each asset, costs are estimated to account for design, construction oversight, traffic control, and mobilization costs. The presently quantified assets and their values are shown in Table 1.

Asset Management Tiers

TIER 1
PERFORMANCE-BASED MANAGEMENT

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Assets in the Tier 1 management level are generally those of higher value combined with higher programmatic risk. These are assets that are very important to the success of the UDOT performance plan. Management plans for Tier 1 assets include elements such as:

- Performance forecasting
- Known cost to maintain assets
- Performance targets
- Life cycle/ deterioration curves
- Accurate inventory
- Accurate asset condition data

TIER 2
CONDITION-BASED MANAGEMENT

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Assets in the Tier 2 management level are generally of moderate value and moderate programmatic risk. Management plans for Tier 2 assets include elements such as:

- Condition targets
- Life cycle costs
- Accurate inventory
- Accurate asset condition data

TIER 3
REACTIVE MANAGEMENT

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Assets in the Tier 3 management level are generally those of lower value with lower programmatic risk. Management plans for Tier 3 assets include elements such as:

- Inventory data
- General condition data

To accomplish the objective of preserving transportation infrastructure in the most cost-effective manner, a tiered system of asset management was developed. There are three tiers into which assets are categorized. Tier 1 is the most extensive management plan for the higher-value, higher-risk assets. Each tier has a different management focus depending on a combination of value, risk, and impact to strategic goals. Figure 3 lists the tier assignment for each transportation asset.

Figure 3. Asset Management Tiers.

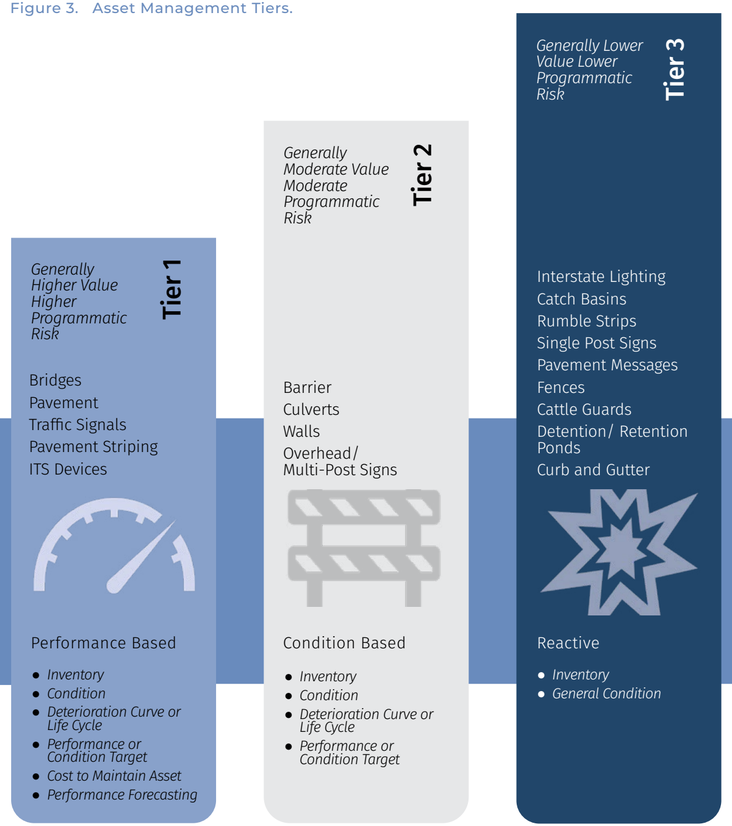


Table 1. Asset Tier Requirements

Tiers	Assets	Inventory	Condition	Deterioration Curve or Life Cycle	Performance or Condition Target	Cost to Maintain Asset	Performance Forecasting
Tier 1	Bridge	Yes	Yes	Yes	Yes	Yes	Partial
	Pavement	Yes	Yes	Yes	Yes	Yes	Yes
	Traffic Signals	Yes	Partial	Partial	Partial	Partial	Partial
	Pavement Striping	Yes	Partial	Yes	Yes	Yes	Partial
	ITS Devices	Yes	Partial	Partial	Partial	Partial	Partial
Tier 2	Barrier	Yes	Partial	Partial	Needed	—	—
	Culverts	Partial	Partial	Partial	Partial	—	—
	Walls	Partial	Needed	Needed	Needed	—	—
	Overhead/Multi-Post Signs	Yes	Partial	Yes	Partial	—	—
Tier 3	Interstate Lighting	Partial	Needed	—	—	—	—
	Catch Basins	Yes	Needed	—	—	—	—
	Rumble Strips	Yes	Needed	—	—	—	—
	Single Post Signs	Yes	Partial	—	—	—	—
	Pavement Messages	Yes	Needed	—	—	—	—
	Fences	Partial	Needed	—	—	—	—
	Cattle Guards	Yes	Needed	—	—	—	—
	Detention/Retention Ponds	Partial	Needed	—	—	—	—
	Curb & Gutter	Partial	Needed	—	—	—	—

Table Definitions

- **Inventory:** documented type and location
- **Condition:** key parameters to determine remaining useful life
- **Cost to Maintain Asset:** understanding cost history from the Department
- **Yes:** confident in results
- **Partial:** started, developing, testing, ongoing
- **Needed:** have not begun acquiring information or data needed

Asset Risk Management and Resilience

UDOT uses a two tiered approach to assess asset risk within the department. The first is from a programmatic perspective to help define to what level the asset will be managed. The second is at the individual asset level concentrated primarily on assessing natural hazard risk along with others discussed below which helps to prioritize the risks and associated funding. These two methodologies and their outcomes are explained below.

The first approach was the analysis of programmatic-level risks that contributed to the allocation of assets into the three management tiers as shown in Figure 3. The three tiers mirror the AASHTO TAM Guide approach with condition-based, interval-based, and reactive based management approaches. The risks used to define these tiers were selected and their values were assigned by executive leadership.

Programmatic Tier Identification

Four areas of risk to the UDOT program were defined as follows:

- **Financial:** analysis of sustainable funding for performance goals
- **Information:** availability and quality of data needed for long-term management
- **Operational:** analysis of probability of asset failure and impact to the operation of the transportation system
- **Safety:** analysis of impact to public safety in the event of asset failure or poor condition

Programmatic risk was assessed for each asset in each of the four risk areas based upon (1) the probability of the risk happening and (2) the estimated consequences. Probability and consequence were assessed separately as high, medium, or low, and a risk number was assigned based on the risk matrix shown in Table 2.

The average of all four risk numbers for each asset, equally weighted, is shown in the overall risk column. A pair-wise comparison between risks was used to develop weights for each risk and then these weights were applied, resulting in the weighted risk column. The management tier was assigned based on the weighted risk factor, monetary value of the asset, and assessment of the importance of the asset to UDOT's strategic goals.

Table 3 shows the current value and risk rankings for each of the Tier 1 and Tier 2 assets. The table shows that Tier 1 assets have the highest operational and overall risk. Performance-based management plans are well defined for the Pavement and Bridge assets and are being developed for the remaining Tier 1 assets. History has proven these management plans minimize costs and emergency repairs which reflects the department's "good roads cost less" philosophy. All four categories of risk are monitored with regularly scheduled detailed inspection and data collection for these Tier 1 assets.

Table 2. Risk Matrix.

Likelihood	Consequence		
	Low	Medium	High
High	4	7	9
Medium	2	5	8
Low	1	3	6

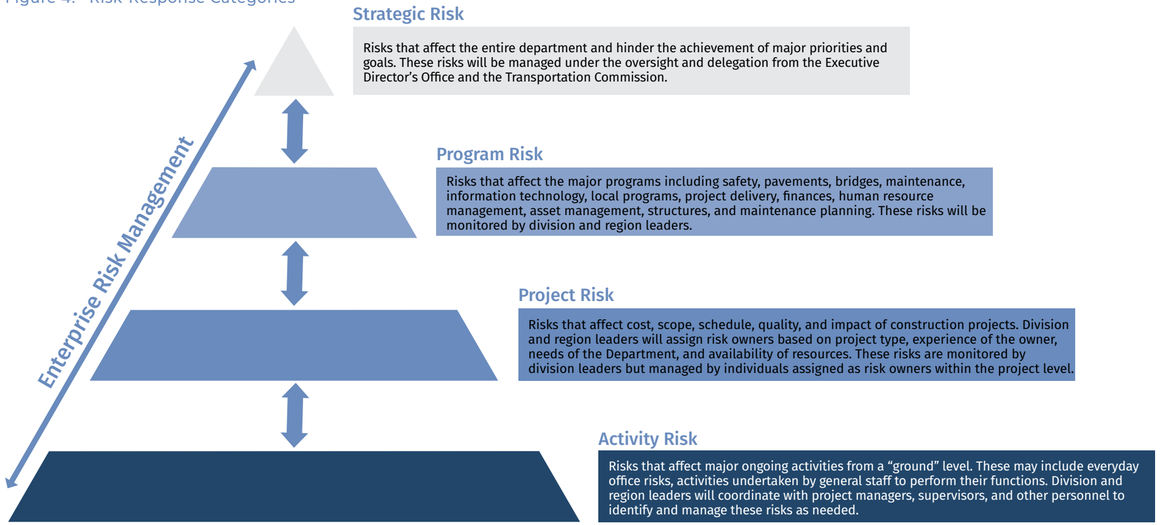
Table 3. Risk Value and Risk Rankings per Asset.

Asset	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Overall Risk	Programmatic Risk	Value	Tier
Bridges	6	6	3	8	6	7.61	$10,100M	1
Pavements	6	6	3	8	6	7.07	$28,500M	1
Traffic Signals	6	6	5	3	5.5	6.86	$331M	1
Pavement Striping	2	1	2	5	2.5	6.44	$41M	1
ITS Devices	6	6	5	3	5.5	5.28	$630M	1
Barrier	3	1	4	2	2.5	5.66	$535M	2
Culvert	6	7	5	3	5	5.02	$2,100M	2
Walls	3	3	5	3	3.5	4.71	$3,400M	2
Overhead/Multi-post Signs	7	5	3	3	4.5	4.46	$375M	2

Asset Risk Management Process

The second approach to incorporate risk management into the UDOT's decision making processes is an effort to align decisions and risk responses within the framework of the AASHTO Enterprise Risk Management (ERM) Guide. The Asset Risk Management Process below addresses the programmatic level of risk within the Department (see figure 4). This framework is being examined and evaluated to improve risk identification and responses in the decision-making process at all levels of UDOT. In addition to the four risk categories listed below, the AASHTO ERM Framework also incorporates risk categories such as natural environment, regulatory compliance, political influence, and liability to litigation or fraud. These additional risk categories are being evaluated for applicability within the organizational structure of UDOT and are being used by the UDOT Risk Management Working Group, which is a larger, more diverse committee of individuals from across the Department who meet to identify and determine risks, response strategies, and responsibility.

Figure 4. Risk-Response Categories



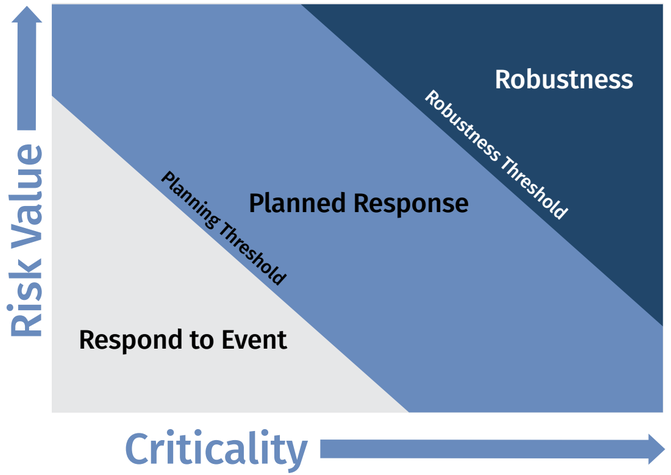
The UDOT Risk Management Working Group identifies asset risks. Currently, the primary focus of this group is to identify risks posed by extreme weather and natural-hazard events, prioritize those risks, and develop response strategies with appropriate return on investment. This includes calculating costs and probability and strategically implementing risk analysis into other UDOT decision-making processes. This model-based approach to risk management provides a consistent method of calculating and analyzing risk from extreme weather and natural hazards that can be applied at the statewide level, UDOT region level, corridor level, and project-level.

Asset risks are captured in the asset risk register are found here. Once the risks are identified, each risk is then categorized, the potential impacts of the event are evaluated, and the likelihood (probability) of the risk occurring is determined. These three factors are used to define the risk priority for each risk. Risk priority rankings are divided into the four following categories:

CRITICAL	HIGH	MEDIUM	LOW
Requires prompt action, likely at the executive management level, to implement new strategic or program level controls to treat the risk.	Affects the ability of the Department to carry out its mission or strategic plan. Existing controls may be effective but could require additional action and/or controls to be managed at the executive management level.	Impacts the completion of a critical agency function. Existing controls must be effective and possible additional actions may need to be implemented.	Managed with current practices and procedures. Impacts are dealt with by routine operations which should be monitored for effectiveness.

Each category of response is separated by a threshold. The boundaries between Robustness and Planned Response (Robustness Threshold), and Planned Response and Respond to Event (Planning Threshold) are not fully developed. It will take time and experience to establish these threshold boundaries. Currently, the risk-response category is determined for each risk analysis completed.

Figure 5. Risk-Response Categories



Resilience (as defined by FHWA in Infrastructure Investment and Jobs Act legislation) is the ability to anticipate, prepare for, or adapt to conditions or withstand, respond to, or recover rapidly from disruptions. This includes the ability to resist hazards or withstand impacts from weather events and natural disasters or to reduce the magnitude of or duration of the impacts of a disruptive weather event or natural disaster; and to have the absorptive capacity, adaptive capacity, and recoverability to decrease vulnerability to weather events and other natural disasters.

Resilience within the UDOT asset risk-management process centers upon forecasting what could happen to each asset for each potential natural disaster or weather event. Preserving assets in good or fair condition is important to creating the ability to resist or withstand the impacts of events and to reduce the magnitude or duration of impacts. Therefore, the goal of preserving infrastructure is critical to system resilience. Also critical to system resilience are the implementation of the four responses of resilience (robustness, response, resourcefulness, and redundancy) to prepare for and increase the ability to recover rapidly from disruptions.

Cross-Asset Investment Approach/Financial Plan

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UDOT relies on the federal funding process, state annual budget process, and distribution decisions by the Utah Transportation Commission for asset management funding.

The amount of funding available each year varies depending on the national and state economies and the priorities of decision-makers. Historically, UDOT receives funding primarily from three sources: (1) State Transportation Investment Fund, (2) State Transportation Fund, and (3) federal funds (Table 4). Aeronautics also provides a very small percentage of funding, which does not contribute to asset management and, therefore, is not addressed in this plan.

Funding Sources

The State Transportation Investment Fund (TIF) is derived from sales taxes on automobile-related services and makes up approximately 45% of UDOT funding. Half of this fund pays the bond for previously constructed projects and half is used to fund current capacity and mobility projects. A percentage of these funds is also designated to preserve existing infrastructure. The State Transportation Fund comes from the state portion of fuel taxes paid by individuals at the fuel pump. This fund makes up approximately 32% of UDOT funding and is primarily used to fund UDOT operations, management, maintenance, and other agencies. These funds also provide the match amount required for federal funds. The federal portion of fuel taxes makes up approximately 22% of UDOT funding and is used primarily for current pavement projects. Dollar estimates of revenue and expenditures for each of these funds for FY 2022 are shown in the table below. Further details of funding sources can be found at this link: UDOT Funding Overview.

Table 4. Revenue and Expenditures.

Estimated Revenue	
Sales Tax- 17%	$638,706,947
Sales Tax- 3.68%	$138,447,869
.Motor Vehicle Reg 1997	$31,362,125
.Motor Vehicle Reg 2009	$64,680,556
Motor Fuel Tax - Transfer from Transportation Fund	$44,985,900
Less: Sales Tax Transfer to CCTIF	$19,224,922
Less: Sales Tax Transfer to TTIF	$22,588,6958
General Funds 1x	$806,200,000
Outdoor Adventure Recreation Funds 1x	$16,200,000
Total	$1,696,769,710

Estimated Revenue	
Bond Payments	$348,729,926
Current Projects	$521,639,784
SB13 State Road Jurisdiction	$4,000,000
HB409	$16,200,000
HB3 Transportation Infrastructure	$806,200,000
Total	$1,696,769,710

Funding Need Projections

All of Utah's transportation agencies and metropolitan planning organizations (MPOs) have worked together to develop the Unified Transportation Plan (UTP). Each agency used shared growth projections, time horizons, and financial assumptions to assemble complementary regional plans that integrate seamlessly into the UTP. These agencies have worked together to develop robust financial planning based on sound technical analysis of current and future projected revenue, which can reasonably be assumed to pay for transportation needs.

Using increasingly sophisticated accounting mechanisms, Utah's UTP provides a robust, technical analysis of growth rates in forecasting the future revenue available for transportation needs in the state. This analysis assumes the increase of revenue from vehicles (registration fees), fuel consumption (fuel taxes), and general purchases (sales taxes).

These growth-rate calculations are conservative and based on historical trends from each region of the state. Calculations were coordinated closely with projections from the Governor's Office of Management and Budget and the Utah Tax Commission, with assistance from private-sector financial advisors.

For planning purposes, the UTP assumes future revenue sources, although specific mechanisms will depend on decisions by state and local elected officials. Revenue sources include statewide vehicle-registration fees, private-sector funding, and local-option taxes (which vary by MPO and county and includes additional local-option fuel taxes, local-option sales taxes, and vehicle-registration fees).

Between 2019 and 2050, the total transportation funding needs for the state totaled $108.5 billion. This includes funding needed to operate the current transportation system and keep the infrastructure in good condition (roadway and transit maintenance, preservation, and operations). It also includes the funding needed to build new roads, build new transit lines, widen existing roads, and extend transit lines (roadway and transit capacity).

Utah's transportation agencies understand that it is unreasonable to assume funding will be available for all the transportation needs in the state. Instead, the agencies have identified a prioritized set of the most critical needs at $90.9 billion (Figure 5).

Existing revenue sources currently in place to fund the UTP between 2019 and 2050 are projected to generate $74.4 billion. The UTP assumes that an additional $16.5 billion will be generated from new sources, leaving $17.6 billion as the remaining amount needed in order to fund all of Utah's prioritized transportation needs.

The Utah UTP 2015-2040 can be found on the UDOT website at this link: Utah Unified Transportation Plan.

Figure 6. Prioritized Set of Needs.

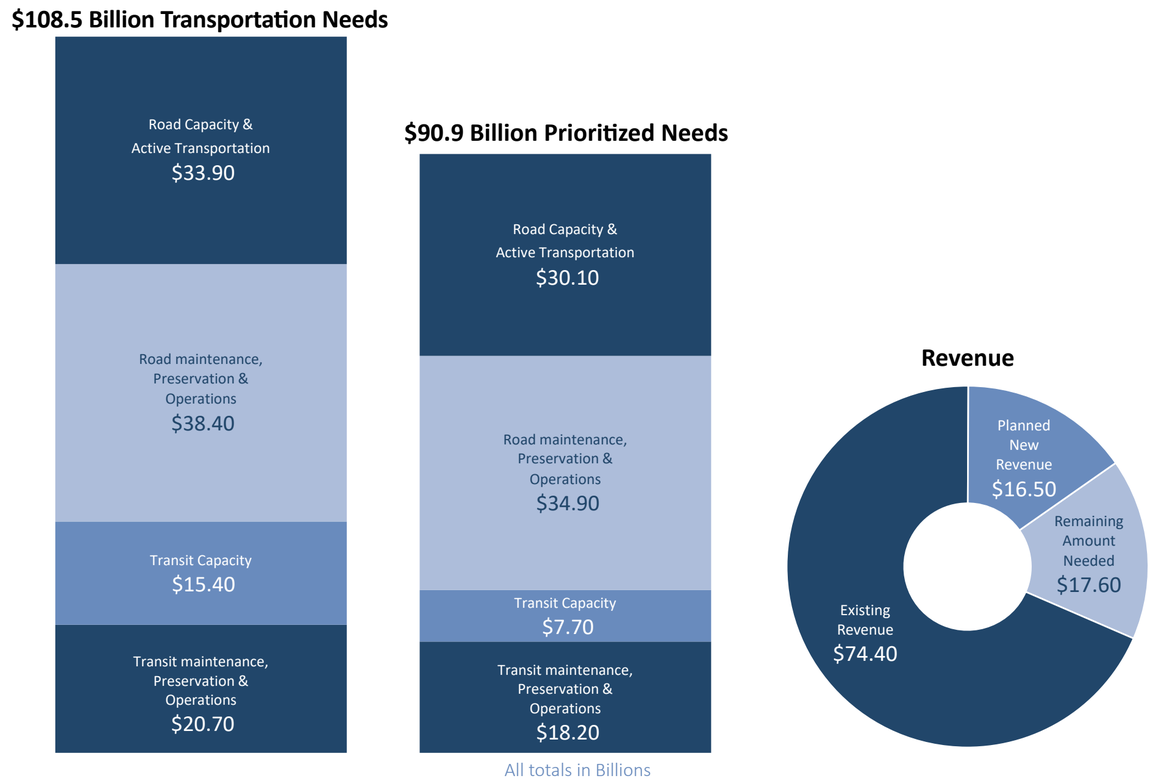

Table 5. Revenue Summary in Millions.

State	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Transportation Investment Fund (TIF) Total	$874	$915	$958	$990	$1023	$1058	$1094	$1131	$1169	$1201
Transportation Fund	$176	$179	$182	$185	$188	$191	$194	$197	$200	$203
One Time General Funds	$1,001	—	—	—	—	—	—	—	—	—
One Time Outdoor Recreation Adventure Funds	$16	—	—	—	—	—	—	—	—	—
Highway Federal Funds	$469	$478	$488	$498	$508	$518	$528	$539	$550	$561
State and Federal Revenues	$2,536	$1,572	$1,628	$1,673	$1,719	$1,767	$1,816	$1,867	$1,919	$1,965

Based on State Consensus Revenues

Table 6. Programming Summary in Millions.

Asset Programs	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
High Volume Roads	$162	$162	$162	$185	$192	$200	$208	$216	$225	$234
Reconstruction	$70	$70	$75	$79	$82	$86	$91	$95	$99	$104
Low Volume Roads	$40	$35	$35	$40	$42	$43	$45	$47	$49	$51
Pavement Management	$2	$2	$2	$2	$2	$2	$2	$3	$3	$3
Structures	$108	$123	$128	$155	$114	$119	$124	$129	$134	$139
Traffic & Safety (Includes Signals)	$48	$53	$54	$54	$57	$59	$61	$64	$66	$69
New and Rebuild Signals portion only	$11	$15	$15	$16	$16	$17	$18	$18	$19	$20
Traffic Management (Includes ITS & Signals)	$16	$25	$30	$36	$39	$43	$47	$51	$55	$61
ITS Deployment and Main. & Signals Main. and Ops. portion only	$11	$16	$20	$24	$26	$28	$31	$34	$37	$40
Transportation Solutions (Includes Striping, CARBON, and PROTECT)	$119	$111	$103	$55	$96	$91	$84	$77	$72	$63
Striping Portion Only	$5	$5	$5	$7	$7	$7	$7	$7	$7	$7
Other (Less SPR)	$26	$27	$27	$27	$28	$28	$28	$29	$29	$30
Asset Expenditures Subtotal	$471	$497	$513	$579	$556	$580	$606	$633	$660	$690
Total Asset Expenditures	$590	$608	$616	$634	$652	$671	$690	$710	$732	$753
Available for Assets	$590	$608	$616	$634	$652	$671	$690	$710	$732	$753

Statewide Transportation Improvement Program (STIP) Process and Investment Strategies

UDOT's Statewide Transportation Improvement Program (STIP) is a six-year plan of highway and transit projects for the State of Utah. The STIP is maintained daily and includes transportation projects on the state, city and county highway systems as well as projects in the national parks, national forests and Indian reservations. These projects encompass the federal and state funding programs discussed above.

The STIP is UDOT's official work plan for the development of projects through conception, environmental studies, right-of-way acquisition, planning, and advertising for construction for all funding sources. Recommendations for projects that maintain the UDOT system and National Highway System (NHS) in a state of good repair are a critical part of the STIP development process.

Initial work recommendations come through the condition evaluation and needs projections of each asset. Coordination with the MPOs and public meetings are part of the recommendation development process. Projects are developed from these recommendations and discussed with local governments. The resulting project list is combined with other state projects and programs including Joint Highway Committee projects. From this draft list the Transportation Commission creates the draft STIP which includes amendments to the current STIP. Public comments are addressed prior to submission to the Transportation Commission for approval and submission to FHWA/FTA for approval each October. Further details of the process are shown in the STIP Process Diagram.

UDOT is in the process of developing methodology to optimize the STIP program based on program and individual project contributions to the FHWA and UDOT performance-based goals. This methodology, when complete, will result in an investment strategy that optimizes available funding each year across the state and across assets.

Pavement Management Plan

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Introduction

The UDOT Pavement Management Plan includes all state route pavement sections for Portland Cement Concrete Pavements and Asphalt Mix Pavements. The pavement sections include the overlays, material treatments, the pavement itself, all base courses, joint fillers, and reinforcement.

Federal Pavement Performance Measures and Targets

FHWA has prescribed pavement performance measures for the NHS. Through a data-driven process, based on historic and projected condition, the UDOT targets have been established for the federal pavement performance measures.

Four metrics make up the federal pavement performance measure. These are calculated based on data from the Highway Performance Monitoring System (HPMS) annual submittal. The four metrics are:

- Pavement roughness, measured using the International Roughness Index (IRI).
- Cracking, measured in terms of the percentage of cracked pavement surface in the wheel path.
- Rutting, quantified for asphalt pavements by measuring the depth of ruts in the wheel path.
- Faulting, quantified and averaged for jointed concrete pavements.

The UDOT targets for the federal performance measures on NHS pavements are:

- Interstate NHS <5% Poor and >60% Good
- Non-Interstate NHS <5% Poor and >35% Good

The federal pavement condition targets have been established to be consistent with our strategy to maintain the NHS in a state of good repair.

UDOT collects condition data on 100% of the NHS irrespective of ownership. Less than 1% of the NHS pavement is non-UDOT owned. Through collaborative discussions with the MPOs and other local owners, it was determined to be most cost-effective for UDOT to collect all condition data for pavements statewide. A Memorandum of Understanding (MOU) was executed on April 16, 2018, between the MPOs and UDOT. This MOU includes the agreement that UDOT will collect pavement condition data for the Utah asset management plan on all NHS routes irrespective of ownership.

Current condition data and information on federal Infrastructure measures can be found at this link: Utah Federal Infrastructure Measures.

Figure 7. Federal Performance Measures

UDOT Pavement Performance Measures and Targets

The federal metrics confirm that the UDOT investment strategies are working but are a lagging indicator. UDOT established performance measures that allow forecasting of future pavement conditions using the pavement management deterioration model. Given anticipated funding, this model incorporates historical data and Utah-specific deterioration curves to predict and maximize pavement condition after implementation of specific treatments.

UDOT performance targets have been set to maintain the status quo, (i.e., fund enough work to not let the pavement condition deteriorate). This "Good Roads Cost Less" strategy was adjusted when sufficient funding for the full system wasn't available. The Low Volume System was created to allow UDOT to focus on maintaining the status quo of the High Volume System. Lower targets were set for the Low Volume System.

The UDOT pavement performance measure is the International Roughness Index (IRI), which indicates the smoothness of the ride for users of the roadway. It is an indicator of the overall performance of the pavement and easy to explain to decision makers and taxpayers.

The statewide UDOT targets for the IRI pavement performance measures are:

- High volume: <5% Poor and >65% Good
- Low volume: <20% Poor and >30% Good

These targets differ from the federal targets because the measure is different and they apply to the entire roadway system, not just the NHS.

GASB-34 is a federal accounting and reporting measure for state and local governments. As part of that measure, UDOT is required to set a goal to demonstrate that it is taking care of its assets and not letting them deteriorate. UDOT set a goal for statewide pavement smoothness (IRI) as the main indicator that the public notices as they travel on Utah roadways.

- Statewide pavements >80% fair

Each year we survey the entire roadway network in the outside travel lane, which includes the Interstate in both directions and all other roads in the positive direction. This outsourced data collection is currently performed by Mandli and results are delivered to UDOT every November. UDOT reports percentages of mileage in good, fair and poor condition using the collected 0.1-mile International Roughness Index (IRI) data. These ranges are:

- Good: with IRI <95 inches/mile
- Fair: with IRI between 95 and 170 inches/mile
- Poor: with IRI >170 inches/mile

Current condition data and information on the UDOT pavement measures can be found at this link: UDOT Preserve Infrastructure Goal.

Pavement Performance Gap

As shown in the Utah Federal Infrastructure Measures, the interstate pavements currently and historically have exceeded the target levels for poor condition. In 2019, the target for good condition was not met. This was due to a major interstate reconstruction project on the STIP for the 2020 construction season. The 2020 pavement condition data show a major increase in pavement good condition as a result of projects. The 2021 Interstate pavement condition will show continued improvement as the projects are completed. The non-interstate NHS pavements currently and historically meet or exceed the target levels for good and poor conditions. The short-term performance gap in federal targets was resolved with previously programmed construction projects.

UDOT is also exceeding the statewide pavement condition performance targets for high-volume and low-volume pavements. Therefore, no pavement performance gap currently exists.

Pavement Life-Cycle Planning

For more than 40 years, UDOT has used the pavement management strategy known as "Good Roads Cost Less" to maintain pavements. UDOT incorporates life-cycle planning into the performance-based management of pavements through the definition of secondary performance measures. These secondary measures focus efforts on optimizing tax-payer dollars and maximizing pavement life.

UDOT uses the pavement management deterioration model to forecast the future pavement condition with a given funding scenario and to suggest the set of treatment strategies and timing that will provide the highest overall benefit to the system condition. The model uses the most current information, including the current pavement management strategies, to recommend projects for the STIP. Details of the model configuration, deterioration rates, costs, and outputs are included in the Pavement Management Manual and can be found at this link: Pavement Management Manual Chapter 4.

As part of the pavement life-cycle plan, UDOT has established the Pavement Preservation Index. This provides information that allows decision makers to select a mix of pavement treatments that will achieve a sustainable pavement condition. The Pavement Preservation Index is defined as:

- Considering that all pavements age 1 year each year, a loss of pavement life can be measured in units of surface-area years.
- The different surfacing projects replace different amounts of pavement life, which can be added up in units of surface-area years.
- The Pavement Preservation Index is the ratio of the work done (planned) to the work required, measured in units of surface-area years.
- Pavement Preservation Index =surface-area years replaced / surface-area years lost

The Pavement Preservation Index associates a benefit to each project in terms of years of added to or replaced pavement life. Using these data, the Index provides an indication of future pavement condition. Values less than 100% forecast a decline in condition, while values greater than 100% forecast an improvement in condition.

For assumptions and benefit years of each treatment, follow this link: Pavement Management Website and scroll down to the Project Category list.

Pavement Risk Management and Resilience

Risks from extreme weather events and responses to those risks are incorporated into the decision making process for pavement through a number of methods. Through our current design process, drainage is evaluated to prevent overtopping of the roadway and erosion of the roadway prism, as well as provide sufficient roadside drainage. UDOT uses a 10-year storm event design to capture roadway drainage, but incorporates a 50-year storm event design for waterways that impact roadways. This approach allows UDOT to continually improve designs to account for the ever-increasing risk of larger storm events. In addition responding to drainage and flood events, UDOT uses different binders for the varying temperatures across the state within the dTIMS (Deighton Total Infrastructure Management System) pavement model to determine pavement treatments. A re-evaluation of those binder recommendations is periodically done, but current and predicted temperatures have not fallen outside of the design binder temperature ranges.

Extreme temperatures, most notably prolonged extreme high temperatures have become more frequent and are expected to continue this trend going forward. These prolonged high temperatures cause an increase in concrete pavement "blow-ups" where the concrete expands beyond the ability of expansion joints and causes concrete panels to buckle and press upward, rendering the pavement impassable, most notably on our interstates along Utah's most populous areas. Mitigations have been evaluated, but what does exist is far more costly than emergency repairs and such mitigations are difficult to maintain, causing potentially larger risks to the overall pavement condition with greater impacts to mobility and safety. UDOT currently has emergency repair contracts in place that allow concrete panel replacements to be made and open the road to the public within 12–24 hours. In addition, UDOT is constantly evaluating alternative pavement designs and applications.

Programmatic Pavement Risk

The largest non-environmental risk to pavement condition is an abrupt increase in the cost of projects. Price fluctuations for pavement projects are generally due to oil prices, but the costs of other supplies and labor also vary. UDOT mitigates this risk by closely monitoring the price of supplies and the availability of contractors to work in Utah. This monitoring allows UDOT to advertise projects at the most advantageous times and to estimate the cost of construction to ensure there is adequate funding for programs.

Implementation of Asset Natural Hazard Risk Management Plan

The Risk Map shows natural hazard risks to pavement in 0.1-mile segments. Review of the risk map is included as a step in the solutions-development and concept-development processes to ensure that pavement maintenance, rehabilitation, and preservation address potential natural hazard threats. The threats are analyzed using the UDOT Asset Risk Management Process and map (Risk Priority Map) to incorporate any cost-effective mitigation into pavement projects.

Analysis of Repeat Damage

The UDOT map layer that shows all projects receiving federal Emergency Relief (ER) Funds is updated regularly through a connection to the UDOT financial system. There are presently no locations where pavement has been damaged repeatedly due to emergency events. This map is reviewed as part of the solutions-development and concept-development processes to ensure knowledge of past environmental events is included in project planning and development.

Pavement Financial Plan

HIGH-VOLUME PROGRAM FUNDING

Historical tracking of pavement condition shows UDOT has been maintaining a status quo condition level for the high-volume system with the current funding levels. Based on forecasted pavement conditions, it is anticipated that UDOT will continue this status-quo level of pavement maintenance. The funding levels typically increase by a small percentage each year to ensure funding for preservation of the system growth due to capacity projects.

LOW-VOLUME PROGRAM FUNDING

The low-volume roads have continued to improve since 2017, when a funding level of $40 million per year was set. Recent traffic modeling shows that we can reduce this funding to $35 million per year and continue to improve the condition. Annual modeling will continue to ensure steady state conditions are obtained and maintained.

RECONSTRUCTION FUNDING

In December of 2016, the UDOT Pavement Working Group (PWG) developed recommendations for including a reconstruction program in their pavement-management responsibilities to complement the preservation and rehabilitation programs. A draft 7-year program (2019–2025) was developed with funding approved to average approximately $50 million per year.

This program addresses roadway sections where the pavement has exceeded its design life and reconstruction is the most economical solution to improve the condition. Since this program began, the statewide pavement condition results show that reconstruction projects are necessary to meet the performance goals. This program funding has been recommended to continue beyond 2025 to ensure pavement performance goals continue to be met.

Table 7. Additional Pavement Reconstruction Funding.

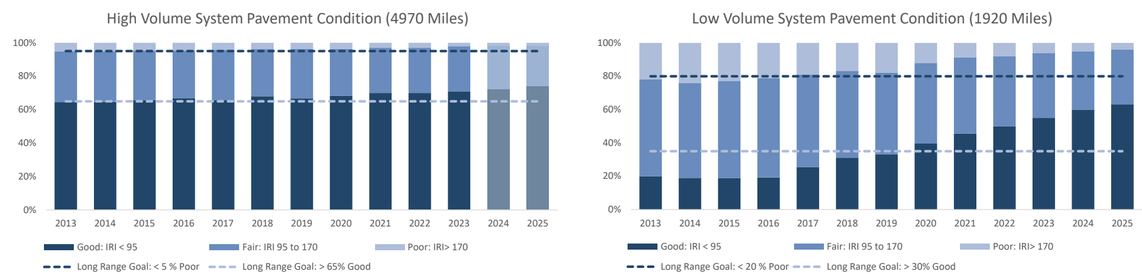
	Year Total:
2019	**$50,360,000**
2020	**$47,500,000**
2021	**$55,100,000**
2022	**$50,000,000**
2023	**$35,000,000**
2024	**$40,000,000**
2025	**$78,000,000**
7 Year Program	**$355,960,000**
Yearly Average	**$50,851,429**

PAVEMENT PROGRAM FUNDING

Funding models are created with do-nothing scenarios and incremental values around the current funding levels to see impacts to future pavement conditions. Modeling shows that the current funding levels maintain the state of good repair of interstate, NHS, and high-volume roads and improves the condition of the low-volume roads.

The projected condition charts are shown below. Distribution by region for pavement funding can be found at this link: Pavement Management Funding.

Figure 8. Pavement State Performance Measures.



Pavement Investment Strategies

Asset management investment strategies are developed by each UDOT division and region. These strategies guide program and project decisions for resource allocation that maintain and preserve transportation assets in the best condition possible with available funds. These strategies are developed and modified as needed to:

- achieve and sustain the state of good repair stipulated by the federal and state performance targets;
- follow the asset-life cycle plan, which improves and preserves the condition of the UDOT system;
- achieve condition and performance of the NHS stipulated by national goals relating to assets; and
- mitigate the risk assessment elements.

The investment strategies guide decisions to create projects that comprise the STIP program, which is the final annual investment strategy. The asset-condition analysis is independent of the STIP process and establishes the annual and long-term investments and projects needed to meet the targets set within the TAMP process. If available funding is not adequate for the needs, additional funding is requested based on the needs projected by the data modeling and analysis to achieve and sustain the desired state of good repair.

UDOT staff recognize that heavily used pavements require different treatment types and frequencies than lightly used pavement. Treatment strategies established for roadways designated as high volume differ from those established for roadways designated as low volume.

- The high-volume system strategy is to implement a mix of treatments that maintain a status quo condition level. This system includes the interstates, most of the NHS, and other routes with over 1,000 AADT.
- The current low-volume system strategy is to implement a mix of treatments that improve the condition level to the set target conditions for good and poor levels. This system consists of the remaining roads with less than 1,000 AADT. These are primarily asphalt pavements with chip-seal surfaces.

The Pavement Preservation Index is a forward-looking management tool developed to upgrade the “Good Roads Cost Less” strategy, which has been in place since early 1978. This index is based on the premise that each surfacing project would provide a benefit to the pavement life. Assuming all pavements lose 1 year of life each year, the program of projects should replace an equivalent amount of pavement life. This index supports UDOT’s long-term vision and pavement-management strategy to maintain pavements in a state of continuously good repair.

- The statewide Pavement Preservation Index target is to achieve 100% replacement benefit each year.

Additional information on the Pavement Preservation Index can be found at: Pavement Preservation Index and in the Pavement Life-Cycle Planning section above.

The overall, long-term, pavement-management strategy is to fund the pavement program sufficiently to achieve a sustainable pavement condition on all pavements. The TAMP analysis ensures that established targets are consistently met by the set of projects developed for the STIP. Projected conditions for both the high- and low-volume systems using these strategies are shown in this link: Pavement Management Condition Projections.

UDOT uses the pavement-management deterioration model to identify our statewide pavement funding needs for each system. This is an iterative process that forecasts pavement condition for a selected program of projects and funding levels. The approved funding levels are then modeled to determine the funding allocations for each region. The UDOT region personnel make the final determination of the appropriate mix of preservation and rehabilitation projects to meet the established performance targets. The reconstruction projects are managed at the statewide level with input from each region. The list of pavement preservation, rehabilitation, and reconstruction projects is then optimized and coordinated with other asset needs.

Bridge Management Plan

TAMP 2023 DRAFT

Introduction

The bridge management plan includes all bridges with spans longer than 20 feet. UDOT is responsible for inspection and load rating for locally owned bridges, and these are included in the plan. Management of UDOT-owned culverts with an opening greater than 20 feet are included in the Bridge Management Manual.

Federal Pavement Performance Measures and Targets

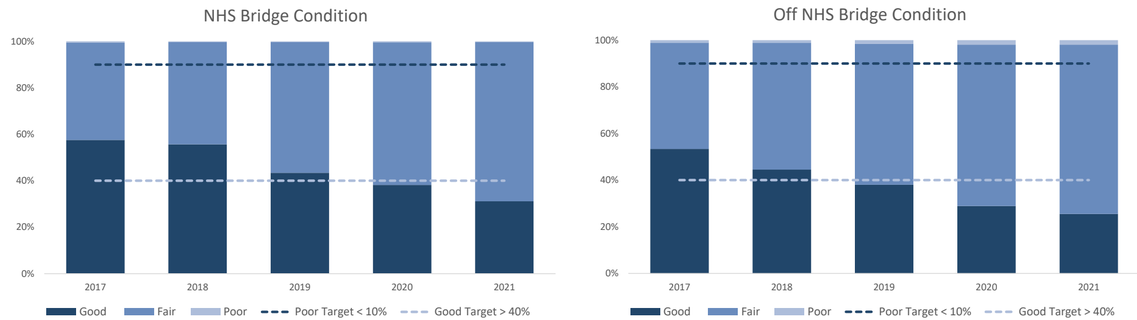
The federal bridge-performance measure applies to all bridges on the NHS system. The measure is based on component ratings from the National Bridge Inventory (NBI). The bridge measure is determined by the lowest component rating of deck, superstructure, substructure, or box culvert, and it evaluates the system wide percentage of deck area in good, fair, and poor condition. A component rating of 7–9 is good condition, 5–6 is fair condition, and 4 or less is poor condition.

The federal targets for NHS bridges are:

- <10% Poor and >40% Good

Current condition data and information on federal Infrastructure measures can be found on the second page of this link: Utah Federal Infrastructure Measures.

Figure 9. Bridge Federal Performance Measures.



UDOT Bridge Performance Measures and Targets

The UDOT performance measure for bridges is based on the Bridge Health Index (BHI), which describes the overall structural condition of each bridge calculated from AASHTO element level ratings. This index is used as a tool for planning and tracking UDOT's bridge system condition and prioritizing work. The BHI is calculated at the element level as a ratio of the value of the bridge in the bridge's current condition to the value of the bridge in the best possible condition. This tool supports decisions focused on maintaining each bridge in a state of good repair. The index was developed to capture the condition of every element of the bridge, which rolls up to an overall condition rating. This index allows data-driven decisions for preservation and improvement of each element and provides a more-granular look at the overall health of each bridge.

A BHI of 80–100 is classified as good condition, a BHI of 60–80 is classified as fair condition, and a BHI less than 60 is classified as poor condition.

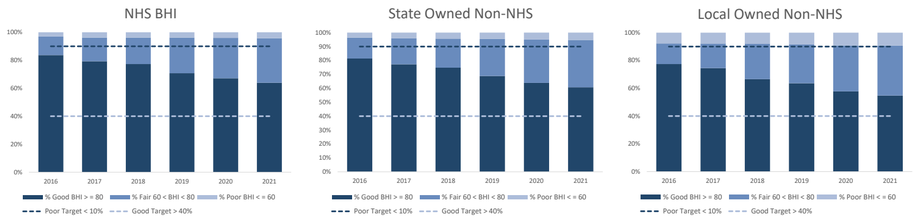
The performance measure targets are as follows:

- <10% Poor and >40% Good

These targets have been set to provide a good riding surface while minimizing maintenance costs.

The measures and targets for the three categories of bridges and the historical and current condition of each can be viewed at the following link: UDOT Strategic Direction.

Figure 10. Bridge State Performance Measures



Bridge Performance Gap

UDOT currently exceeds the federal target set for poor bridges. The federal target is to have less than 10% of NHS bridges in poor condition. Less than 2% of UDOT's bridges are in poor condition. Therefore, UDOT is not at risk of a federal penalty.

UDOT is not meeting the federal target set for bridges in good condition. Both the state and federal measures show a gradual decline of bridges in good condition over the last 5 years, both on and off the NHS system.

This performance gap was projected. It is due to an aging system and is common across other states where the interstate system was built over a span of a few years. UDOT increased funding for bridges in 2017. This has slowed the decline in bridge condition, but it did not stop it. The gap is being narrowed with available funding by analyzing each bridge to apply the most cost-effective treatments to extend the lifespan.

Bridge Life-Cycle Planning

For the purposes of life-cycle planning, bridges built prior to 2005 are assumed to have a 50-year design life. Bridges built in 2005 and after are assumed to have a 75-year design life. The Bridge Management Division has been collecting bridge element-level condition data for many years. By understanding the inventory and through the planning process, the Bridge Management Division creates a plan for every structure to define preservation, rehabilitation, and replacement options. Under the federal measure condition, the NBI component ratings for deck, superstructure, substructure, and box culvert provide the high-level information necessary to systematically predict the type of work needed for the structure (Table 8). The BHI is used to prioritize the work for each bridge element.

The Bridge Management Division developed the BHI as a means to describe the overall condition of each bridge. The BHI is also used as a structural performance measure and for work effort prioritization. The BHI is made up of the three following metrics: (1) deck, (2) superstructure, and (3) substructure. These metrics are weighted to underscore the importance of each category in overall bridge health. The weighting of these categories is as follows:

$$BHI = (Deck\ Score \times 0.40) + (Superstructure\ Score \times 0.35) + (Substructure\ Score \times 0.25)$$

The health of deck elements is weighted more heavily because the elements contribute to preserving many other areas of the structure.

Box culverts have a different BHI scoring system and are rated from 1 to 100, based on inert box culvert elements.

Table 8. Bridge Treatment Service Life.

Treatment	Condition State (NBI)	Treatment Service Life
Preservation	≥7	10 years
Rehabilitation	6–5	25–40 Years
Replacement	≤4	75 Years

Table 9. Bridge Preservation Treatment Service Life.

Preservation Deck Treatment Type	Condition State (NBI)	Treatment Service Life
Thin Bonded Polymer Overlay	≥7	10 years
Polyester Concrete Overlay	6	25 Years
Hydrodemolition	6–5	30 Years
Deck Replacement	≤4	40 Years

The service life for each treatment assumes appropriate preservation treatments are being applied at the appropriate times throughout the life of the bridge for each condition state.

The deck is the component that protects the structure. Detailed treatments have been implemented for deck preservation, depending on the work needed as seen in Table 9.

Assumptions for preservation treatments are overstated, and national efforts are underway to make better estimates of bridge-life extension for each treatment. This effort is expected to be complete in 2024 or 2025.

A health index score is calculated for each element as a ratio of the value of the element in the element's current condition to the value of the element in the best possible condition. Each of the three category scores are then calculated as a weighted average of the health indices of the bridge category elements, where elements are weighted by the total quantity of the element and relative importance. The category score is calculated for the deck, superstructure, and substructure before combining the resulting scores, as described above, into a final BHI.

The BHI is used to prioritize bridges statewide for replacement and rehabilitation projects. Health indices for individual elements, such as the deck overlay, are used to identify projects for preservation treatments or for targeted projects.

Bridge Risk Management and Resilience

The UDOT Structures Division takes several approaches to mitigate risk when preserving, replacing, and rehabilitating structures. When selecting projects for rehabilitation or replacement, UDOT Structures evaluates the AADT of the routes to prioritize routes that would be more heavily impacted if the was reduced capacity due to poor condition, scour, earthquakes, or other events. When selecting for preservation projects, UDOT Structures identifies and prioritizes based on scour critical ratings, foundations types, and if scour is currently observed. Bridges of highest risk and with the highest AADT are added to the preservation programs for scour mitigation.

When UDOT is rehabilitating or replacing bridges, as well as constructing new bridges a seismic strategy is documented to evaluate and mitigate for seismic activity in the future. In addition, a history of overheight load impacts and other crash history is used to evaluate if a bridge can be rehabilitated, or if it should be replaced to reduce future crash likelihood. When new bridges are constructed or bridges are replaced, they are designed to meet current seismic, hydraulic, and vertical clearance standards unless strong mitigating factors prevent this.

Programmatic Bridge Risk

The largest non-environmental risk to the bridge program is the yearly deterioration of a large number of bridges built within a short time frame. This creates a risk of inadequate funding to replace or reconstruct bridges preserved beyond their design life. This risk is mitigated to the extent possible by analyzing each bridge to apply the most cost-effective treatments to extend the lifespan and with additional funding.

Implementation of Asset Natural Hazard Risk Management Plan

The Risk Map shows natural hazard risks to bridges including earthquake risk. The bridges are rated red, yellow, and green for potential earthquake impact based on various statewide earthquake scenarios analyzed. Review of the risk map is included as a step in the solutions-development and concept-development processes to ensure that bridge maintenance, rehabilitation, and preservation address potential natural hazard threats.

Analysis of Repeat Damage

The UDOT map layer that shows all projects receiving federal Emergency Relief (ER) Funds is updated regularly through a connection to the UDOT financial system. There are presently no locations where bridges have been damaged repeatedly due to emergency events. This map is reviewed as part of the solutions-development and concept-development processes to ensure knowledge of past environmental events is included in project planning and development.

Bridge Financial Plan

Historical tracking of bridge condition (based upon component condition data) shows an overall decline in the number of bridges in poor condition. The number of bridges in fair condition has also continued to increase. Currently, 27% of the state bridge inventory exceeds the 50-year original design life. Maintenance and preservation treatments have extended the lifespans of these bridges, but rehabilitation or replacement will be required for these bridges within the next 20 years.

UDOT evaluated funding from all sources, including structure-specific funding and larger-capacity projects, to establish the shortfall. Based upon the identified shortfall, UDOT increased annual bridge funding from $18.7 million to $48 million between 2015 and 2018. This was accomplished through redistribution of federal funding and the addition of the 2015 state fuel tax increase.

Figure 11. Bridge Condition Projection.

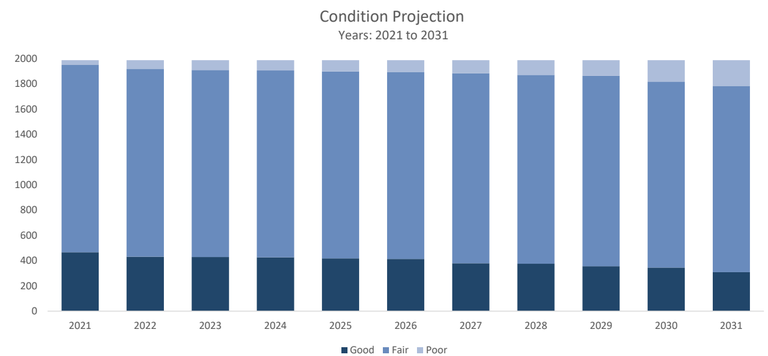
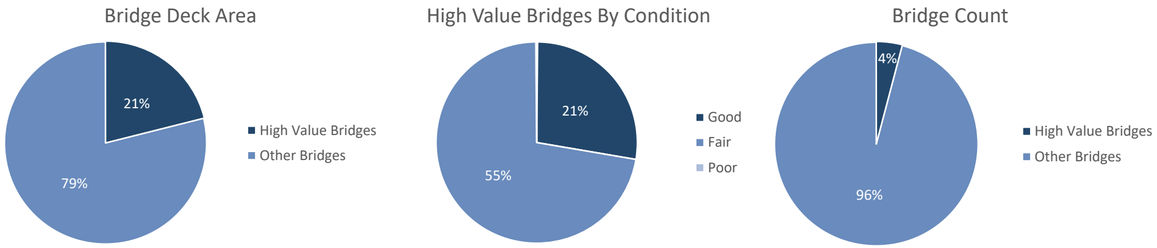


Figure 12. High Value Bridges by Condition.



Modeling of current funding levels over the next 20 years predicts a continued decrease in the number of bridges in good condition and increases in the number of bridges in poor condition. This is based on the assumption that bridges remain in fair condition for only a certain amount of time. This trend is offset by preservation treatments.

Two primary contributors to the negative trend are the increasing size of inventory and the aging and declining conditions of high-value bridges. High-value bridges are complex bridges, those with spans of 300 feet or more, or bridges with total lengths greater than 1,000 feet. While there are few high-value bridges on the system, they account for almost one quarter of the system-wide deck area and many are in fair condition. Almost all of these bridges are on I-15 and were built in 2000 for the 2002 Winter Olympics.

Bridge Investment Strategies

As with pavement, not all state bridges have the same traffic, performance requirements, or associated risks. NHS routes tend to be those most heavily traveled. Also, NHS routes are those which most severely impact the traveling public during major rehabilitation or replacement projects.

State routes tend to have higher AADT than local routes, but lower AADT than NHS routes. All state-owned bridges, whether on or off the NHS, are treated through a balance of proactive preservation and condition-based rehabilitation or replacement. This allows for the programming of all bridges in poor condition for replacement, and the evaluation of bridges in fair and good conditions with specific treatments for rehabilitation or preservation work.

Locally owned bridges generally have the lowest AADT. UDOT does not control the overall condition of the locally owned bridge system. Projects require a financial match from the local owner. If the local owner is unable to participate in the project, UDOT cannot complete the project.

Investment strategies for bridges are a mix of preservation, rehabilitation, and reconstruction treatments. The specific treatment for each bridge is based on analysis of the annual bridge inspection program data, performance targets, and funding.

STRATEGIES

- Prioritize structures based on vulnerability and criticality to identify candidates for rehabilitation or replacement.
- Schedule preservation activities, (e.g., rehabilitating bridge decks, bridge element protection systems, and routine maintenance) that aid in extending the life of a bridge for relatively limited costs.
- Align the bridge-preservation cycle with the pavement-preservation cycle activities to optimize funding.
- Extend the life of selected aging bridges to flatten the curve of declining bridge condition due to aging.

The investment strategies and management vision is further described in the Bridge Management Manual, which can be read at this link: Bridge Management Manual.

Additional State-Managed Assets

Introduction

UDOT has management plans in place for several assets that are not required to be reported to FHWA.

These assets are managed differently, based on which tier they were assigned (Figure 3).

TRAFFIC SIGNAL MANAGEMENT PLAN

TAMP 2023 DRAFT

Introduction

Traffic signal systems include all elements involved in the operation of signalized intersections. This includes elements such as signal heads, mast arms, poles, foundations, conduit, controllers, and internal components. Traffic signal systems include all other overhead or ground-mounted signal components as well.

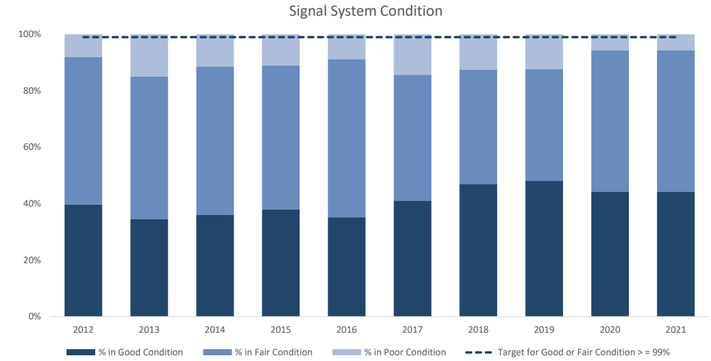
UDOT Traffic Signal System Performance Measure and Target

The performance measure for the UDOT signal system is the percent of signals that are in good or fair condition. The target is to maintain 99% of the statewide system in good or fair condition. This target reflects the critical nature of traffic signals and their importance to the safety of the traveling public.

Signal system condition is measured by conducting periodic inspections in the field. The physical condition of each element, including all electronics and physical infrastructure, is assessed. Each location is given a numeric rating of 1 through 5. A rating of 1 is poor, fair is 2–3 and good is 4–5.

Historical and current condition data and information on the signal system can be found at the following link by scrolling down to the Signal Condition section: UDOT Strategic Direction Preserve Infrastructure.

Figure 13. Signal System Condition.



Traffic Signal System Performance Gap

The UDOT signal system is included in the highest management tier. Signalized intersections and related infrastructure manage traffic and provide for the safe and reliable movement of goods, services, and people.

The signal system has been and is currently below target condition. Minor repairs are made throughout the year with signal maintenance funding. Replacement and installation of new signals is funded through projects on the STIP. A rebuild list is generated and prioritized for the Traffic and Safety Division to use limited rebuild funds to address the most urgent needs.

The management plan to attain the signal system condition target and close the performance gap includes the following steps:

- Update the signal-assessment process to make it more objective and consistent across the state.
- Map signal condition in UDOT's internal GIS map repository (UPLAN).
- Communicate signal replacement and upgrade needs to the regions so they can incorporate the costs into the project-scoping and construction estimates for STIP projects.
- Replace signal systems with highest priorities first, with available funding.

Traffic Signal System Life-Cycle Planning

Life-cycle planning for the signal system involves replacing elements and systems on a priority basis as funding and contractor resources are available.

TOP PRIORITY

Top priority is given to system-critical elements, those that would shut down the system if they failed.

SECOND PRIORITY

Second priority is given to electronics that (based on regular inspection) are at or near the end of their life-cycles.

FURTHER PRIORITY

Further priority consideration is given to a shift in technology that creates benefits to system capacity, preservation, or safety that are greater than the cost of implementation.

Traffic Signal Risk Management and Resilience

Extreme weather events for signals have been accounted for by developing an Emergency Response Plan found here. In addition to this plan, several recurring impacts due to natural hazards have been incorporated into every design.

The traffic signal design guideline has been changed to include a mitigator (damper) device installed on all mast arms 45 feet and longer. Signal heads have heaters installed in the lens covers to melt driving snow. All signal foundations are designed to resist predicted seismic events.

Traffic Signal System Funding

Beginning in 2018, the signal system received $2 million in additional funding each year to rebuild signalized intersections and address the problems of the aging infrastructure.

Trends and changes to the statewide condition of signal systems are being monitored and analyzed to determine the level of additional funding needed to meet the signal-system performance target. Available funds are currently being applied to rebuild or replace as many of the systems that are in poor condition as possible.

A shortage of availability among firms with the necessary knowledge of signal system maintenance and construction is currently hampering the ability to improve the condition of the system. Additional funding would not improve signal system condition at this time.

Traffic Signal System Investment Strategies

The primary goal of signal system management is to prevent the failure of equipment. The preventative-maintenance plan is designed to preserve and enhance equipment reliability by replacing worn components before they fail. The plan includes the following strategies:

SYSTEM REBUILD

- Rebuild systems in poor condition.
- Track progress of each rebuild.
- Prioritize rebuilds to maximize limited funding.

PREVENTATIVE MAINTENANCE

- Ensure that components of the traffic-signal system that are consumed in normal operation, and age or deteriorate, are regularly refreshed to prevent equipment failures.
- Minimize the potential for damage by others and, if it occurs, repair in a timely manner.

EMERGENCY MAINTENANCE

- Formalize the priority, process, and plan of emergency-response to traffic signals (Emergency Response Plan for UDOT's Traffic Signals).

MAINTENANCE MANAGEMENT

- Ensure trained staff with flexible hours are available to respond to emergency situations.
- Produce monthly reports of activities and work completed.
- Track equipment failures with the asset-management system.

The progress for each signal system rebuild is tracked to document completion. Signal system rebuilds coming from capital funding or procurement are also tracked.

Further details of these investment strategies, including specific responsibilities, can be found at this link: Traffic Signal Management Plan.

Next Steps to Reach Tier 1 Requirements

Tier 1 assets are in the top UDOT asset management tier and are expected to be managed with performance-based management plans. The current management plan is condition based and includes all the requirements of Tier 2 asset management.

Performance forecasting and targets are under development to fulfill Tier 1 management requirements.

Intelligent Transportation System (ITS) Management Plan

TAMP 2023 DRAFT

Introduction

The UDOT Intelligent Transportation System (ITS) consists of ramp meters, variable message signs (VMS), traffic monitoring stations (TMS), CCTV cameras, express lane systems, road weather information systems (RWIS), communication switches, and other devices and the supporting infrastructure for these devices.

UDOT Intelligent Transportation System Performance Measure and Target

The ITS is critical to achieving the UDOT strategic goals of (1) zero fatalities, incidents, and crashes and (2) optimizing mobility. The system devices are included in the highest asset management level (Tier 1). They must be communicating to ensure reliable information is being provided to the traveling public and traffic operations staff.

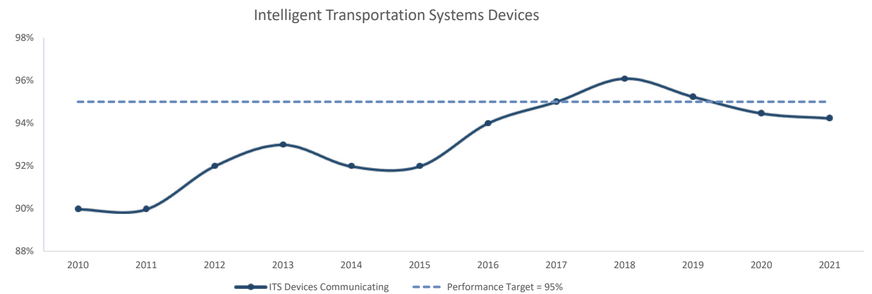
The UDOT performance measure for ITS is the percentage of time that devices are communicating with the Advanced Traffic Management System (ATMS) at the Traffic Operations Center (TOC). This performance measure is calculated by taking monthly snapshots of devices actively communicating with the TOC and recording the number communicating with respect to the total number of devices.

- The performance target is 95% of the system communicating.

Historical and current condition data and information on the ITS performance measures and targets can be found at the following link: UDOT Strategic Direction Preserve Infrastructure.

The chart below shows the annualized percentage of periodically sampled ITS devices actively communicating (e.g., “communications uptime”) with the TOC. “Communicating” in this case means that a “ping” (or signal) is sent to each communications device, and each device “pings” (or signals) back. If the communications device is working, that also means there is electric power in the cabinet that houses the device equipment, which generally implies that the ITS device itself is functioning.

Figure 14. Percentage of ITS Devices Communicating.



ITS Performance Gap

In the last 2 years UDOT has been below the ITS device performance target largely due to the advanced age of the existing system, along with limited resources, which have hindered the ability to maintain the system at desired levels. It is anticipated that the increased end-of-life replacement funding received in recent years, coupled with anticipated increases in other resources, will close this performance gap.

ITS Life-Cycle Planning

UDOT has determined that the most-effective ITS management strategy is to consider the entire life-cycle of critical components for each device type. Like the strategy used for pavement and bridges, a "plan for every ITS device" is necessary to address the device from cradle to grave. Unlike pavement and bridges, ITS devices have varying lifespans, sometimes based on age, but frequently based on functional obsolescence.

ITS Risk Management and Resilience

The major impacts to ITS are primarily informational and external risks. Informational risks, such as cyber-attacks and similar system-wide failures, pose the greatest threat to the network as a whole and at the individual component levels. To mitigate this risk, there are two operational management systems that operate independently and in separate locations so if one was compromised, either by a cyberattack or natural disaster, the other would be able to replace it. Both systems operate with the highest levels of security and independence from other systems to limit outside access and provide maximum protection.

External risks, such as large-scale natural disasters that could compromise the power grid or data connection network, also pose a threat to ITS devices. Emergency response plans are in place to help reduce the impacts of such natural disasters. In addition, emergency response crews are stationed nearby to restore operation to impacted devices within hours of events.

ITS Funding

In 2019, an assessment was performed to determine the funding needed to maintain and replace those ITS devices which were approaching end-of-life. This assessment showed that a more than 50% increase in ITS end-of-life replacement funding was needed. As a result, a 22%increase in funding was granted, which is being used to replace the devices with the highest priorities.

ITS Investment Strategy

Investment in monitoring and maintaining the performance of each ITS device is the current major strategy. The WhatsUp Gold software monitors device communication. When failure is noted, work orders are created that trigger technicians to address the communications issues in a timely manner. This software is expected to document and create a history of device lifespans. This is information which is currently undocumented and knowledge that is lost between staff transitions.

Next Steps to Reach Tier 1 Requirements

Tier 1 assets are in the top UDOT asset-management tier and are expected to be managed by performance-based management plans. The current management plan is based on the percentage of devices communicating, which implies device functionality.

- Cost to maintain ITS devices and additional condition data is being collected and recorded.

Performance forecasting and targets are under development to fulfill Tier 1 management requirements.

Pavement Striping Management Plan

TAMP 2023 DRAFT

Introduction

Pavement striping managed by this plan includes durable striping (tape) and waterborne (paint) striping. Pavement preparation such as striping grooves are not managed after initial construction and are therefore not included in this plan.

UDOT Pavement Striping Performance Measures and Targets

Pavement striping is important to achieving the UDOT strategic goals of (1) zero fatalities, incidents, and crashes and (2) optimizing mobility. Pavement striping is included in the highest asset management level due to the high level of public feedback and the asset's contribution to UDOT's safety and mobility goals.

The durable striping performance measure is based on condition rating and vehicles served. The condition rating is based on retroreflectivity. The measurements are weighted by the amount of vehicles served to incorporate the increased public perception in more populous areas. Retroreflectivity is measured in milli-candelas (mcd) per square meter per illumination intensity (lux). Values of retroreflectivity of 150 or more are rated as good, 120–150 as fair, and less than 120 as poor.

Due to the inherently short span of time that waterborne pavement markings remain visible, it is difficult to ascertain exact deterioration rates that can be observed before re-application. The performance of waterborne striping is based on time after application, with the condition being affected by three factors: recess ("grooved-in"), roadway volume, and plow exposure.

When waterborne striping is recessed, it is considered to be in good condition for the first year, regardless of roadway volume or plow exposure. At the end of the first year, recessed pavement striping is considered to be in fair condition. At the end of the second year, recessed pavement striping is considered in poor condition and is typically replaced.

For non-recessed waterborne striping, the striping is typically replaced every year within the confines of limited funding. New striping is considered to be in good condition initially, but reaches fair condition by the end of the first year. Non-recessed striping is considered to be in poor condition when it remains longer than one year.

The performance measure for pavement striping is vehicles served with each rating of striping. Vehicles served is a method of normalization with respect to the volume of users within each segment of road. Traffic volume (expressed in AADT) is multiplied by the combined durable and waterborne length (in miles) of striping for each rating.

Targets for pavement striping performance are:

- 35% of vehicles served with striping in good condition
- 35% of vehicles served with striping in fair condition
- 30% of vehicles served with striping in poor condition

There is limited historical data for this performance measure. This performance measure was initiated in 2021 using the 2019 roadway data collection and the 2021 data from December.

Pavement Striping Performance Gap

With only two cycles of data collected on striping, it is difficult to determine a more-accurate performance measure. We do not have sufficient data to support any performance or condition gaps. There is, however, an expectation gap that was recently discovered. While current funding levels were thought to allow re-application of waterborne striping each year, we are actually only able to support a 1–3 year replacement cycle. As a result, a more-robust application schedule, methods, and types of applications are being developed to utilize the limited available funding more efficiently. In addition, an increase in annual funding has been requested as a result of performance measures tied directly to safety measures that are affected by inadequate striping.

The current targets will be evaluated and adjusted with time and as more data are collected. Condition data on the durable striping will be collected and maintenance crew striping applications will be tracked to determine if the targets are met and what adjustments need to be made as a result.

Pavement Striping Life-Cycle Planning

Life-cycle of the pavement striping is based on the product warranty and deterioration curves of the materials. The combination of these data takes into account plow exposure, AADT, and the pavement material, and these factors are used to predict when areas need to be re-striped.

The deterioration curves for durable striping are being refined and adjusted as we continue collecting data. There are multiple deterioration curves to account for each product type, surface material type, plow exposure, recess, and AADT.

Pavement Striping Risk Management

The primary extreme weather event that affects striping are harsh winters. Research is underway to show the trends of the frequency, time, and duration of snowfall with particular emphasis on the frequency of snow plowing that results. Temperatures could also play a factor in the life of the materials, but nothing has been done to examine such effects as the general consensus is that the current materials are not affected by such extreme temperatures as we have seen. Colder temperatures have the greatest effect and Utah seems to be trending to milder winters rather than colder.

Pavement Striping Funding

Currently, UDOT spends an average of $13.1 million on maintenance and construction projects to apply striping. An additional, one-time request for $6 million is being made as an in-line item transfer to apply durable striping on urban interstates with AADT greater than 30,000.

With this funding combination, it is anticipated that performance targets will be met within the next 4 years. The one-time funding increase leaves a gap of required additional, ongoing funding to maintain and improve upon the performance metrics.

These targets will be evaluated and adjusted with a better understanding of the deterioration curves and as more data are collected. We foresee the program needing additional funds to meet the pavement striping targets due to increased expectations from the public, particularly in more-urban and populated areas and trends of increases in the costs of material and labor. There are also proposed changes in the Manual of Uniform Traffic Control Devices (MUTCD) that will increase the funding needed to meet those requirements.

Pavement Striping Investment Strategy

The current investment strategy is to install durable striping on urban interstates with AADTs greater than 30,000 and continue using waterborne striping on the remaining network.

Striping is placed following a pavement striping matrix that defines the frequency and material type that should be used on each roadway segment.

Vision for Management Plan

Tier 1 assets are in the top UDOT asset management tier and are expected to have performance-based management plans. The current management plan is based on asset condition and time. These measures will be modified as data are collected over time to support performance-based measures.

The vision for pavement striping management is to collect more data and expand our research into better materials and methods for reaching striping performance goals. This will require adjusting the performance measure to better reflect what is happening on the road as the data are collected and quality checked. Current efforts are being made to research other data collection methods, such as crowd-based video monitoring, artificial intelligence, and machine-learning-based analysis to increase the availability and quality of striping condition data available for asset management decision making. This improved data will improve the ability to effectively plan and manage striping on all routes.

Next Steps to Reach Tier 1 Requirements

- Refine deterioration curves for durable striping.
- Collect additional information about the data on our non-interstate routes and the effects of funding (or the lack thereof) on those routes.
- Develop communication methods with the regions to report what is being re-striped and done by construction projects.
- Better define where and what pavement striping applications are required for all planned projects throughout the state.

Performance forecasting and targets are under development to fulfill Tier 1 management requirements.

Wall Management Plan

TAMP 2023 DRAFT

Introduction

Retaining walls are defined by UDOT as any vertical retaining structure over 3 feet high. Sound walls may or may not retain material in addition to providing a sound barrier. Both types of walls are included in this management plan. This management plan does not include walls that may be in the UDOT right-of-way but not maintained by UDOT. These walls are managed through a maintenance agreement with the wall owner.

Current Management Plan Status

WALL INVENTORY

The current inventory of walls is a database populated from construction as-built, lidar data, structural number assignments, a geotech database, and a previous research project. The inventory is incomplete and does not have an assigned person or group responsible for maintaining or updating the database. There is currently no defined process for collecting wall data. Wall attributes are listed within design plans. Structural numbers are assigned to retaining walls during design. The number is the same for each type of wall within a project with a, b, c, etc., attached to it if there is more than one wall of the same type in a project. These structural numbers and the noted attributes are stored in a Google sheet. Additional information on location and type of wall are not always included. Additionally, a consistent method of identifying wall type is not included in the lidar data collection process.

WALL CONDITION AND TARGETS

Very little condition data exists for UDOT walls. Currently the Structures and Geotechnical departments are notified if field staff raise concerns about a wall that arises during their normal field activities and inspections. UDOT geotechnical or structures staff members respond by inspecting the wall and requesting a work order if needed. No formal documentation process has been established. No condition targets have been established.

WALL FUNDING

Wall construction is funded through construction projects that include walls in the design. Currently, no additional funding is specifically identified for the maintenance or inspection of walls.

Vision and Next Steps For Wall Management

The UDOT vision is to manage walls as Tier 2 assets with condition-based targets. There are several initial steps required to begin the process of accomplishing this vision:

- Identify resources with the Structures Department necessary to collect and maintain an accurate inventory and condition database.
  - Develop a process to inventory walls and maintain a database of walls that includes rating criteria, QC/QA processes, inspection frequency, training required, and database management procedures in conjunction with maintenance and construction activities.
  - Define a different management plan for each wall type that includes inspection, rating, and data collection processes.
  - Use the forms from the 2009 Utah Transportation Research Advisory Council (UTRAC) project as a starting point for criteria.
- Develop a life-cycle plan for each wall type.

More Steps to Reach Tier 2 Requirements

Incorporate existing and new-construction data within the proposed maintenance database system, with provisions to accommodate more rigorous inspection and review processes.

- Use the list of wall types included in UDOT's maintenance system.

Barrier Management Plan

TAMP 2023 DRAFT

Introduction

The barrier-management plan and UDOT inventory includes cable, precast concrete, cast-in-place concrete, and guardrail barrier types, as well as all end treatments associated with those barrier types.

Current Management Plan Status

BARRIER INVENTORY

The inventory of barriers is obtained every 2 years from the lidar data-collection and photo log process. Barriers are measured by linear feet of each type and counted by each unit for the end treatments. The data is stored in a spreadsheet: Barrier Inventory. The data-collection process does not differentiate between permanent and temporary barriers.

BARRIER CONDITION AND TARGETS

UDOT's barrier assets are divided into three categories: (1) eligible for federal funding, (2) prior-generation, and (3) obsolete.

The target for obsolete barriers is 100% replacement. At current rates of funding, and with projects contributing according to the proposed policy, it will take 10 years to replace or eliminate 90% of obsolete barriers.

Prior-generation and eligible barriers do not have measures or targets set at this time.

BARRIER FUNDING - LIFE CYCLE COSTS

The life cycle of UDOT barrier assets is estimated at 30-50 years. The prior-generation barrier is less than 30 years old with installation started in the early 1990s. Therefore, no funding for maintenance or condition-based replacement has been established. Currently, transportation solutions funds are being used effectively to remove or replace obsolete barriers.

Sections of barrier that are impacted or deteriorate sooner than expected are replaced by maintenance staff on a reactionary basis.

Barrier Investment Strategy

We have proposed that all projects of a certain size and impact will be responsible for addressing obsolete barriers within the project limits. We have also been requesting funding for individual barrier projects. To further this process we have prioritized obsolete barriers by type, AADT, and posted speed.

Vision for Management Plan

Barriers are designated as Tier 2 assets and are therefore designated for condition-based management. Currently, condition data for barriers are not available and no process exists for systematically collecting condition data.

Next Steps to Manage Barriers as Tier 2 Assets

- Develop a condition-based management plan for prior generation's barriers by 2030. It is anticipated that the obsolescence-based management plan will need to be reintroduced within 10-15 years after that.
- Consider as an additional measure to replace obsolete barriers 10% per year by dollar amount.
- Adopt a crash-worthiness policy on how to deal with obsolete and prior-generation barriers based on the percentage of sections damaged or deteriorated.

Culvert Management Plan

TAMP 2023 DRAFT

Introduction

Culverts included in this management plan are storm drainage pipes and boxes with less than a 20-foot width, as measured parallel to the centerline of the road. Pipe culvert inventory includes corrugated steel, reinforced concrete, plastic, and very limited numbers of other materials. End sections, grates, and all other associated attachments are included in the culvert inventory.

Current Management Plan Status

Figure 15. Overall Pipe Rating Method.

CULVERT INVENTORY

The current inventory of culverts is a combination of three incomplete and outdated data sets. There is currently no defined process for collecting culvert data. Each region and the Maintenance Department have their own system for collecting and storing culvert data.

- A process has been proposed with data collection prioritized based on natural hazard risks, which includes flooding, and MS4 water quality on a percentage basis each year. From this collection, condition and risk will be used to prioritize its next collection date.

CULVERT CONDITION AND TARGETS

The method for determining the Overall Pipe Rating (OPR) is based on the NASSCO Quick Rating Method. Each pipe is inspected and given a score from 5,949 (highest severity) to 1,010 (lowest severity) using the four scores shown in the figure below. Rating includes barrel alignment, joint defects, corrosion, cracking, surface damage, deformity, and splits.

The severity grade scores for this rating method are based on a system from the Pipeline Assessment and Certification Program (PACP). A rating of 1–5 is assigned for defects by material type. The condition defects by material type are defined in the UDOT Pipe Defect Rating Sheets.

Targets are proposed based on ratings of good, fair and poor culvert conditions:

- Good: greater than 55%, based on a score of less than 2,999
- Fair: 35% based on a score of 3,000–4,000
- Poor: less than 10%, based on a score of greater than 4,000

CULVERT FUNDING

Culvert rehabilitation and new installation is funded through general construction projects and through culvert-specific construction projects Pipe reconstruction, rehabilitation, and maintenance expenditures average $4 million per year based on historical ePM/OMS data. The cost of a culvert inspection program is estimated to be $3.4 million per year based on recent data from Region 2. This cost would cover inspection of 10% of the currently known culvert inventory per year and includes the cleaning of the culverts for proper evaluation.

No culvert inspection funding is presently identified. A request for funding a formal culvert program will be made when additional data has been collected.

Vision and Next Steps For Culvert Management

The UDOT vision is to manage culverts as Tier 2 assets with condition-based targets. There are several initial steps required to begin the process of accomplishing this vision:

- Develop a process to obtain and maintain a complete and accurate inventory and condition database.
  - A system has been proposed and is being reviewed.
  - The ATOM system, when in place, will record updates and edits from inspections by the maintenance staff.
- Establish an inspection cycle and rating system for consistent condition analysis.
  - A cycle and rating system has been proposed.
- Develop a Statewide Culvert Asset Management Manual.

More Steps to Reach Tier 2 Requirements

- Develop a capital-improvement project list after data collection is complete.
- Develop life-cycle cost data from initial deterioration curves.
  - Deterioration curves are being developed through a current UTRAC project.

Overhead and Multi-Post Sign Management Plan

TAMP 2023 DRAFT

Introduction

Signs included as UDOT Tier 2 assets and covered by the Sign Management plan are all overhead signs and ground-mounted signs with more than one post. The management plan includes the elements of the signs including the sign face, posts, foundation, and hardware. VMS signs (electronics) are managed in the ITS plan, sign supports are part of overhead sign management plan.

Current Management Plan Status

SIGN INVENTORY

The current inventory of signs is collected and updated during the biennial lidar asset data collection process. The inventory includes location, size, sign-face condition, and some information on the mountings. Data regarding post and foundation condition are not collected and there is no assigned person or group responsible for inspecting these features. The year of sign installation has been marked on the back of each sign face starting in 2016.

SIGN CONDITION AND TARGETS

Condition (legibility) of the sign-face material is collected, but the rating may not be consistently applied. Retroreflectivity data are not currently routinely collected. Data regarding condition of posts and foundations are not collected. Due to the lack of condition data, no targets have been set for sign condition.

There is a crash-rating system for the ground-mounted sign foundations. Grading around the foundation is the primary element of concern. The relevant information is collected inconsistently due to lack of cell phone coverage in some areas to use the available app. The data collected without using the app are not going into a central repository.

SIGN FUNDING

Sign installation is funded through construction projects and occasionally through a specific sign project. Currently, no additional funding is specifically identified for the maintenance or inspection of signs. Maintenance funds are used to refresh galvanization or to paint sign structures when needs are identified.

No funding is currently designated to replace existing overhead sign structures as a result of structural obsolescence.

Vision and Next Steps For Sign Management

The UDOT vision is to manage overhead and multi-post signs as Tier 2 assets with condition-based targets. The management plan will include routine inspection and maintenance of overhead structures focusing first on the oldest installations. The plan will also consider the cost-effectiveness of collecting and maintaining retro-reflectivity data. There are several initial steps required to begin the process of accomplishing this vision:

- Identify an owner for the sign asset responsible for creating and maintaining the management plan.
- Obtain the resources necessary to collect and maintain an accurate inventory and condition database.
  - Currently, traffic and safety and maintenance have reactive involvement.
  - Structures collects and organizes structure information for new overhead signs.
- Develop a process to inventory and maintain a condition database of signs, including rating criteria, QC/QA processes, inspection frequency, training required, and database management procedures in conjunction with maintenance and construction activities.
  - The Local Technical Assistance Program at Utah State University has been approached to establish the contents of an inspection database.

Tier 3 Assets

Reactive Management

Assets in the Tier 3 management level are assigned to the Maintenance Division and are managed reactively as needed as they are damaged or as they deteriorate beyond usefulness.

Inventory and condition data to manage these assets are collected as needed by maintenance staff during their regular duties.

UTAH TRANSPORTATION ASSET MANAGEMENT PLAN

2023 Draft

Utah Department of Transportation

UDOT Keeping Utah Moving