Infrastructure Asset Line Appendices

Amtrak's Five-Year Plans

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Amtrak's FY24-29 Five-Year Plans

AMTRAK®

FY24-29
Five-Year Plans

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Appendix A: Asset Management Plan

Since 2016, Amtrak's IMCS Department has undertaken a review of its Asset Management maturity, developed a roadmap for improvement and proactively progressed its Asset Management capabilities. This section provides a summary of the current state.

Overview

Appendix A sets out Amtrak's plan for managing the infrastructure it owns and/or maintains, including its Asset Management Policy. The appendix provides a summary of the organization and its roles and responsibilities and the key business processes that guide Amtrak IMCS in delivering safe and reliable infrastructure.

Background

In 2006, Amtrak's IMCS Department selected and implemented a work and asset management software system. The Computerized Maintenance Management System (CMMS) was initially designed to be used for timekeeping and the management of compliance with federally mandated inspections of infrastructure assets. However, over the last decade, Amtrak's use of the CMMS has continued to grow.

Data regarding inspection completion and non-conforming items is continuing to be captured electronically and data about asset maintenance and replacement is now tracked by the Maintenance organization and Technical Disciplines. Although that information is not currently integrated into existing work identification, prioritization and/or scheduling processes, the goal is to further develop this program within the period of this plan to incorporate information about asset condition into planning infrastructure work. The Industrial & Systems Engineering teams within IMCS have recently began to document current preventative maintenance activities within the various discipline-specific manuals, as well as consult with Deputy Chief Engineers to fully understand current maintenance processes to develop a standardized preventative maintenance regime for each asset within each discipline. These standardized maintenance activities will be uploaded into the CMMS and sent to the responsible parties to carry out within the specificized timeframe thus allowing the ability to appropriately define, schedule, and record maintenance work being completed, extending the overall life of an asset.

Recent changes to the management structure and the introduction of FAST Act have resulted in a recognition of improvements that are necessary to introduce a proactive management approach by which engineers can make data-driven decisions – setting full life cycle strategies, establishing standards, and defining the necessary investment and maintenance work.

An early adopter of this process is the Roadway Equipment team, who is currently recording roughly 30% of all preventative maintenance and equipment overhauls into the CMMS. Current maintenance planning practices include inspections performed ahead of a scheduled maintenance day or upon arrival into the shop to detect and document any defects with the plan to address them during the scheduled down time in the shop. The RWE team is also using task lists within the system to plan out the scope of work based on Foreman experience, maintenance manuals, and/or any feedback from inspections or unresolved corrective maintenance issues that were applied as temporary fixes in the field. Collaboration with equipment operators and their respective leadership also takes place to better plan and attribute the appropriate labor for large maintenance projects such as overhauls. Further advancement of the maintenance development initiative is underway to begin using task and engine hour data to build out usage-based preventative maintenance schedules that would automatically generate and assign work orders within the system. Digitization of the Work Equipment Daily Maintenance and Inspection Logbook (RMM Log) is also being developed, which will also automatically generate work orders in the system and proactively plan appropriate maintenance measures.

These learnings will be combined with the maintenance regime work outlined above to establish holistic maintenance strategies within the other engineering disciplines.

Asset Management Policy

The Asset Management Policy defines the guiding principles by which Amtrak will manage the infrastructure it owns and maintains. This policy establishes the direction and objectives for developing asset management capability and implementing an asset management plan.

Purpose

Infrastructure asset management is the strategic and systematic practice of operating, inspecting, maintaining, rehabilitating, and replacing infrastructure assets. Underpinning asset management is the strategy of preserving existing assets to extend the asset's useful life and performance. Assets will be maintained and replaced consistent with their criticality to customer service. Infrastructure asset management is a strategic approach to maximizing useful life and high service reliability while minimizing lifecycle cost at a holistic level across asset classes. This is performed with an awareness of the needs associated with existing infrastructure, high speed trainsets, increased demand, and profitable growth.

Principles

The Asset Management Policy applies to all infrastructure assets owned or maintained by Amtrak. It is governed by the following seven standards:

1. Asset management is undertaken within a transparent, integrated corporate-wide framework. Asset management requires the delivery by all Amtrak departments of their respective responsibilities hereunder to ensure that the goals and objectives of Amtrak's service levels are effectively and efficiently supported.

2. Ownership, control, accountability, and reporting requirements for assets are established, clearly communicated, and implemented. Explicitly defined roles and responsibilities are established for the management of infrastructure assets. Maintenance access is factored into train operating plans. There is a shared responsibility between Transportation and IMCS for safety, reliability, and holistic assessment of on-time performance (OTP).

3. Risk management (criticality) is used to inform the asset management decision-making process. We will continually work to better understand the characteristics of infrastructure assets through a risk management framework that will advance preventive activities to reduce risks based on their impact on of safety, service and reliability.

4. Best in class, appropriate asset management practices are used throughout all stages of the infrastructure lifecycle. The asset management system will control activities to meet the safe, reliable, high-performance expectations of our customers and stakeholders. There is **one** infrastructure asset management plan in place, managed by the IMCS Department, in collaboration with Capital Delivery Engineering Services.

5. Lifecycle costs are fundamental to all significant investment options and decision making. Decisions will be data driven and consider all aspects of an asset's lifecycle and its impact across asset classes. Asset management plans will exist for each asset class (Track [TK], Electric Traction [ET], Communications and Signals [C&S], Bridges and Buildings [B&B]). These plans define the condition and performance objectives for the assets, establish the standards for accomplishment and determine the resources necessary for implementation (of the plan). The asset management plans will be fully aligned with federal rules and regulations. Corporate policies and/or practices will be adhered to for justification and acquisition of capital approval.

6. Amtrak's enterprise technology provides information systems that support meaningful information for investment and management decision making. A single system of record will be used for all asset data. Information will be transparent and accessible to those responsible for infrastructure asset management. All work will be recorded in the single system of record. There will be no work on the infrastructure without a work order.

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Asset Management systems, processes, and practices will continually be improved. The biennial infrastructure asset management plan will include an improvement plan that will direct process improvement efforts. Quality assurance will ensure that asset maintenance is conducted correctly and that asset management activities are aligned with Amtrak's vision, goals and objectives. This plan will align with corporate asset management policies as they are developed.

Responsibility

The Infrastructure Asset Management Plan will be delivered as follows:

1. *Asset Technical Owners.* Deputy Chief Engineers of Track, ET, C&S, and B&B are responsible to:
    a. Ensure infrastructure assets achieve their ideal economic life through asset maintenance strategy
    b. Determine optimal point of replacement prescribed by asset renewal strategy
    c. Prioritize asset renewal requirements to ensure cross asset investment optimization
    d. Establish, with Transportation, asset criticality through identification of infrastructure pinch points

2. *IMCS Asset Management Planning.*
    a. Work closely with the Deputy Chief Engineers of Track, ET, C&S, and B&B to update asset management strategies within each of the discipline-specific appendices
    b. Collaborate with IMCS Leadership and Capital Delivery to ensure context within the IALP accurately depicts current processes and strategies
    c. Ensure infrastructure asset inventory remains up to date within the GIS database and discipline-specific data models are accessible to DCEs and executive leadership to allow visibility into asset lifecycles and SOGR scores
    d. Update and deliver the Infrastructure Asset Line Plan biennially in compliance with the FAST Act and Amtrak NEC Grant Agreement

3. *Asset Plan Delivery.* Assistant Vice President (AVP) of Maintenance of Way is responsible to:
    a. Implement the maintenance strategy developed by the Asset Technical Owners
    b. Provide asset condition and risk assessment information to Asset Technical Owners
    c. Document all infrastructure work through work orders
    d. Share reliability and OTP goals with Vice President (VP) of Transportation
    e. Jointly own track access plans with VP Transportation

4. *Infrastructure Project Delivery.* Vice President (VP) Infrastructure Project Delivery is responsible to:
    a. Manage delivery of capital projects within scope, schedule, and budget
    b. Ensure opportunities for piggybacking maintenance on capital projects track access are explored
    c. Manage the transition of new and rehabilitated assets to operations and maintenance

5. *Asset Management Essential Support.* Asset Management is undertaken within a transparent, integrated, corporate-wide framework.

    a. <u>EVP Business Transformation and Chief Financial Officer</u>: Deliver a reliable funding stream that aligns with the Infrastructure Asset Management Plan. Provide current, reliable and easy-to-access financial information to permit analysis of asset useful life and replacement costs.

    b. <u>EVP Marketing and Chief Commercial Officer</u>: Deliver a long-term business plan for the Northeast Corridor consistent with established asset criticality and the **one** infrastructure asset management plan.

c. VP Operations Transportation: Jointly with AVP of Maintenance of Way, own track access plans having shared reliability and OTP goals.

d. VP Chief Procurement & Supply Chain Officer: Maintain inventory investment to support asset maintenance plans; deliver a staff of professional buyers who understand infrastructure commodities, services, and equipment for timely purchase; lead strategic acquisitions of equipment to support asset renewal strategy. Establish and publish standard purchase action lead times by level of complexity and cost. Provide reliable purchase delivery status to ensure materials, equipment, and services are smoothly integrated into work plans.

e. EVP Chief Safety Officer: Deliver a trained and fully staffed IMCS workforce that aligns with the 1-5-year asset renewal plan.

f. EVP Digital Technology and Innovation (CIO): Deliver a best-in-class computerized maintenance management system (CMMS); highly skilled developers and support staff who understand out of the box CMMS functionality; a mobility solution for work and asset management to IMCS front line personnel; develop and deliver service level agreements to ensure the efficiency and effectiveness of user support.

Leadership Commitment

AMTRAK®

Infrastructure Asset Management Policy

Leadership Commitment:

CEO	Stephen Gardner
President	Roger Harris
EVP Service Delivery & Operations	Gerhard Williams
VP Infrastructure Maintenance & Construction Services	Donald Lee Moss

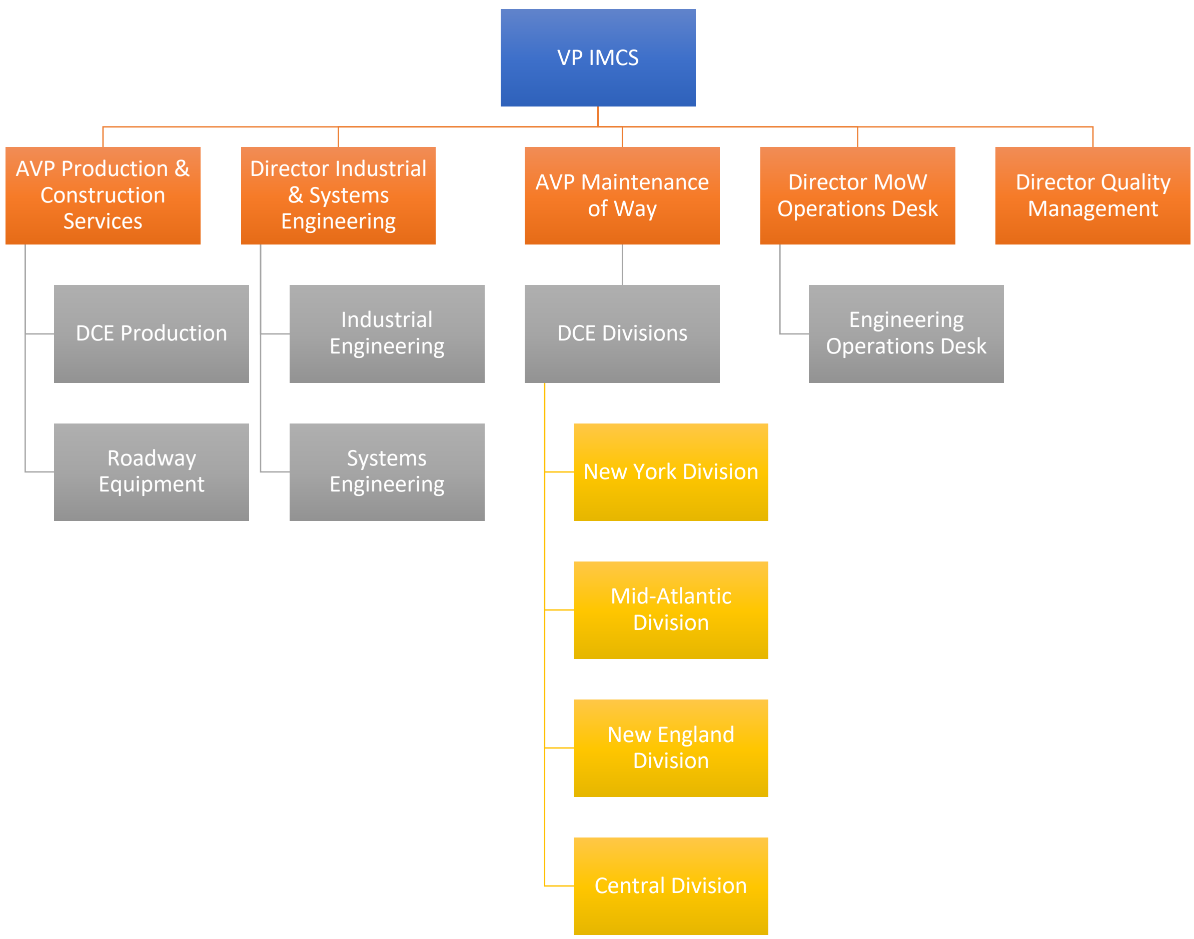
Asset Management Practices

Infrastructure Asset Management at Amtrak is enabled through an organization, with asset and asset management decisions informed by asset knowledge and information, supported by technology and implemented through business processes that ensure we have consistent practices.

IMCS Organization

Amtrak manages its infrastructure through the following organizational structure (see Figure 6).

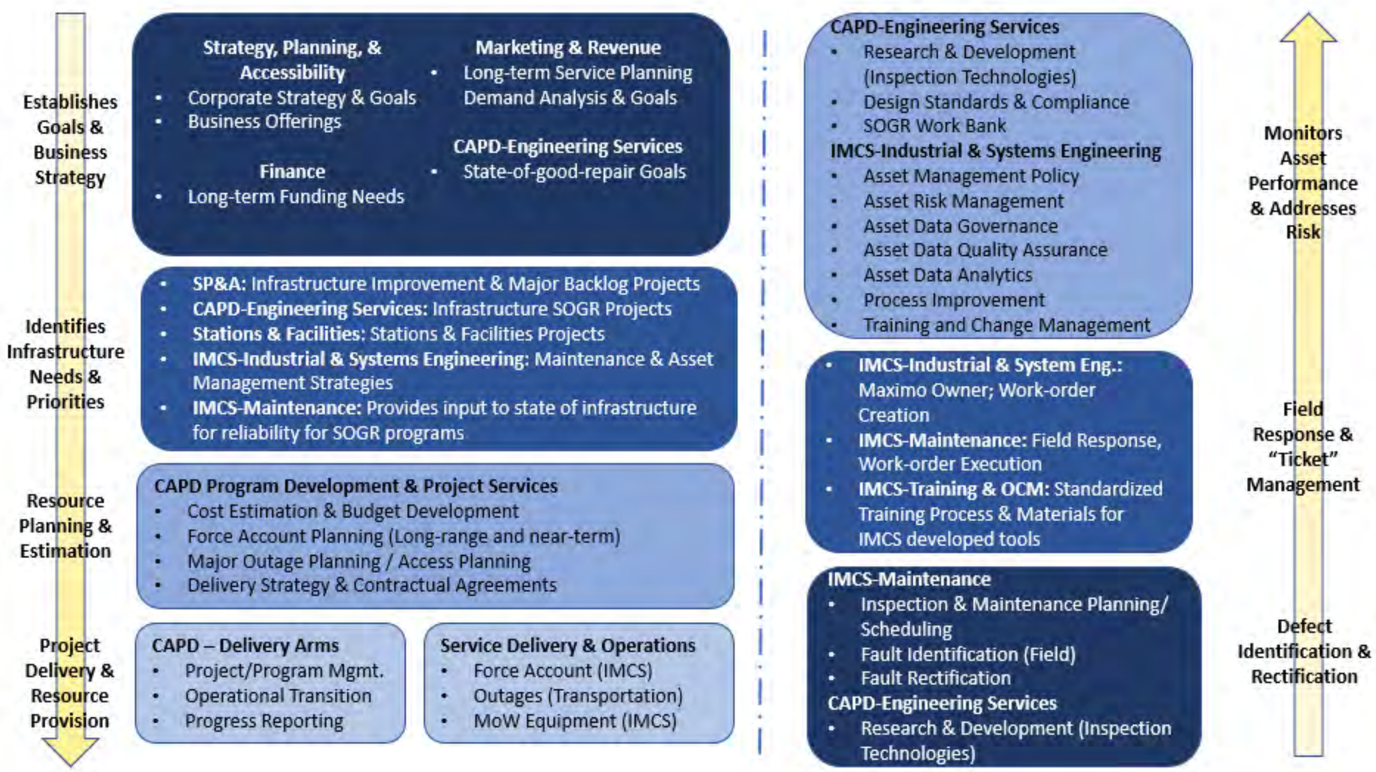
Figure 6: Amtrak IMCS Department – Organization



Asset Management Framework

The framework detailed below highlights the connection between IMCS and Capital Delivery, and the strategies established to ensure successful implementation of high-quality asset management policies and practices.

Figure 7: Amtrak Asset Management Framework



Infrastructure Asset Management

The key roles and responsibilities related to Amtrak's asset management strategy are summarized below:

- Establish Goals & Business Strategy – To ensure the organization's overall success, multiple teams contribute to long-term strategic planning, guided primarily by the organization's Annual Operating Plan. Asset management goals originate from different departments within the organization and are overseen by Executive Leadership within their respective subject matter areas. The Strategy, Planning, and Accessibility teams align their objectives with corporate strategies and business services. Meanwhile, Marketing and Revenue set their aims based on service planning and in-depth demand analysis. The Engineering Services team within the Capital Delivery department prioritizes their projects with the overall goal of maintaining assets in a state-of-good-repair. The Finance department ultimately decides on long-term funding requirements based on the diverse goals presented.

- Identify Infrastructure Needs and Priorities – Teams within IMCS and Capital Delivery (CAPD) work together to address the pressing needs and priorities of Amtrak's aging infrastructure. The IMCS - Industrial & Systems Engineering Department acts as a vital resource for IMCS and other business lines, improving the effectiveness and quality of asset management by devising asset management strategies and developing advanced tools for infrastructure data collection and analysis. The Strategy, Planning, and Accessibility teams prioritize infrastructure improvements and major backlog activities, whereas Capital Delivery - Engineering Services focuses on maintaining infrastructure in a state-of-good-repair. IMCS – Maintenance provides perspective on infrastructure asset health to ensure the basis for the SOGR programs, while Stations and Facilities focuses on just that, the overall health of stations and facilities.

- Resource Planning and Implementation – The CAPD Program Development and Project Services team mission is to develop, maintain, and facilitate the implementation of a resource constrained, long-range, capital plan and ensure resource allocation decisions maximize productivity and efficiencies and reflect the collective best interest.

- Project Delivery and Resource Provision – Program and Project Managers within CAPD – Delivery plans work closely with Production leadership to ensure projects adhere to the planned timeline and budget. The two teams convene on a recurring basis in a series of "T-" meetings before and after each project to share updates regarding the project's scope, schedule, and budget, with the aim to address any potential risks that could impact on-time project delivery.

  In addition, the Service Delivery and Operations (SD&O) organization holds a pivotal position in ensuring that projects are executed punctually, and resources are allocated optimally. The meticulous budgeting of force accounts, denoting the structured management of internal labor and resources, is imperative. Moreover, it is incumbent upon SD&O to systematically coordinate track outages in conjunction with the Transportation department, a step that mitigates potential disruptions and fosters seamless project evolution. Additionally, the availability of reliable equipment is of utmost significance. Collectively, these measures not only fortify the successful realization of a project but also assure the efficacious deployment of all requisite resources.

→ Defect Identification and Rectification – Defects in infrastructure assets are discovered either through reported asset failures or from anomalies found during routine inspections by the discipline specific IMCS – Maintenance teams. Once a defect is pinpointed, it is up to the field personnel to address it on-site and report both the cause and the resolution. This data is then documented in the specific work order created for that incident in Maximo.

To improve routine inspections, the Research and Development team within Capital Delivery is currently evaluating cutting-edge inspection technologies. These sophisticated tools will enable more assets to be inspected in less time, boosting defect detections and, in turn, enhancing overall asset reliability.

→ Field Response and Ticket Management – When an infrastructure asset failure occurs, it is reported through various channels to the IMCS - Engineering Operations Desk. Here, a work order is initiated in Maximo, remaining open until the proper cause and remedy have been identified and reported. Maintenance field personnel are tasked with addressing such asset failures and must promptly report the corrective action to the Engineering Operations Desk. For specific failures such as Geometry Car Level 1 incidents or Sperry Car Defects, while the Engineering Operations Desk is responsible for initiating the ticket into Maximo, it is up to the relevant department within IMCS – Maintenance to provide details on the cause and remedy to close out the work order in Maximo.

To provide more clarity, the AVP of Maintenance of Way oversees immediate responses to incidents, while the DCEs for the asset classes are involved in investigation and review. (Please note: There are distinct procedures for major incident and event management which are overseen by Transportation and other departments based on the incident's severity and nature, which are not covered in this context).

→ Monitoring Asset Performance and Addressing Risk – To enhance asset reliability, both the Capital Delivery and IMCS teams play crucial roles in monitoring asset performance and mitigating risks.

The teams and activities within Capital Delivery that help carry out this initiative include the Design Standards and Compliance groups, the SOGR work bank, and a recently established team known as the Research and Development group, which specializes in advanced data collection techniques and inspection technologies. The CAPD - Research and Development group has most recently tested programs such as Pavemetrics' L-Rail for visual track assessment and ENSCO's "virtual track walk" technology, aiming to potentially replace human track inspectors and increase coverage of inspected territories more efficiently. Furthermore, the CAPD - Design Standards and Compliance team focuses on implementing the latest designs and technology to enhance overall asset performance and reliability. To maintain a steady state, or normalized, replacement cycle and avoid an increase in the SOGR backlog, CAPD prioritizes annual asset replacements within the established SOGR work bank. The work bank is determined based on Amtrak-employed lifecycle management strategies that can be found within each discipline-focused appendix.

The IMCS - I&SE team refines existing business processes, ensuring the delivery of accurate information which in turn aids leadership in making informed choices. The recent integration of tools, such as the IALP SOGR Dashboard, has been pivotal, granting immediate insights into asset inventories, stability metrics, SOGR ratings, and financial data to DCEs and other decision-makers. Automated connections between dashboards and data collected using digital tools have elevated the quality of asset reporting, promoting better asset care.

The I&SE team has also founded a Training and Organizational Change Management department. The goal of this team is to increase understanding and utilization of the tools developed by IMCS using effective and consistent communication, as well as more impactful and engaging training opportunities. By providing IMCS employees with consistent messaging and more training opportunities, work should become more standardized across IMCS groups and ultimately, more efficient.

IMCS Asset Management Team

To coordinate and bring various asset management activities together across IMCS, the Industrial and Systems Engineering team collaborates with key champions in the technical disciplines and divisions to:

- → Support the delivery of the improvement activities in the *IMCS Asset Management Improvement Program*.
- → Guide the identification of improvement opportunities and direct actions to improve future planning performance.
- → Support the communication and circulation of information about EAM and the Asset Management Plan.
- → Solicit input about the Infrastructure Asset Management Plan and the EAM planning process to support future improvements.

Core Business Processes

Table 8 below provides a summary of Amtrak's core business processes and planned improvements to deliver the *Infrastructure Asset Management System*.

To demonstrate the interactions between core business processes to achieve our performance objectives we have developed the following series of five *core process workflow* diagrams (see Figures 8 through 12).

Figure 8: Providing safe and reliable infrastructure for train services – through a day-to-day focus on asset performance

The workflow demonstrates how Amtrak currently manages the infrastructure on a day-to-day basis with a focus on safety and reliability, addressing issues as they arise and identifying opportunities for improvement.

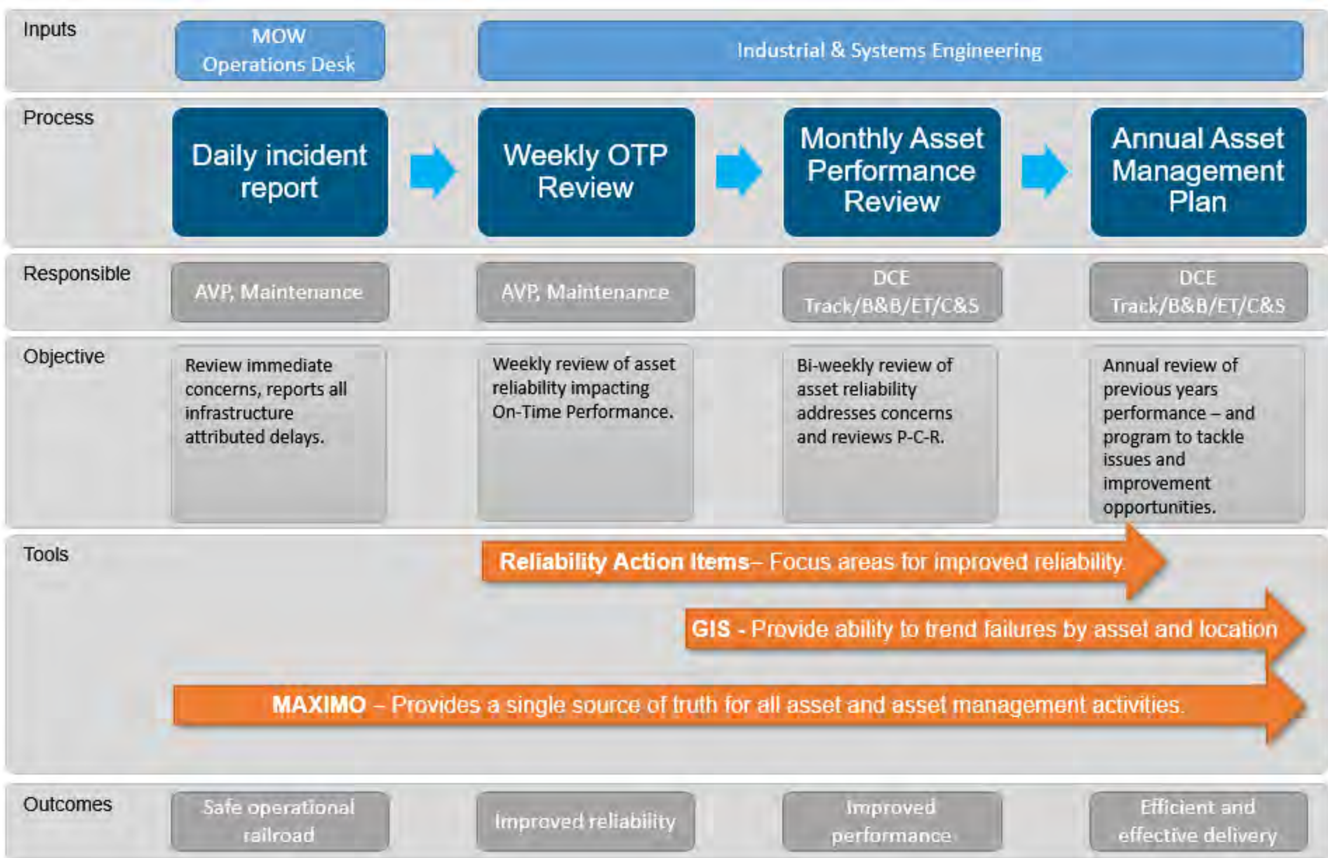
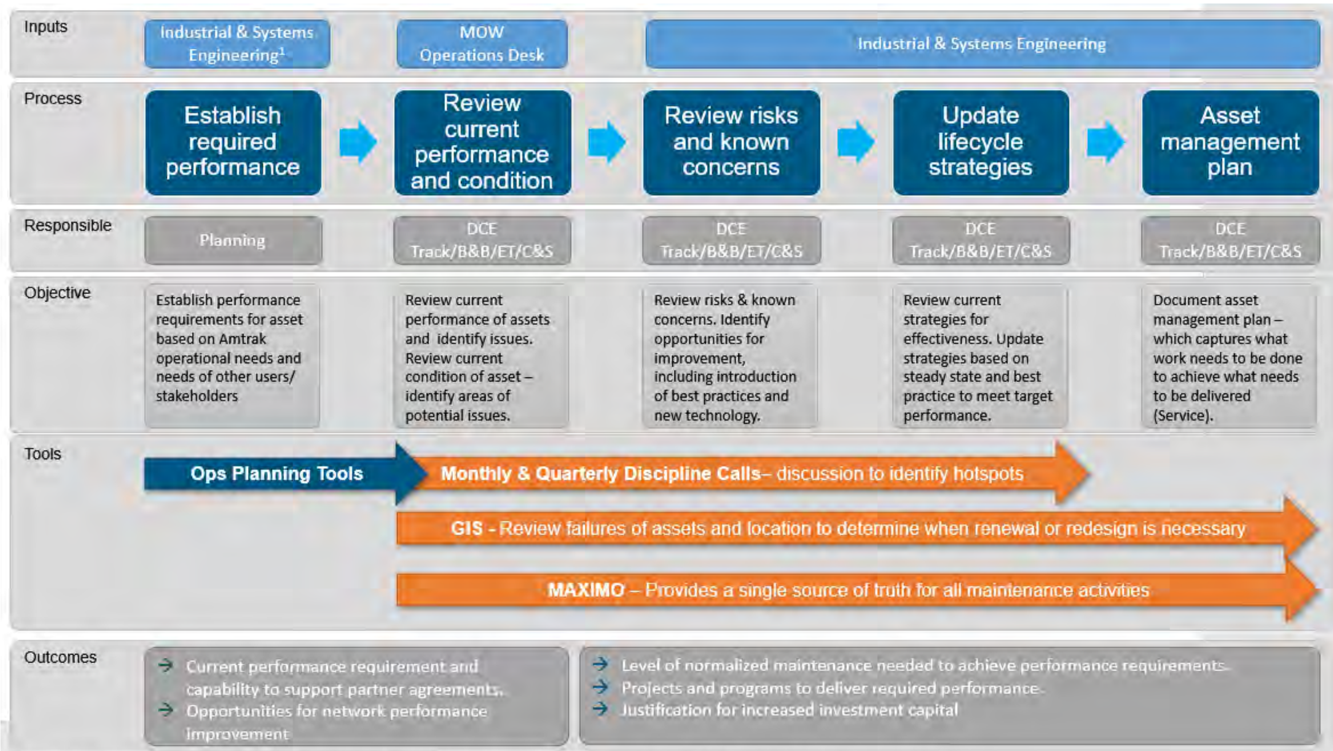


Figure 9: Obtaining funding and financing for infrastructure investment and improving network performance – through a more comprehensive asset management planning approach

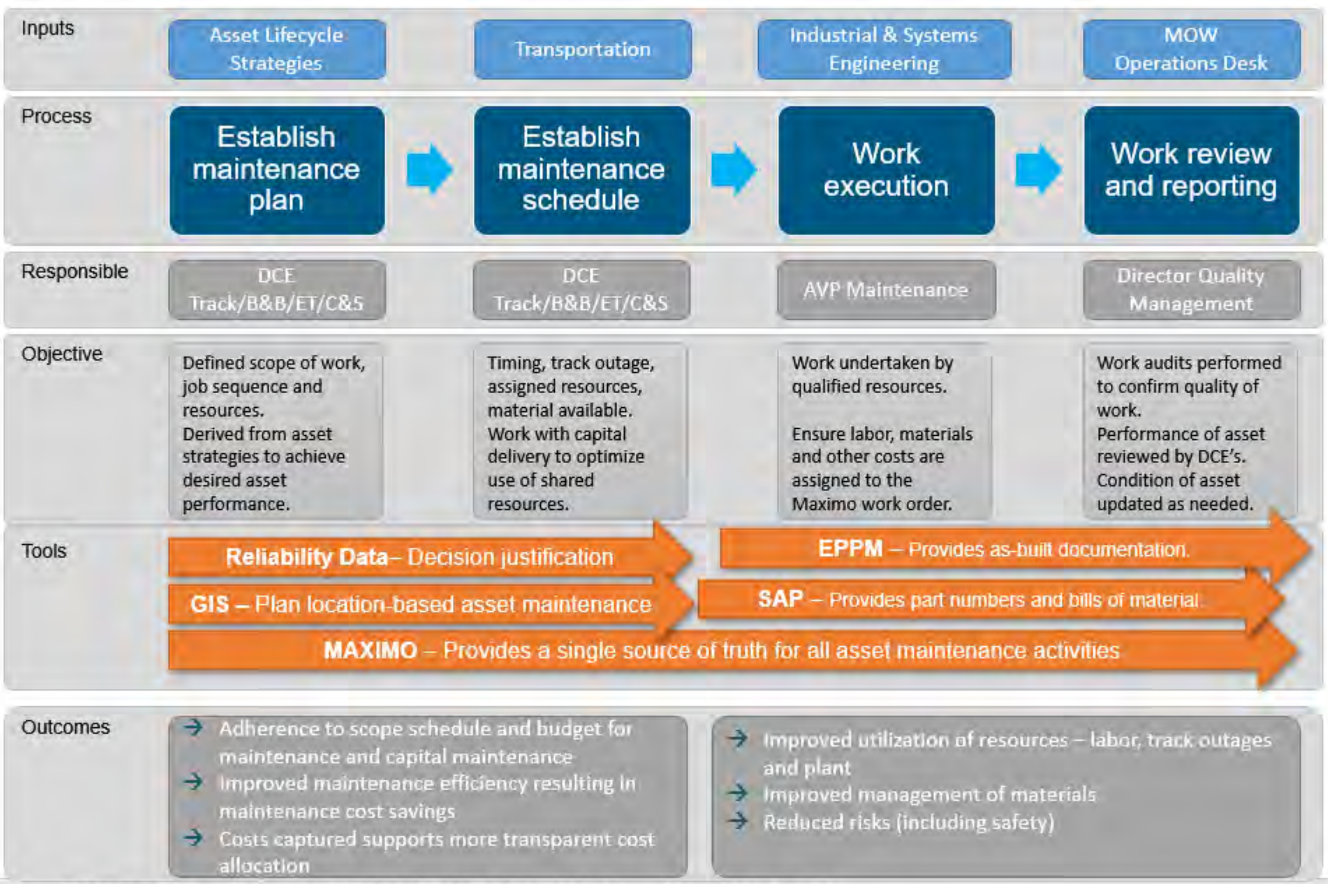
The workflow demonstrates how Amtrak plans to develop asset plans to achieve the required infrastructure performance – including where necessary future network performance.



1. *Amtrak Service Lines: NEC Business Development, State Supported Services Business Development; Long Distance Business Development*

Figure 10: Supporting adherence to the cost allocation policy - through better maintenance planning and cost capture

The workflow demonstrates how Amtrak plans to deliver maintenance to provide cost transparency and support adherence to the cost allocation policy.



1. *Condition Assessment Framework – updated condition depending on type of maintenance activity*

Figure 11: Improving capital planning - through prioritized plans that are linked to performance requirements
The workflow demonstrates how Amtrak plans to improve capital planning to ensure goal driven projects and programs are established to deliver required performance, and support justification for increased capital investment.

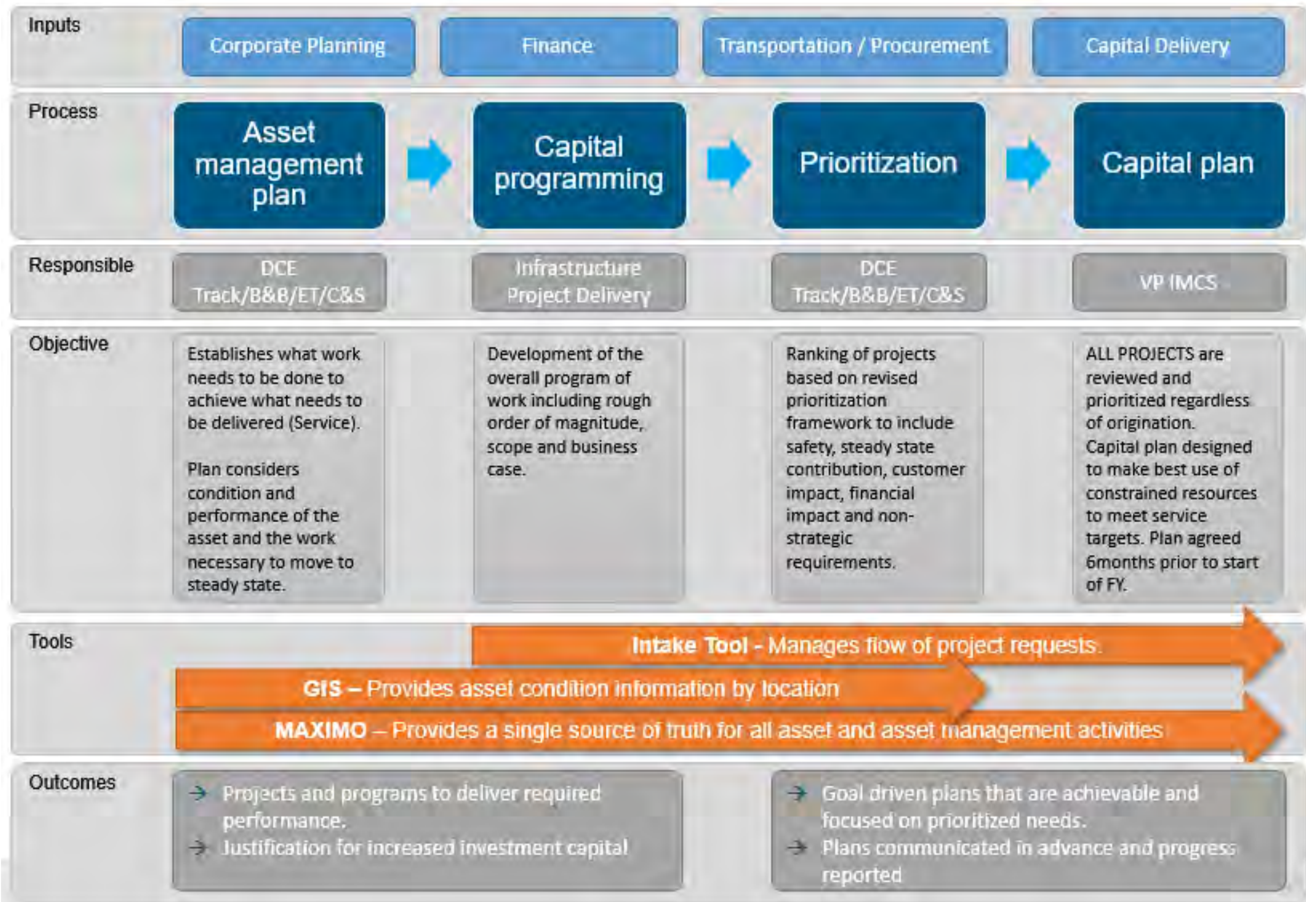


Figure 12: Improving project delivery - through better capital project management and close out

The workflow demonstrates how Amtrak currently delivers capital projects

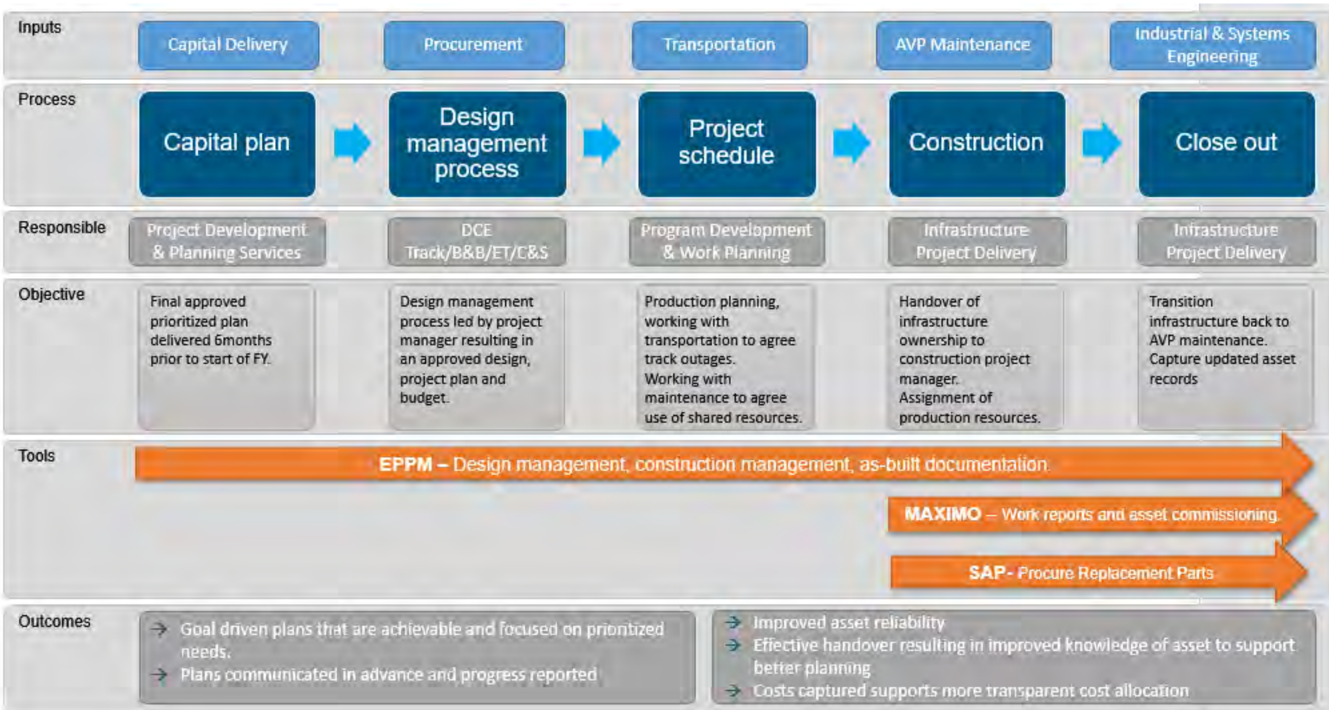


Table 8: Amtrak IMCS - Core Business Processes - Status and Improvement Initiatives

Core Process	Status	Improvement Initiative
Alignment to organizational goals		
Long-term strategic planning	Organization strategic planning is not at sufficient granularity, to translate into asset or asset management objectives.	Align Amtrak's five-year corporate strategy, Five-Year Service Line Plans and the asset plans, to establish a clear, common purpose.
Service planning	Current service plans do not provide the level of specificity needed to develop technical levels of service (performance targets) for each asset class.	Further develop Amtrak's Five-Year Service Line Plans, capturing customer level-of-service targets for infrastructure performance, and align with service agreements with Amtrak Transportation and other users of (commuter and freight) Amtrak's infrastructure.
Control of assets		
Daily incident reporting	Daily incident reporting and reviews are conducted by IMCS management each morning. The review considers all faults or failures resulting in train delays. Immediate concerns are identified, and plans put in place to address. *New report format – delivered by the Engineering Operations Desk – sets out what happened, the cause and how it was resolved (referred to as problem-cause-remedy). Further analysis is conducted on repeat failures within a 90-day period.*	Continue to develop and roll-out reporting in line with further development of asset and asset management performance measures.

Monthly asset performance review meeting	Monthly reviews of the asset performance, projects and initiatives are conducted by the DCE's for Track, B&B, ET, and C&S. Action on systemic and repetitive failures are taken.	Further develop monthly asset performance review meetings to include monitoring and review of asset management planning.
Management system	Asset standards, procedures, and specifications are documented, but in some areas require updating. Asset management practices are being developed – including reliability monitoring, condition assessment, lifecycle strategies, asset management plan development and review and capital prioritization.	An overall asset management framework has been developed and a plan established to continue to document standardized asset and asset management practices during the planning period.
Key performance measures	Key Performance Indicators are primarily associated with on-time performance of trains, with the greatest performance benefits associated specifically with Acela trains. Performance measures related to infrastructure performance have been introduced as part of the Annual Operating Plan. Measures focus on OTP and reliability action improvements. Targets are set quarterly and focused on addressing asset issues.	Continue to progress the development of asset and asset management performance measures.
Work activity assurance and review	*For FRA mandated inspections:* An audit process is in place to ensure that inspections required by FRA and Amtrak standards are undertaken and appropriately recorded. *For maintenance and construction activities:* There is currently no audit program to ensure maintenance was conducted efficiently or completely.	Introduction of a quality management team to ensure that processes and procedures are followed and provide confidence that "we do what we say we do". Alignment of inspections with asset information needs.
Asset management decision making		
Asset strategies	Current maintenance limits and requirements for inspections are captured in each asset class' standards. Lifecycle strategies for capital maintenance, replacement and improvement were developed for I-AMP2017 and have been updated as part of IALP2024. The strategies begin to define the steady state or normalized maintenance necessary to sustain each asset class and estimate the state of good repair backlog necessary to transition to steady state.	Continue developing the asset lifecycle strategies through the plan period. This will include further analysis of the strategy based on updated asset information and further analysis of the implementation of the strategies based on funding levels and addressing other issues (track access, resourcing etc.).
Prioritization processes	Prioritization of asset investments was introduced during 2018 for the development of the 2019 construction program. The approach scored each project against three key pillars – safety, customer service and financial excellence. This process continues to be refined through 2023 and 2024.	Introduction of a criticality framework to determine the service impact of individual sections of the Amtrak system. Introduction of a capital evaluation and prioritization processes and procedures that require lifecycle cost analysis, consider full benefit/ costs and include risk and criticality assessment. The process will be applied to all projects regardless of origination. This will ensure constrained resources are properly utilized to address the needs of the infrastructure that have the greatest impact on performance *overall.*
Asset management planning processes	I-AMP2017 established a baseline from which Amtrak IMCS will continue to develop its practices.	The processes for managing asset management planning and ensuring it is integrated into other business planning processes, including maintenance and capital budgeting, will be implemented through the plan period.

Condition assessment	Amtrak IMCS, in collaboration with CAPD Engineering Services, will undertake a range of condition assessment processes as further described in the appendices. These assessments focus on ensuring the assets current condition meets safe operational standards. Pursuant to 49 U.S.C § 24904(c) Amtrak developed an asset condition assessment framework and a series of guides for each asset class. The framework assesses the long-term *condition* of the asset and is used to support capital planning and prioritization decisions.	Amtrak IMCS is currently in the process of updating and implementing an asset condition assessment framework and a series of guides for each asset class.
Capital planning and delivery		
Capital program development	The capital program consists of capital maintenance, capital replacement and capital improvement projects. Capital maintenance and replacement projects are requested through an established IMCS business process. Capital Improvement projects are identified by Corporate Planning.	Improve as part of the documentation of standardized asset management practices.
Capital project delivery management	Amtrak has processes in place to ensure that construction standards and quality control are achieved. The procurement process for contracted work is also well-defined.	No action required.
Asset commissioning and handover	Current processes for commissioning and handover of assets are not well documented. The transitioning task is left to the project manager resulting in inconsistencies and gaps.	Improved as part of the documentation of standardized asset management practices.
Maintenance Planning and delivery		
Mandated asset inspections/ condition monitoring	Amtrak IMCS currently conducts extensive condition monitoring (inspection) programs of all its infrastructure assets, as further described in the appendices.	No action required.
Maintenance definition/ planning	Current maintenance limits are captured in each asset class' standards. Preventive maintenance is generally not undertaken. Maintenance planning is inhibited by the high volume of reactive/corrective work necessary.	Plan and implement a maintenance frequency regime for all asset classes to determine the most appropriate strategy is in place.
Inventory management	SAP is used to manage the materials inventory. Processes are in place for aligning material availability to recurring inspections and maintenance. However, inventory is not always available to meet emerging needs. Material usage reports support efforts to optimize inventory levels and determine which materials should be considered for obsolescence.	Asset management plan will provide a forward view of necessary work. Procurement to review purchase action lead times and develop procurement plan aligned to asset management plan.
Operations and incident management		
Operations management/ access planning	Track access remains a challenge for Amtrak. Processes are in place for scheduling major track outages, but as much of the maintenance intervention is reactive, attaining planned outages is challenging.	Review and further development of the track outage process – including review of opportunities to re-engineer the current process to provide improved planning to enable better use of track access time. This will include developing processes to deliver better 'piggybacking' of track access.

Engineering Operations Desk processes	The Engineering Operations Desk is responsible for documenting asset failure information in the EAMS and analyzing and reporting that information to management. The information is received from front-line support desks such as the C&S Trouble Desk and ET Power Directors, or directly from the Transportation department when those processes do not exist. Work orders are created and routed to field personnel to complete the feedback loop for the resolution of failures with completed Problem, Cause and Remedy.	Opportunities to streamline delay assignments and failure and incident management will be researched through the plan period.
Fault management	Asset in-service faults are called into the appropriate trouble desk. Faults are recorded as an open work order in EAMS with no resources assigned.	No action required.
Incident management	The Emergency Management Department handles any significant incident, and the Transportation Department is responsible for communication. In the event of an incident, evidence is gathered as necessary, and a work order is set up to capture the costs associated with the incident.	No action required.
Business continuity planning	Reviews of the infrastructure for life safety and survival during catastrophic events are undertaken, and capital programs are established to address needed improvements.	No action required.
Informed decisions		
Asset cost capture	A general cost code is used to capture costs related to maintenance and renewals work. This limits Amtrak's ability to optimize asset replacement based on whole-life-cost. In recognition of PRIIA requirements for additional segregation of cost reporting, Amtrak IMCS has updated its cost structure.	Continued development of cost capture model for all maintenance and renewal activities to be captured at the asset level.
Asset information standards	Asset hierarchy structures and asset relationships have recently been reviewed. Data silos have been eliminated to align with Amtrak's reporting needs. Amtrak IMCS lacks an information standard that provides a management framework for the collection, maintenance, and update of asset information.	As part of Amtrak's upgrade of EAMS – an asset registry has been developed and an information standard is in the process of being finalized.
Asset Registry	The asset registry is currently maintained in an enterprise geospatial database (EGS), also known as the geographic information system (GIS). There are gaps in the attributes held against assets (for example age or type data is missing).	Improvements to the asset registry information in line with the improvement actions identified in the appendices of this document.
Asset inventory management	The enterprise geospatial database (EGS), also known as the geographic information system (GIS), serves as a central repository for asset inventory data; additional data is held in the EAMS system.	Maximo 7.6 will house the asset registry (comprised of asset hierarchies and relationships) and serve as the inventory basis for all asset inventory management tools.
Resource capabilities		
Workforce strategy	Amtrak is currently undertaking a review of workforce needs.	No further action identified.

Competence and training	Roles are clearly delineated at Amtrak, and we ensure that all employees undergo the requisite training and obtain the necessary certifications for their respective positions. An internal tracking system is in place to monitor each employee's licenses, certifications, and qualifications.	No action required.
Workforce succession planning	Amtrak is aware of its high attrition rate resulting from a generation of retirements. The agency has taken initial steps towards succession planning by forecasting the attrition and by identifying the skills and knowledge gaps associated with the attrition. Additional succession planning is constrained by an HR policy that limits on-the-job training that new employees could potentially acquire from retiring employees, who have the institutional knowledge. Succession planning is challenging for the unionized workforce due to union rules that facilitate employees moving between roles.	No action required.
Supplier management	Processes for managing contractors during capital projects are not well-established.	Improved as part of the documentation of standardized asset management practices.

Asset Management Core Supporting Technology

To support the execution of the business processes identified above – Amtrak IMCS is attempting to streamline the technology available to enable access to information to inform decisions, to control the execution of processes and to demonstrate compliance that activities have been completed. Table 9 provides a summary of Amtrak's core asset management technologies and planned improvements.

Table 9: Amtrak Engineering - Core Support Technology for Asset Management

Core Technology	Status	Improvement Initiative
EAMS	IBM Maximo 7.5 was implemented in 2006 to help monitor and execute work against assets – primarily focused on demonstrating FRA inspection compliance and a condition logic matrix. The implementation was significantly customized to support manual processes utilized at that time. Unfortunately, the degree of customization makes it infeasible to implement new business processes or keep the system up to date. The current version of Maximo does not support asset lifecycle reporting or best practices in asset management.	Amtrak has begun work to move from Maximo 7.5 to Maximo 7.6 MainLine Rail (MLR), a project requiring a full re-implementation due to the previous highly customized configuration. The EAMS reimplementation rescheduled for initial rollout in 2024 will utilize Maximo's standard functionality along with MainLine Rail business processes which tailor the IBM Maximo solution for railroad industry clients. for transportation users. Amtrak's implementation of Maximo 7.6 MLR will enable continued compliance with FRA- and Amtrak-mandated tests and inspections and incorporate the previously developed condition logic matrix in addition to rolling out full linear model capability, updated asset registry and location referencing for all assets along the right-of-way, and new processes for work management. Maximo 7.6 MLR will be the single source of truth about the lifecycles of infrastructure assets. Implementation of Maximo 7.6 MLR is underway and will be phased by subdivision and discipline, with Amtrak's Philadelphia Subdivision planned for rollout in 2024.
GIS	Amtrak IMCS recently completed migration from a homegrown, non-spatial infrastructure asset database that was inaccessible to most business users to a geospatial database (aka geographic information system – GIS) where it can be easily viewed on a map by anyone with access to Amtrak's network. The GIS, implemented using Esri's ArcGIS platform, provides the single source of truth for what and where Amtrak's fixed infrastructure is, and will be integrated with Maximo 7.6 MLR where each asset's lifecycle is managed. This solution enables full analysis of a right-of-way section and allows Amtrak to visualize all assets, with other data that may be used to determine an optimal construction program – including integrating across multiple asset classes.	Amtrak's infrastructure GIS will continue to be improved with linear referencing capabilities and development of a trace network that will allow Amtrak to produce track charts in-house. In addition, Esri's ArcGIS tools will be used to collect and display data about assets in a user-friendly way.

Improvement Plan

This section provides a summary of the key improvement actions highlighted in IALP2024.

Key Improvement Actions from IALP2024

Table 10 presents the Key Improvement Actions identified through the development of IALP2024. Completed improvements are identified in bold. Improvements are grouped by document section.

Table 10: Key Improvement Actions

Ref:	Key Improvement Action	Responsibility	Date
Asset Management Practices			
001a	Develop a Strategic Asset Management Plan that sets out the blueprint for how IMCS will manage infrastructure – including meeting all requirements and aligning planning cycles	Director Industrial and Systems Engineering	Updated to Q4 FY 2024
001b	As part of the SAMP, establish the asset management organization capability requirements	Director Industrial and Systems Engineering	Updated to Q4 FY 2024
001c	Undertake organization change impact assessment and establish implementation plan for SAMP	Director Industrial and Systems Engineering	Updated to Q4 FY 2024
002	**Further develop existing Engineering standards into an Asset Management – management system (asset management framework). Aligned to global best practices and consistent with the requirements under the FAST Act.**	**Director Industrial and Systems Engineering**	**Complete**
002b	**Update capital planning process as part of the development of the Asset Management system – to include full alignment to the FAST Act**	**Director Industrial and Systems Engineering**	**Complete**
003a	Implement a quality assurance process to ensure that processes and procedures are followed and provide confidence that “we do what we say we do”.	Director Quality Management	Updated to Q4 FY 2024
003b	Review and revise current work execution documentation and signoff procedures to enhance current quality control efforts	Director Quality Management	Updated to Q4 FY 2024
003c	Identify and introduce QA/QC resources	Director Quality Management	Updated to Q4 FY 2024
004	Document the processes for managing asset management planning and ensure it is integrated into other business planning processes – including maintenance and capital budgeting.	Director Industrial and Systems Engineering	Updated to Q4 FY 2024

005	Review and further development of the track outage process – including review of opportunities to re-engineer the current process to provide improved planning to enable better use of track access time. This will include developing processes and tools to deliver better 'piggybacking' of track access.	Director Program Development and Work Planning	Updated to Q4 FY 2024
006	Establish a cost capture model for all maintenance and renewal activities at the asset level – which includes review and development of a revised G/L structure.	Finance; VP Project Development & Planning Services	Updated to Q2 FY 2025
007	**Document the Infrastructure *Digital Strategy* which sets out the organizational capabilities, asset information requirements and technology solutions to enable Amtrak to meet all needs**	**Director Industrial and Systems Engineering**	**Complete**
007b	**Development of an asset information standard to ensure that ongoing improvements to Maximo and other asset management technologies are configured to align to the needs of the business and that the requirements for consistent, accurate data collection are understood.**	**Director Industrial and Systems Engineering**	**Complete**
008	Plan and execute the initial rollout of version 7.6 for Maximo, which includes enabling additional functionalities within Maximo, as well as completing integration with geospatial and geoschematic tools currently under development. For context, the complete implementation of Maximo 7.6 is projected to span over the next 7-8 years.	Digital Technology	Updated to Q4 FY 2025
008b	Document the business requirements for Maximo 7.6	Digital Technology	Updated to Q1 FY 2024
009	**Complete development of Product Lifecycle Management (PLM) application to support configuration control and QA**	**Digital Technology**	**Canceled**
009b	Review item master functionality within ERP to drive implementation of bill of materials for Engineering inventory.	Procurement	Updated to Q4 FY 2023
010	**Document the business requirements for ESRI ArcGIS.**	**Director Industrial and Systems Engineering**	**Complete**
010b	**Implementation of ESRI ArcGIS and related integrations.**	**Information Technology**	**Complete**
Asset Inventory			
011	**Review and further improve the current asset registry information for all assets in line with the gaps identified in the appendices – in time for inclusion in future infrastructure asset line plans.**	**DCE (All asset classes)**	**Complete**
012	**Complete the development of the asset class condition assessment framework.**	**DCE (All asset classes)**	**Complete**
013	Establish plan for implementation and roll-out across all divisions.	Director Industrial & Systems Engineering	Updated to Q2 FY 2024

014	Undertake a condition assessment of key assets utilizing the updated condition assessment framework.	DCE (All asset classes)	Updated to Q2 FY 2024
015	Establish a review of condition data to establish asset deterioration rates to enable better predictive analysis	DCE (All asset classes)	Updated to Q2 FY 2024
016	Develop revised asset transition processes that include the timely capture of asset information	Director Industrial and Systems Engineering	Updated to Q2 FY 2024
Lifecycle Management Strategies			
017	**Plan and undertake a maintenance strategy review of all asset classes (prioritized by criticality, utilization and location) to ensure the most appropriate strategy is in place for each asset**	**Director Industrial and Systems Engineering and DCE's all asset classes**	**Complete**
018	**Develop capital evaluation and prioritization processes and procedures that require lifecycle cost analysis, consider full benefit/ costs and include risk and criticality assessment.**	**Director Industrial and Systems Engineering**	**Complete**
019	**Review and further develop the asset lifecycle strategies set out in the appendices. This should include further analysis of the strategy based on updated asset information and further analysis of the implementation of the strategies based on funding levels and addressing other issues (track access, resourcing etc.).**	**Director Industrial and Systems Engineering**	**Complete. Ongoing Review**
Work Plans and Budget Forecasts			
020	**Update capital planning process as part of developing Engineering Asset Management system – to include full alignment to FAST Act requirements**	**Director Industrial and Systems Engineering**	**Complete**
021	Further analyze and breakdown operating and capital costs to activities or groups of activities to support budget forecasting.	Finance	Updated to Q4 FY 2025
022	Long-term: Introduce Activity Based Costing across all asset classes and establish requirements for the updated EAM system to support this.	Finance	Updated to Q4 FY 2025
023	Establish lifecycle strategies and condition assessments as per other key improvement actions. Develop and introduce a whole life cost modeling capability to support capital planning and investment forecasting.	Director Industrial and Systems Engineering	Updated to Q4 FY 2025

Improvement Program

An *Asset Management Improvement Program* was previously developed, which sets out a roadmap for Amtrak Engineering to achieve its target asset management capability state. The overall program and the target asset management capability is achieved through four phases, with each phase providing benefits and a foundation for the subsequent phase.

The first phase of work is focused on standardizing work practices. Activities include defining and documenting standard processes and practices and continuing to build the organization capability. Preparation for implementation of an enterprise geospatial database (EGS) and Maximo 7.6 asset management system (EAM) will ensure that location-based records of all assets exist, and data standards are in place. Configuration of the EGS and EAM systems will be aligned to both Engineering and wider Amtrak/ industry requirements.

The second phase of work is focused on implementation. Activities include the implementation of Esri GIS as the EGS system to house Amtrak's asset inventory database with all associated location-based information, and implementation of Maximo 7.6 as the EAM system, with associated tools and applications to support Engineering reliability analysis, capital planning, forecasting, and asset management planning. Full roll out and adoption of the standard processes and practices developed during phase 1 are also included.

The third phase of work focuses on applying. With standard practices, EGS, EAM, and other support tools in place, this phase focuses on applying and embedding practices across asset classes. We will continue to refine lifecycle strategies and continue to embed asset management planning as part of service commitment review and capital investment cycles.

The fourth phase of work focuses on performing. With improved knowledge and information available, established and implemented decision support tools to aid analysis, we will work to continue to improve performance through targeted maintenance and renewal intervention.

Appendix B: Track Asset Strategy

Appendix B: Track Asset Strategy

Appendix B provides additional information on Amtrak's track assets and establishes the lifecycle management strategy to achieve a state of good repair (SOGR).

Overview

Pursuant to 49 U.S.C § 24320(a)(2) this appendix captures the *unconstrained funding* needs to adopt a normalized or steady state management strategy necessary to achieve a SOGR. It represents our latest thinking at the time of publication of what work needs to be accomplished based on the proposed use of the asset and its current condition.

The appendix is structured to be consistent with the main body of the IALP2024 with the following sections:

- Asset Inventory – provides further details on the track infrastructure assets across all parts of the passenger rail network.
- Asset Condition – presents our current understanding of track asset condition and our plans for improving our knowledge of the state of the asset.
- Asset Strategy – presents the lifecycle strategies for the management of track infrastructure assets and our strategy for moving towards achieving a steady state replacement of such.
- Additional Funding Needs – provides an assessment of the unconstrained steady state program and the forecasted SOGR work bank necessary to bring the track infrastructure assets into a SOGR.

Responsible Official

Pursuant to 49 U.S.C. § 24320(c)(3)(c) the following individual is responsible for Track infrastructure owned or managed by Amtrak:

- ***Herbert Wescott, Deputy Chief Engineer Track***

Track Asset Inventory

Amtrak manages track assets (track, turnouts, ties, and fences) valued at nearly $10 Billion. This includes 2,507 track miles of track infrastructure (including yards and sidings) nationwide, of which 2,091 track miles are on the Northeast Corridor (main and branch lines) connecting Washington D.C., Philadelphia, New York, and Boston.

Inventory Development

Amtrak Infrastructure Maintenance and Construction Services (IMCS) acknowledges that the asset registry for Track assets is lacking some data attributes. The focus to date has been to ensure safety-critical assets are included. As part of an ongoing program of improvement, the following issues will be addressed:

- Age records – were initially updated as part of I-AMP2017 (NEC and NEC Branch Lines) and IALP2019 (National Network). Updates to asset ages (i.e., through renewals) have been captured in subsequent IALP updates, and otherwise remaining gaps will be resolved during further inventory updates in this plan period.
- Asset attributes – gaps existing in the asset attribute data will be analyzed and updated in this plan period.
- Common Referencing – asset records for track are currently maintained in several systems (separate systems for inventory information, track geometry, and curvature). While each system locates the asset or characteristic on the right-of-way, the method by which that is achieved is different in each instance (milepost and offsets, etc.). To enable analysis in the future, a common referencing structure needs to be used. This is being considered as part of the Maximo 7.6 and ArcGIS database programs.

A summary of Track infrastructure features is shown in Table 11 below.

Table 11: Track Infrastructure Summary

Asset Type	Count	Units	Av Install Date
Rail & Ballast			
Main Line	**2,141**	**Track Miles**	**1982**
NEC Main Line	1,240	Track Miles	1986
NEC Branch Line, Owned by Amtrak	420	Track Miles	1968
NEC Branch Line, Owned by CSX	181	Track Miles	2007
National Network, Owned by Amtrak	130	Track Miles	1968
National Network, Owned by Michigan	171	Track Miles	1967
Yards and Sidings	**366**	**Track Miles**	**1974**
NEC Main Line	192	Track Miles	1979
NEC Branch Line, Owned by Amtrak	49	Track Miles	1959
NEC Branch Line, Owned by CSX	9	Track Miles	1990
National Network, Owned by Amtrak	77	Track Miles	1970
National Network, Owned by Michigan	40	Track Miles	1967

Ties			
Concrete	3,196,626	Each	2002
NEC Main Line	2,852,132	Each	2001
NEC Branch Line, Owned by Amtrak	338,820	Each	2010
NEC Branch Line, Owned by CSX	5,674	Each	2010
National Network, Owned by Amtrak	*	Each	*
National Network, Owned by Michigan	*	Each	*
Wood	2,619,250	Each	2011
NEC Main Line	1,370,846	Each	2006
NEC Branch Line, Owned by Amtrak	1,121,680	Each	2016
NEC Branch Line, Owned by CSX	99,088	Each	2010
National Network, Owned by Amtrak	728,640	Each	2010
National Network, Owned by Michigan	742,720	Each	*
Turnouts			
Turnouts	**3,437**	**Each**	**1990**
NEC Main Line	2,075	Each	1991
NEC Branch Line, Owned by Amtrak	448	Each	1988
NEC Branch Line, Owned by CSX	130	Each	1989
National Network, Owned by Amtrak	614	Each	1986
National Network, Owned by Michigan	170	Each	1994

** Tie inventory data was not available for confirmation in this IALP, but it will be incorporated in future IALP updates.*

Track Asset Condition

Amtrak's Track department conducts a program of condition monitoring activities to identify faults, prioritize intervention and ensure safe operation of the railroad. However, it has recognized a need to improve its condition assessment capability to predict the optimal point of replacement.

Overview

Amtrak IMCS currently conducts an extensive condition monitoring (inspection) program of track infrastructure assets at intervals in line with the designated track class of the infrastructure. Track assets are monitored in accordance with the Amtrak MW 1000 standard[1], which exceeds Federal Rail Administration (FRA) standards.

The current monitoring activities ensure safe operation of the railroad. They are used to identify faults and potential faults, which result in prioritized and scheduled maintenance actions. There is little predictive analysis conducted to determine the rate of deterioration of assets and predict future track conditions and deficiencies. Additionally, it is worth noting that a Condition Assessment Framework has recently been developed to provide additional context on asset conditions to complement the existing Track Management Program. The following table summarizes the Track Monitoring Program.

[1] AMTRAK MW 1000, "Limits and Specifications for Track Safety, Maintenance and Construction." - Revised Date July 1st 2023.

Table 12: Summary of Track Condition Monitoring Activities

Activity	Scope / Description
Visual Inspections – walking or hi-rail	Visual inspections to check general track and roadbed conditions, check for safety limits, gauge, alignment, surface, ties, rail etc. Some seasonal inspections.
Track Geometry Car	Assess the geometric profile of the track system, including both vertical and horizontal alignments, super-elevation, rail profile, ride quality etc.
Sperry Rail Defect Car and Handheld Ultrasonic Inspection	Assess the rail for internal defects. Handheld ultrasonic test conducted following Sperry Car to confirm defect.
Ground Penetrating Radar	Assess the track bed foundation and identify defects.
Automated Wood Tie Inspection	Assess the condition of crossties across a 4-point rating system to identify inadequate conditions and forecast deteriorating conditions like inadequate rail anchorage conditions, plate cut, or loss of tie section.

Asset Condition Assessment Methodology

Pursuant to 49 U.S.C § 24904(c) Amtrak is required to undertake a "*condition assessment of those inventoried assets for which a provider has direct responsibility and to level of detail to monitor and predict performance of assets and inform investment prioritization" (U.S. 49 CFR § 625.25(b)(2)).*

In meeting this obligation, Amtrak has developed a track asset condition assessment guide[2] and plans for its implementation are progressing. The guide assesses a series of condition factors, each graded on a scale of zero (asset is non-operable) through five (asset is new or nearly new). The approach will result in a condition index for each asset and will enable assessment of SOGR.

Amtrak considers a track asset to be in a SOGR when it meets maintenance limits described in MW 1000, *Limits and Specifications for Track Safety, Maintenance and Construction*, when it is in a condition where it can continue to meet and perform the functional requirements for which it was designed, and when the lifecycle investment needs of the asset have been met – including all scheduled maintenance. This definition is consistent with the definition laid out in *U.S. 49 CFR § 625.17.* Amtrak grades an asset in a SOGR if it scores 2.5 on its updated condition assessment framework, described above.

For IALP2024, the age of the asset is being used to estimate the asset's SOGR based on the remaining useful life of the asset. The Track Department will soon (i.e., beyond the IALP2024) provide SOGR scores for turnouts based on the measured, visual and age factors of condition, as described earlier in this document.

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[2] *Infrastructure Asset Condition Guidelines – Track. Version 5, Issued September 4th 2018.*

IALP 2024 – Assessed Track Asset Condition

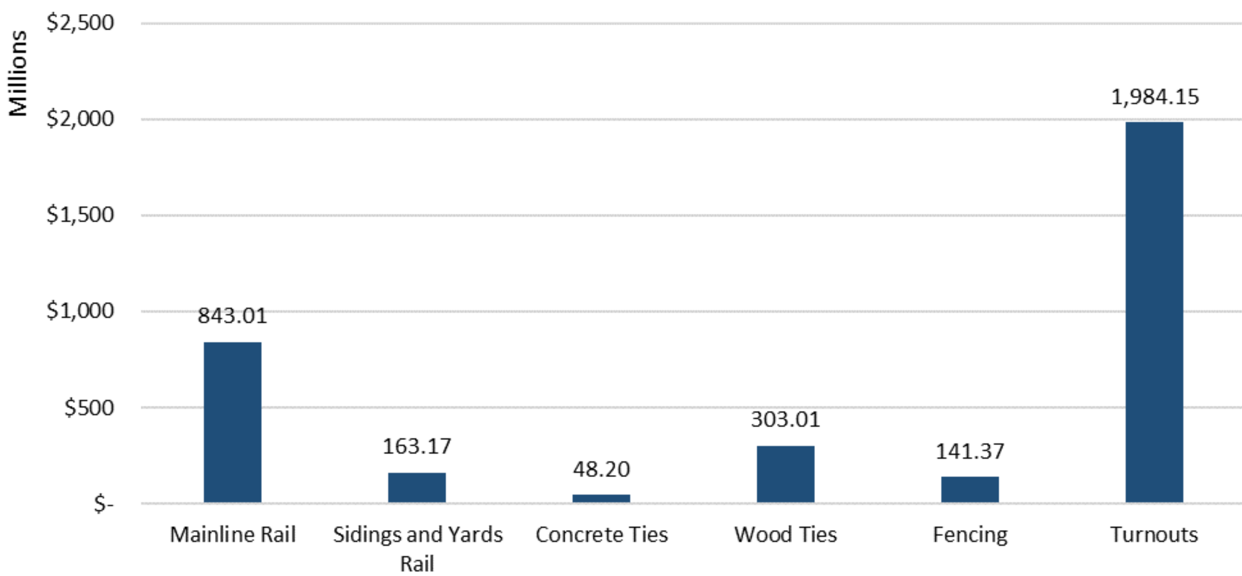
For IALP2024, the assessed asset condition of track, based on useful life of the asset is presented in Table 13.

Table 13: 2024 Assessed Condition of Track Assets

Asset Type	Av SOGR	% of Total NOT in SOGR
Rail & Ballast		
Main Line	**2.52**	**52%**
NEC Main Line	2.89	37%
NEC Branch Line, Owned by Amtrak	1.58	83%
NEC Branch Line, Owned by CSX	4.39	8%
National Network, Owned by Amtrak	1.34	100%
National Network, Owned by Michigan	1.03	100%
Yards and Sidings	**1.84**	**85%**
NEC Main Line	2.12	75%
NEC Branch Line, Owned by Amtrak	1.29	100%
NEC Branch Line, Owned by CSX	2.93	8%
National Network, Owned by Amtrak	1.79	100%
National Network, Owned by Michigan	1.02	100%
Ties		
Concrete	**4.21**	**3%**
NEC Main Line	4.13	3%
NEC Branch Line, Owned by Amtrak	4.37	0%
NEC Branch Line, Owned by CSX	5.0	0%
National Network, Owned by Amtrak	-	-
National Network, Owned by Michigan	-	-
Wood	**4.20**	**24%**
NEC Main Line	3.13	43%
NEC Branch Line, Owned by Amtrak	4.44	2%
NEC Branch Line, Owned by CSX	4.00	0%
National Network, Owned by Amtrak	4.00	0%
National Network, Owned by Michigan	-	-
Turnouts		
Turnouts	**2.43**	**56%**
NEC Main Line	2.45	55%
NEC Branch Line, Owned by Amtrak	2.48	58%
NEC Branch Line, Owned by CSX	2.08	63%
National Network, Owned by Amtrak	2.19	62%
National Network, Owned by Michigan	3.13	45%

The replacement value of Track assets with a condition rating below 2.5, which are assessed as not being in a state of good repair, is estimated to be over $3.3 billion in 2023 dollars. This is Amtrak's SOGR Backlog for Track assets. The largest portion of this is the NEC main- and branch-line assets owned by Amtrak, which is estimated to be nearly $2.8 billion in 2023 dollars. An additional $113 million backlog is present on the CSX leased lines which are capitally funded by the State of New York. The national network accounts for $260 million in backlog, with an additional $174 million backlog on the Michigan owned infrastructure. Figure 13 presents the backlog by Track asset type. Turnouts represent the largest portion of the backlog at $2.0 billion – with backlog on the NEC Main Line and Branch line alone representing $1.7 billion.

Figure 13: Track Estimated SOGR Backlog by Asset Type ($m 2023)



Track Asset Strategy

Lifecycle management strategies updated as part of IALP2024 capture the normalized or steady state activities necessary to maintain a state of good repair and ensure track assets are functional and able to continue to support a safe, efficient, and sustainable national rail network.

Overview

The current track lifecycle management strategies are focused on maintaining the minimum safety standards and removing known concerns through programmed capital replacement. These strategies are documented in the MW 1000 standard, which provides more stringent lifecycle management approaches over the FRA standards.

Current strategies are developed through engineering judgment and knowledge of the asset from maintenance inspection reports. Capital investment decisions are prioritized using a committee approach, reviewing risks and other information to determine the capital plan.

In I-AMP2017, Amtrak IMCS commenced a review of the lifecycle strategies for all infrastructure assets. Its purpose was to develop the long-term normalized or steady state infrastructure maintenance and improvement program. Amtrak recognized that to achieve this requires addressing a sizeable backlog in infrastructure investment before a program of steady state or normalized maintenance can be adopted.

The recent passage of the Infrastructure Investment and Jobs Act (IIJA), now signed into law as the Bipartisan Infrastructure Law (BIL) provides $66 billion for intercity passenger and freight rail. This funding provides and outstanding opportunity for Amtrak to reinvest in its infrastructure to continue progress toward addressing its backlog and achieving its SOGR objectives. Projects that may have been deferred in the past could benefit from funding. Specific projects and initiatives that may potentially benefit from this funding will be discussed in this appendix; however, this additional funding is not expected to fully enable Amtrak to achieve the overall goal of steady state asset replacement.

The lifecycle management strategies for Track infrastructure described in the following sections define the approach adopted for the 2024 program and the revised approach for subsequent years to address backlog and approach state of good repair.

In addition to the outlined strategies, the BIL funding may enable Amtrak to prioritize and complete larger projects and provide even greater benefits to passengers. Moreover, while projects may require more coordination among its various infrastructure departments to deliver these improvements, they may also enable departments to take advantage of work being performed primarily by their peers.

Current Asset Strategies

The lifecycle management strategies employed by Amtrak to achieve its Track asset objectives are described in Table 14. These strategies have been applied to determine the work bank.

The aim of the Track department is to maintain and improve the condition of the track infrastructure to minimize the risk to safety and train service impact. Work is categorized into the following:

- → *Inspection/Monitoring* activities to confirm the asset can function in its required state and provide a safe operational environment.
- → *Preventive Maintenance* activities to help an asset achieve a required level of performance and maintain a safe operational environment.
- → *Corrective Maintenance* activities to return the asset to its required function and restore a safe operational environment.
- → *Capital Maintenance* to restore the asset to a specified design standard and maintain performance.
- → *Capital Replacement* to renew the asset and maintain performance.
- → *Capital Improvement* to replace the asset and improve performance or network capability.

Table 14: Current Lifecycle Management Strategies - Track

Category	Description
Inspection/ Monitoring	Inspections and monitoring activities to identify defects before failure. These include: → Track Geometry Car (including Ground Penetrating Radar (GPR) to scan and analyze soil conditions below ties) → Sperry Ultrasonic Rail Inspection Car (internal rail defect identification) → Gauge Restraint Measurement System (GRMS) → Monitoring Systems on Acela (ARMS) → Track walk/high rail visual inspections → GPR inspection of Track bed (sub-grade) conducted monthly, which guides the undercutting program. Ballast condition and layers are assessed across three elements: fouling index (how dirty is it?), moisture index (how wet is it?), and measuring index (how thick is it?), which are critical to monitor as the track surface will take the shape of the track bed so need to ensure it remains stable and unchanged. → Automated Wood tie inspection system (performed on as-needed basis and is not needed more frequently than current cycle of approximately 5 years) Other remote condition monitoring systems used to detect detrimental wheel/rail interface issues include: → Wheel Impact Load Detectors (WILDs) → Lateral Load Devices (used to manage detrimental bi-level train wheel/rail interaction at New England locations) → Rail temperature monitoring to intervene with operating restrictions to protect track against buckling/pull-apart
Preventive Maintenance	Preventive maintenance activities to achieve the asset useful life benchmark in its current operational environment (load, speed etc.) – this includes rail lubrication, spot repairs to the fastening system (ties, clips, etc.). Preventive maintenance to prepare for seasonal changes to maintain minimum operation standards as defined in MW 1000.
Corrective Maintenance	Unplanned maintenance following identification of all defects and failures to return track to minimum operation standards per MW 1000 standard. Planned corrective maintenance to remove other defects based on risk and install permanent solutions where appropriate.
Capital Maintenance	Capital maintenance to restore track structure to operational design standard – as defined in both the FRA standard and MW 1000 standard. This includes: → Surfacing and lining operations to restore track geometry design → Undercutting to improve ballast quality and restore track geometry design → Limited rail grinding to restore the railhead profile, remove rail corrugation and reduce rail deterioration
Capital Replacement	Replacement in whole or part of the track structure, to restore design capability of the asset when it no longer becomes cost effective to maintain or presents an unacceptable safety or operational risk. Factors considered: defect rate, wear and age.
Capital Improvement	Replacement in whole or part of the track structure, to improve the capability of the track infrastructure. Improvement includes increases to track class resulting in ability to operate at higher speeds and improvements to track layout to improve network capacity.

Moving Towards Normalized or Steady State Maintenance

Overall Approach

There are four key elements to the track lifecycle management strategy, namely:

Achieve SOGR	The primary objective of this strategy is to bring the track assets to a state of good repair and then maintain them in a steady state to ensure sufficient capability to meet operational needs.
Prevent Insidious Decline	While Amtrak progresses towards a SOGR, the inspection and monitoring regime documented in the MW 1000 standard will guard against the insidious decline in the condition of any individual sections of track and ensure that the asset remains in a safe operational state.
Maintain Performance	The implementation of the strategy is through a program that is prioritized to ensure that the track infrastructure is able to function in its required state, thus minimizing performance loss due to asset faults and failures, temporary speed restrictions or extended IMCS access.
Support Network Capability Improvement	The program is also designed to ensure that track assets contribute to capability targets established through the Amtrak Service Plans and exploit opportunities for improved alignment and track configuration to enable higher speeds and improved network capacity.

Transition Strategy

The approach taken has been to establish useful life benchmarks (ULBs) to define a program of steady state or normalized maintenance necessary to maintain a SOGR. Useful life benchmarks have been established through several sources, including:

- Previous SOGR reports and studies conducted in the last 5 to 10 years
- IMCS review and judgment of typical lifecycle of assets on Amtrak property
- Independent review by outside parties
- International benchmarking against comparable rail networks including those in the United Kingdom and Continental Europe

The concept of a useful life benchmark supports the development of a required work bank but is not an asset management strategy itself. This is because the transition to a steady state maintenance workflow requires backlog needs to be addressed first. Further, as we move to a steady state replacement cycle, the first iteration needs to be *staged* (prioritized) such that the ongoing work program is manageable year over year. Table 15 summarizes the proposed replacement cycles and implementation strategies. As highlighted in the main body of this document, the transition strategy also needs to consider:

- Track Access – current outage availability restricts efficient project delivery. This will need to be reviewed to economically address the backlog. One piece of the strategy includes scheduling more work simultaneously during planned outages.
- Qualified labor Resources – currently production workforces are only available for track capital work.
- Equipment – current equipment capacity is insufficient. More equipment is being acquired to help alleviate the equipment shortage. This is addressed in Appendix F.
- Funding – the backlog identified is significant – a robust and consistent funding stream needs to be established.

Several initiatives to leverage existing data in new ways or incorporate entirely new data sources are also ongoing. For instance, georeferenced surfacing will enable Amtrak to rebuild sections of curved track more easily and accurately, as well as potentially detect changes over time. Amtrak is anticipating a delivery of two Amberg Trolleys in Q4 of FY2023, which will allow for rapid surveying of track before and after tamping and more precisely line and surface curves. These trolleys are the first major step in implementing georeferenced surfacing, which employs control tampers to precisely line and surface curves. Additionally, new technologies and efforts aimed at combatting and avoiding ballast degradation may provide insight for track maintenance and renewal activities. Even the possibility of partially automated track inspections can help Amtrak free-up its teams to focus on addressing issues already identified.

One of the most promising potential new technologies that Amtrak is beginning to work with has the potential to automate the majority of current in-person track visual inspection activities, as well as add a layer of analytics to passenger rail and transit. The Laser Rail Inspection System (or L-Rail) technology from Pavemetrics is a hi-rail inspection car-mounted technology that captures an accurate visual manifestation of the track (i.e., a missing bolt, a ballast wash-out, joint bars, crossties etc.). Amtrak is currently piloting the technology and allowing an artificial intelligence-based program to develop a baseline (i.e., a "noise floor" so that it can know what to flag as in issue). Once trained, the system will perform an inspection near Lancaster, Pennsylvania, concurrent with human track inspectors for comparison. This is currently scheduled for the final months of 2023. Pavemetrics is also working to enhance the data processing algorithm such that it will be able to produce inspection reports shortly after completing the inspections, drastically reducing the post-processing time. If the L-Rail technology can meet Amtrak's visual inspection standards, it could replace a significant amount of human inspection effort. Moreover, the L-Rail technology may be able to cover approximately 60-80 miles per shift versus the approximately 7 miles per week of a human track inspector. This effort savings would allow Amtrak to re-train and utilize its current inspector legions to perform other needed roles.

In a similar vein, Amtrak is also testing out an implementation of an ENSCO "Virtual Track Walk", which is a visual inspection system on its Track Geometry Car. The intent of this technology is similar; however, there are a few key differences including the ability to capture imagery at high speeds (up to 125 mph) and the ultimate need for all captured imagery to still be reviewed by that of a human inspector. The manual review of the captured images is a resource intensive process, despite track inspectors no longer being required to physically walk the track.

Another improved technology application that Track is exploring is related to the use of a GRMS Car (Gauge Restraint Measurement System) to test the track structure and fastening hardware. The GRMS Car will be outfitted with new assessment hardware and be accompanied by another assessment vehicle. Together they will be able to assess ties and fastening systems through the use of a non-destructive testing regimen that stresses the track and projects its reaction to a given load at particular speeds.

A third, is an enhanced technology application related to the use of a LiDAR system to monitor clearances along the roadway. The LiDAR system will be updated and better configured based on preliminary runs. Additionally, Amtrak has recently constructed a Clearance Database and by comparing its reference measurements to those captured by systems affixed to the T-Sav car (Track Structure Assessment Vehicle) or the GRMS car, when it is released, will allow Amtrak to determine if there are clearance issues for passenger service or maintenance operations.

In addition to these new inspection and assessment technologies, Amtrak has recently kicked off a new project with the University of Massachusetts aimed at predicting track degradation rates. Using GPR, LiDAR, and other inputs the objective is to predict changes in geometry based on historical measurements. So far, the effort has proven fairly promising when considering that when given 4 years' worth of geometry data it was able to predict the state of the 5th year with approximately 95% accuracy. One example application of this type of insight could be predicting the tamping score for track sections, which could help drive the capital program to address locations before they become areas of need, prolonging the life and safety of the network.

Finally, Amtrak will soon kick off a new project with Kansas State University aimed at predicting the future condition of concrete ties. The initial expectation for the life of a concrete tie was 45 years; however, that assumption is proving to be conservative. Therefore, Amtrak is seeking to gain insight on the residual life of its concrete ties and better understand the deterioration profile so that the rate does not accelerate drastically (i.e., based on specific material composition, manufacturer, etc.). This would allow Amtrak to replace concrete ties based on their use or "duty cycle" as opposed to age.

As Amtrak works towards a SOGR, it can highlight major accomplishments for FY 2023. One being the extension of the Harrisburg Line where Track 2 was extended westward from Caln to WN Junction (Coatesville Bypass). A second is Grundy interlocking, which included renewed crossovers (the 23 was upgraded from a No. 10 to a No. 14). Third, the Burgos interlocking (formerly known as Hanson) was put into service in late September 2023 and will allow high-speed crossover moves at a critical location on the railroad. The retirement of the Landover interlocking less than a mile to the south will remove a crossover located in a curve that has been overdue for retirement.

Table 15: IALP2024 Track Lifecycle Management Strategy

Activity	Lifecycle Strategy / Benefit	Implementation Strategy
Inspection/ Monitoring		
General	→ To prevent insidious decline of track assets, continue to perform activities based on FRA and MW 1000 standard.	→ No significant change to current practice.
Preventive Maintenance		
General	→ To prevent insidious decline of track assets, continue to perform activities based on FRA and MW 1000 standard.	→ No significant change to current practice.
Corrective Maintenance		
General	→ To prevent insidious decline and maintain operational performance of track assets, continue to perform activities based on FRA and MW 1000 standard.	→ No significant change to current practice.
Capital Maintenance		
Surfacing	**Track class 1-5:** → No cyclical program of surfacing. **Track class 6-8:** → To maintain operational performance and support network capability, undertake track surfacing on a 3-4 year cycle as a preventive maintenance activity.	→ Cyclical track surfacing is driven by analysis of data collected from track geometry car. A program of increased reference surfacing will be developed through this plan period. Increased work volume will require procurement of additional high-speed surfacing equipment.
Undercutting	→ To achieve a SOGR and maintain operational performance and prevent insidious decline, rehabilitate ballast through undercutting performed every 15-18 years.	→ A program of increased undercutting will be developed through this plan period. Increased work volume will require procurement of additional undercutting equipment. Analysis of gang consists and schedules to increase productivity is also underway. → Undercutting is conducted during tie replacement to extend asset lifespans.
Rail Grinding	**Track Class 6-8:** → To maintain operational performance and prevent insidious decline, undertake a program of rail grinding on a 3-year cycle.	→ To achieve extension of life benefits, the Track Department is targeting an increased rail grinding program for this plan period.

Capital Replacement		
The NEC mainline is the busiest railroad in North America. Scheduled frequencies are fluctuating with demand, which will result in a decreased or inconsistent opportunity to do track work on the main line. Track access is therefore a significant constraint to implementing the lifecycle management strategies below. With that in mind, an amended *work package* strategy is proposed that makes more efficient use of track access. This includes the following strategies: → The replacement of the entire track system if more than two primary assets (rail, ties, or ballast) are within 10 years of their useful life benchmark. → Extension of the length of planned track system renewal should other sections within the vicinity be within 10 years of their useful life benchmark. Improve coordination with Communications and Signals by upgrading symbiotic components simultaneously, such as head timbers or turnout renewals with switch machine and other devices. This will ensure that multiple track occupancies are avoided.		
Concrete Ties	**Track class 1-4:** → To achieve a SOGR and maintain operational performance, concrete ties plan to be replaced every 60 years on all off corridor running rail in track class 1-4, depending on traffic usage and track class. **Track class 5-8:** → To achieve a SOGR and maintain operational performance, concrete ties will be replaced every 45 years on all tangent running rail in track class 5-8. → To achieve a SOGR and maintain operational performance, concrete ties will be replaced every 45 years on all curved running rail in track class 5-8. → Any remaining Rocla ties are in small clusters and will be replaced in 1s and 2s as they wear out.	**Track class 1-4:** → A program of concrete tie replacement is introduced through this plan period. To manage the backlog of renewals and provide a levelled work program, delivery of the work bank is spread over a 15-year period. **Track class 5-8:** → A program of concrete tie replacement is introduced through this plan period. To manage the backlog of renewals and provide a levelled work program, delivery of the work bank is spread over a 10-year period. → For efficient use of track access, replacement of concrete ties will coincide with rail renewal if rails are life expired within 10 years of planned work.
Wood Ties	**Track class 1-4:** → To achieve a SOGR and maintain operational performance, wood ties will be replaced every 35 years on all off corridor running rail in track class 1-4, depending on traffic usage and track class. **Track class 5-6:** → Our general strategy is to replace wood ties with concrete ties where economical to do so on higher class lines (e.g., the Harrisburg Line). → To achieve a SOGR and maintain operational performance, wood ties will be replaced every 25 years on all corridor running rail in track class 5-6, depending on traffic usage and track class.	**Track class 1-4:** → A program of wood tie replacement is introduced through this plan period. To manage the backlog of renewals and provide a levelled work program, delivery of the work bank is spread over a 10-year period. → Note: Typical production delivery, replaces every 3rd tie only. As a result, each location should be visited 4 times in a 35-year period (roughly every 8 years) **Track class 5-6:** → A program of wood tie replacement is introduced through this plan period. To manage the backlog of renewals and provide a levelled work program, delivery of the work bank is spread over a 10-year period. → For efficient use of track access, replacement of wood ties with concrete will coincide with either ballast renewal or rail renewal if either are life expired within 10 years of planned work.

	→ To improve network performance, it is our desire to replace wood ties with concrete ties on corridor at the earliest cost-effective opportunity. **Track class 7-8:** → No wood ties remaining.	→ Note: Typical production delivery, replaces every 3rd tie only. As a result, each location should be visited 3 times in a 25-year period (roughly every 8 years).
Rail	**Track class 1-4:** → To achieve a SOGR and maintain operational performance, rail will be replaced every 60 years on all off corridor running rail in track class 1-4, depending on traffic usage and track class. → To achieve a SOGR and maintain operational performance, rail will be replaced every 55 years on all curved running rail in track class 1-4. **Track class 5-8:** → To achieve a SOGR and maintain operational performance, rail will be replaced every 50 years on all tangent running rail in track class 5-8. → To achieve a SOGR and maintain operational performance, rail will be replaced every 40 years on all curved running rail in track class 5-8. **Obsolete Sections:** → All 119lb., 152lb. and 155lb. rail sections will be replaced at the earliest opportunity – as these sections are no longer manufactured. **Cascading:** → With the arrival of the new rail delivery train, a program of cascading rail from high track classes to low classes/yards/sidings will be developed.	**Track class 1-4:** → A program of rail replacement is introduced through this plan period. To manage the backlog of renewals and provide a levelled work program, delivery of the work bank is spread over a 10-year period. **Track class 5-8:** → A program of rail replacement is introduced through this plan period. To manage the backlog of renewals and provide a levelled work program, delivery of the work bank is spread over a 5-year period. → For efficient use of track access, replacement of rail will coincide with tie renewal if ties are life expired within 10 years of planned work or if they are wood.
Turnouts	**Track class 1-4:** → To achieve a SOGR and maintain operational performance, replace turnouts every 35 years, depending on usage. **Track class 5-8:** → To achieve a SOGR and maintain operational performance, replace turnouts every 35 years, depending on usage. → To maintain operational performance, wood tie turnouts will only be replaced with concrete turnouts when the surrounding wood tie tracks are replaced with concrete.	**Track class 1-4:** → A program of turnout replacement is introduced through this plan period. Proposals for new interlockings and configurations are under a heightened level of scrutiny by the Track Department to ensure zero net gain in turnouts and redundant or obsolete assets are removed as part of the proposals. **Track class 5-8:** → A program of turnout replacement is introduced through this plan period. Proposals for new interlockings and configurations are under a heightened level of scrutiny by the Track Department to ensure zero net gain in turnouts and redundant or obsolete assets are removed as part of the proposals.

Fences	To maintain a SOGR, replace fences every 50 years.	A program of fence replacement will be developed through this plan period.
Capital Improvement		
Harrisburg Line Wood to Concrete Tie Replacement	→ To improve network performance and increase useful life, wood ties on the Harrisburg Line (Track 1 from Cork to Rheems, and then Roy to State) will be replaced with concrete ties. During this effort the track bed will be undercut to restore it essentially a wholly renewed state.	→ Within current capital plan.
Ham Interlocking Wood to Concrete Tie Replacement	→ To improve network performance and increase useful life, wood ties on the at the Ham interlocking will be replaced with concrete ties.	→ Within current capital plan.
National Network Improvement s	→ Tie replacement (upgrading from wood to concrete) and track layout improvements – including adding sidings as needed – should be delivered before new services are added.	→ Within current capital plan.
Track A Bridge to Winans	→ Tie replacement (upgrading from wood to concrete).	→ Within current capital plan.
Thorndale Yard	→ To improve storage for undercutter and Track Laying Machines (TLMs) working on adding storage on the Harrisburg Line.	→ Within current capital plan.
Ham Interlocking Renewal	→ Replacement of all crossovers and convert wood ties to concrete. Existing No. 15’s will be converted to No. 20’s.	→ Within current capital plan. And future renewals are planned for Point Zoo, Perry, Holly, Elmora, Bergen, Cliff, and Holmes interlockings.

Appendix C: Bridges and Buildings Asset Strategy

Appendix C: Bridges and Buildings Asset Strategy

Appendix C provides additional information on Amtrak's Bridges and Buildings (B&B) assets and establishes the lifecycle management strategy to achieve a state of good repair (SOGR).

Overview

Pursuant to 49 U.S.C § 24320(a)(2) this appendix captures the *unconstrained funding* needs to adopt a normalized or steady state management strategy necessary to achieve a SOGR. It represents our latest thinking at the time of publication of what work needs to be accomplished based on the proposed use of the asset and its current condition.

The appendix is structured to be consistent with the main body of the IALP2024 with the following sections:

- Asset Registry – provides further details on the B&B infrastructure assets across all parts of the passenger rail network.
- Asset Condition – presents our current understanding of B&B asset condition and our plans for improving our knowledge of the state of the asset.
- Asset Strategy – presents the lifecycle strategies for the management of B&B infrastructure assets and our strategy for moving towards achieving a steady state replacement of such.
- Additional Funding Needs– provides an assessment of the *unconstrained* steady state program and the forecast SOGR work bank necessary to bring the B&B infrastructure assets into SOGR.

Responsible Official

Pursuant to 49 U.S.C. § 24320(c)(3)(c) the following individual is responsible for B&B infrastructure owned or managed by Amtrak:

- ***Paul DelSignore, Deputy Chief Engineer Structures***

B&B Asset Inventory

Amtrak manages B&B assets valued at over $60.4 Billion – including 1,251 undergrade bridges, 14 movable bridges, and 103,157 linear feet of tunnel systems nation-wide.

Overview

Much of the major infrastructure owned and/or managed by Amtrak was constructed in the late 1800s to early 1900s and in many cases, have exceeded their useful life. Major structures are designed to last much longer than other assets; however, deferred maintenance and rehabilitation has resulted in an asset portfolio which now urgently needs investment. The recent passage of the Infrastructure Investment and Jobs Act (IIJA), now signed into law as the Bipartisan Infrastructure Law (BIL), provides $66 billion for intercity passenger and freight rail. This funding provides an outstanding opportunity for Amtrak to reinvest in its infrastructure to continue progress toward addressing its backlog and achieving its SOGR objectives. Projects and initiatives that may potentially benefit from this funding will be discussed in this appendix; however, this additional funding is not expected to enable Amtrak to achieve the overall goal of steady state asset replacement.

It is important for Amtrak to invest in its assets in a manner that minimizes their total lifecycle cost, i.e., applying the correct preventive or rehabilitative treatments before asset conditions have deteriorated to the point of requiring more substantial investment. Additionally, poor conditions on major infrastructure have an adverse impact on other asset classes. For example, the extensive deterioration of the lining in tunnels – built in the 1871 to 1934 time-period – results in water ingress that impacts track conditions through mud spots and defects in alignment, as well as impacts to signals through track circuit defects and impacts to electric traction power assets. The same potentiality of impacting other asset classes exists for facility assets, even though they may not be in the right-of-way, since the activities and maintenance they support are critical to Amtrak's overall train operations (i.e., if a facility is in poor condition, maintenance activities may not be able to be performed).

In addition, potential changes to operations, particularly on the NEC main line – the desire to run more services quicker, are hindered by the bottlenecks that exist across the network, most of which are aggravated by aging structure. For example, when seeking to improve the alignment of some tunnels that currently prevent Amtrak's high-speed trains from operating at design speed, Amtrak also faces the need to significantly rehabilitate its infrastructure prior to any alignment modifications, which impacts the ability to deliver a desired optimal train schedule.

Inventory Development

Amtrak acknowledges that the asset registry for B&B assets is lacking some data attributes. The focus to date has been to ensure safety critical assets are included. As part of an ongoing program of improvement, the following issues will be addressed:

- Age records – were updated as part of an in-depth validation performed for I-AMP2017 (NEC and NEC Branch Lines) and IALP2023 (National Network); moreover, data has been enriched where missing and updated to ensure currency in all subsequent IALPs. Gaps remaining will continue to be resolved during further inventory updates in this plan period.
- Asset attributes – are mostly completed, some gaps remain and will be addressed during normal inspections. This will be undertaken under the plan period.

A summary of Bridges and Buildings infrastructure is shown in Table 19 below.

Bridges and Buildings Assets

Table 19: Bridge and Building Assets

Asset Component	Count	Units	Count	Units	Av Install Date
BRIDGES					
Undergrade Bridge	**341,274**	**Lin Ft**	**1,251**	**Each**	**1928**
NEC Main Line	281,513	Lin Ft	770	Each	1931
NEC Branch Line, Owned by Amtrak	36,555	Lin Ft	274	Each	1912
NEC Branch Line, Owned by CSX	13,306	Lin Ft	106	Each	1916
National Network, Owned by Amtrak	3,332	Lin Ft	41	Each	1911
National Network, Owned by Michigan	6,568	Lin Ft	60	Each	1918
Movable Bridge	**14**	**Each**			**1928**
NEC Main Line	10	Each			1937
NEC Branch Line, Owned by Amtrak	1	Each			1909
NEC Branch Line, Owned by CSX	1	Each			1901
National Network, Owned by Amtrak	1	Each			1901
National Network, Owned by Michigan	1	Each			1909
Signal Bridge	**568**	**Each**			**1920**
NEC Main Line	451	Each			1920
NEC Branch Line, Owned by Amtrak	87	Each			1918
NEC Branch Line, Owned by CSX	14	Each			1931
National Network, Owned by Amtrak	4	Each			1910
National Network, Owned by Michigan	12	Each			n/a
Culvert	**1,412**	**Each**			**1898**
NEC Main Line	487	Each			1910
NEC Branch Line, Owned by Amtrak	349	Each			1883
NEC Branch Line, Owned by CSX	58	Each			1910
National Network, Owned by Amtrak	75	Each			1910
National Network, Owned by Michigan	173	Each			1910
Tunnel	**103,157**	**Lin. Ft.**	**19**	**Each**	**1912**
NEC Main Line	100,476	Lin. Ft.	15	Each	1910
NEC Branch Line, Owned by Amtrak	2,681	Lin. Ft.	3	Each	1955
NEC Branch Line, Owned by CSX	57	Lin. Ft.	1	Each	1912
National Network, Owned by Amtrak	-	Lin. Ft.	-	Each	-
National Network, Owned by Michigan	-	Lin. Ft.	-	Each	-
Retaining Walls	**86,200**	**Lin. Ft.**			**N/A**
NEC Main Line	79,500	Lin. Ft.			N/A
NEC Branch Line, Owned by Amtrak	6,700	Lin. Ft.			N/A
NEC Branch Line, Owned by CSX	-	Lin. Ft.			N/A
National Network, Owned by Amtrak	-	Lin. Ft.			N/A
National Network, Owned by Michigan	-	Lin. Ft.			N/A
National Network, Owned by Michigan	-	Lin. Ft.			N/A

B&B Asset Condition

Amtrak's B&B Department conducts a program of condition monitoring activities to identify faults, prioritize intervention, and ensure safe operation of the railroad. Additionally, condition assessments are undertaken as part of Amtrak's Bridge Management Program where regular assessment of bridge components takes place to support prediction of the optimal point of repair/replacement.

Overview

Bridge Condition Monitoring

For bridges, Amtrak Infrastructure Maintenance and Construction Services (IMCS) currently conducts an extensive condition monitoring (inspection) program of bridge infrastructure assets at intervals in line with Amtrak's Bridge Management Program manuals and procedures, as well as FRA requirements. The current monitoring activities are used to identify existing or potential faults, which result in prioritized and scheduled maintenance and capital needs, as well as ensure a safe operation of the railroad. The condition assessments performed as part of the Bridge Management Program allow for predictive analysis to determine the rate of deterioration of components and to predict future bridge conditions. Additionally, it is worth noting that a Condition Assessment Framework has recently been developed to provide additional context on asset conditions to complement the existing Bridge Management Program. Table 20 summarizes the Bridge Management Program.

Table 20: Summary of Bridge Condition Monitoring Activities

Activity	Scope/ Description
Fixed Bridges	
Condition Assessment and Defect Identification (Annual)	→ Comprehensive visual assessment of bridge components with standard scoring from 0-6 (which is converted to a 1-5 scale for IALP purposes). → Defects coded as emergency and non-emergency. → Covers undergrade bridges, signal bridges, public overhead highway bridges, and private overhead bridges.
Condition Assessment and Defect Identification (Semi-Annual)	→ Visual assessment of deck components and rail fasteners of open deck and undergrade bridges. → Pin connections of undergrade through and deck truss bridges.
Special Inspections (As Needed)	→ Comprehensive inspections required for emergency situations (i.e., incidents) or unusual conditions.
Testing and Analysis	→ Concrete and Steel Corrosion Testing and Analysis (e.g., sampling, boundary element methods (BEM) developed to analyze the rate of corrosion, etc.).
Cyclical Maintenance	→ Concrete and steel surface painting, coating, waterproofing etc. → Replacement / rehab of expansion joints.
Movable Bridges	
Monthly and Quarterly Inspections	→ Monthly comprehensive inspections cables, electrical equipment, machinery, miter rails, shoes, etc.

Monthly and Quarterly Detailed Assessments	→ Detailed assessment and measurement of miter rails and expansion joints completed in parallel with monthly/quarterly assessments.
Other Bridges and Structures	
Bridges Over Waterways (Monthly)	→ Monthly comprehensive inspections and as needed. → Underwater: Inspect foundations for scour. Substructures receive periodic diving inspections. → With sounding line, measuring probe, or hydrographic instrument, record soundings around all in-water piers, and abutments. → Flash floods: special inspections after flooding incidents (i.e., by Track Inspection Foreman and Bridge Inspector).
Tunnel Inspections (Annual)	→ Conventional tunnels (constructed by mining or boring). Cut & cover type structures and overbuilds are treated as overhead highway bridges and inspected at the same frequency required for such highway structures.
Culvert Inspections (Annual)	→ Timing of these inspections may vary to take advantage of the lack of vegetation or dry periods.

The condition assessments performed as part of the Bridge Management Program will be used in the future for predictive analysis to determine the rate of deterioration of components and to predict future bridge conditions.

This condition code scale will be mapped to align with other Amtrak IMCS asset classes as described in the following section under assessment methodology. With an assessed condition, Amtrak can accurately assess the *State of Good Repair (SOGR)* of its assets to inform future investment needs and prioritization efforts.

Facilities Condition Monitoring

For facilities, Amtrak currently employs outside resources to conduct condition assessments. The results are provided in a report for Amtrak engineers to utilize. Facilities assets are grouped into the follow categories:

- → Civil/Landscape
- → Building Exterior
- → Building Interior
- → HVAC
- → Electrical
- → Plumbing
- → Fire/Life Safety & Security

Amtrak currently does not undertake any predictive analysis and the data is not mapped back to assets in the CMMS. However, the IALP does not yet include an inventory of facility assets (or sub-assets by category) or their calculated condition ratings. IMCS has begun to work with the Amtrak engineers overseeing the facility assessments develop an inventory for IALP purposes, including a means to map the overall facility assessment ratings so that they are consistent with other infrastructure assets (i.e., 1 to 5 scale), as well as to ensure future assessments are performed up to Amtrak's revised assessment guidelines (see next section). In conclusion, while the IALP does not include inventory and condition information for its facility assets, the current and planned strategies for Amtrak's facilities are highlighted.

Asset Condition Assessment Methodology

Pursuant to 49 U.S.C § 24904(c) Amtrak is required to undertake a "*condition assessment of those inventoried assets for which a provider has direct responsibility and to level of detail to monitor and predict performance of assets and inform investment prioritization" (U.S. 49 CFR § 625.25(b)(2)).*

In meeting this obligation, Amtrak has further developed its bridges and tunnels asset condition assessment guide[3]. The approach is fully aligned to current practices and aligned to IMCS's overall asset condition assessment framework. Amtrak has also developed a facilities[4] condition assessment guide. The guide builds off industry good practice – including facility condition assessment guidelines provided by the Federal Transit Administration. An implementation plan for facilities assessments to be performed in accordance with the assessment guide, as performed by the outside resources, is currently being developed.

The guides provide instruction on the assignment of condition ratings, each graded between zero (asset is non-operable) through five (asset is new or nearly new). The approach results in a condition rating for each asset and will enable assessment of SOGR at the asset and at higher levels (i.e., network or location). Amtrak considers an asset to be in SOGR when it is in a condition where it can continue to meet and perform the functional requirements for which it was designed and when the lifecycle investment needs of the asset have been met. This definition is consistent with the definition laid out in *U.S. 49 CFR § 625.* Amtrak grades an asset in SOGR if it scores greater than or equal to 2.5 on the condition assessment framework, described above.

For Bridges and Buildings, IALP2024 uses the inspection data collected during the most recent physical assessment of undergrade bridge assets in accordance with the new Condition Assessment Framework discussed previously. Age was used as a proxy for assigning condition ratings to tunnels, movable bridges, signal bridges, culverts, and retaining walls. For Facilities the assessments are not currently summarized in the IALP, for the reasons noted earlier. These asset rating approaches, as described here, will continue to be implemented through the plan period; however, Amtrak will seek to expand its condition-based asset scoring beyond undergrade bridges as the new assessment frameworks are finalized.

IALP 2024 – Assessed B&B Asset Condition

For IALP2024 the assessed condition of B&B bridge assets, based on both assessed condition and useful life is summarized in Table 21. As noted previously, the assessed condition for facility assets is captured; however, it has yet to be standardized to the IMCS rating scale and is therefore omitted from this section, which will be implemented during this plan period.

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[3] *Infrastructure Asset Condition Guidelines – Bridges and Tunnels. Version 3, Issued October 2018.*

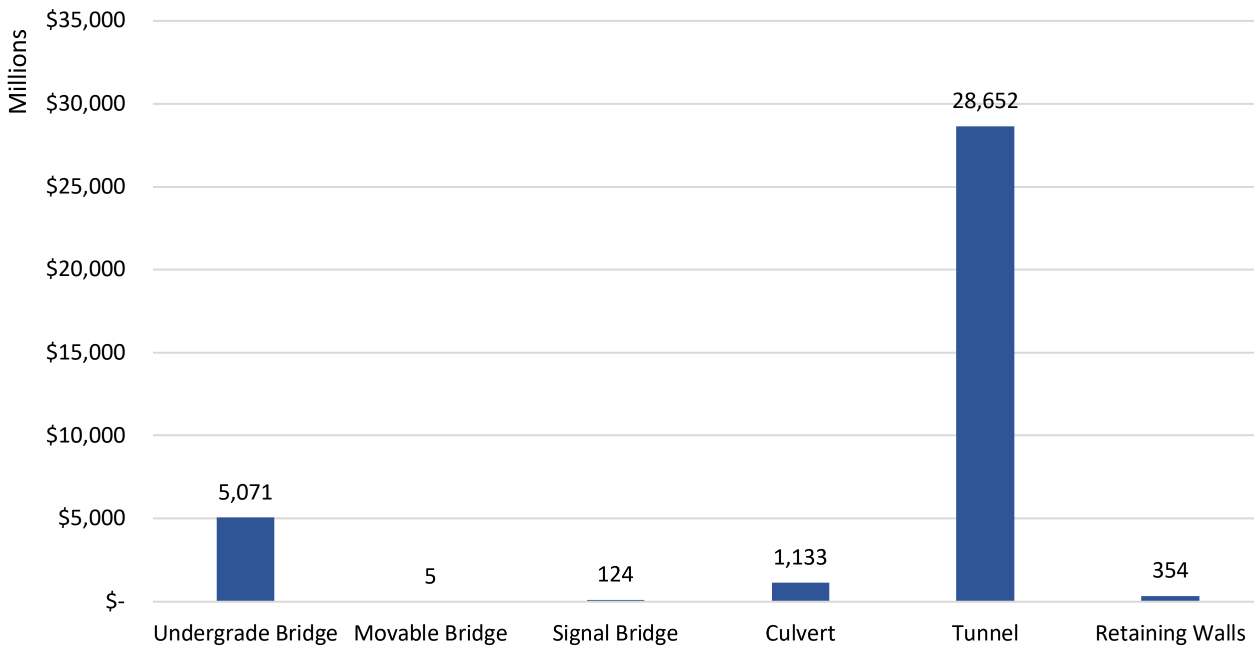
[4] *Infrastructure Asset Condition Guidelines – Facilities. Version 3, Issued October 2018.*

Table 21: Summary of Assessed Bridge Conditions

Asset Component	Av SOGR	% of Total NOT in SOGR (by Lin. Ft. for Undergrade Bridges and Tunnels)
BRIDGES		
Undergrade Bridge	**2.38**	**18.6%**
NEC Main Line	2.39	18.3%
NEC Branch Line, Owned by Amtrak	2.29	17.9%
NEC Branch Line, Owned by CSX	2.46	30.2%
National Network, Owned by Amtrak	2.26	12.2%
National Network, Owned by Michigan	2.50	13.3%
Movable Bridge	**2.64**	**57.1%**
NEC Main Line	2.90	40.0%
NEC Branch Line, Owned by Amtrak	2.00	100.0%
NEC Branch Line, Owned by CSX	2.00	100.0%
National Network, Owned by Amtrak	2.00	100.0%
National Network, Owned by Michigan	2.00	100.0%
Signal Bridge	**1.23**	**87.5%**
NEC Main Line	1.24	88.5%
NEC Branch Line, Owned by Amtrak	1.23	92.0%
NEC Branch Line, Owned by CSX	1.21	100.0%
National Network, Owned by Amtrak	1.00	100.0%
National Network, Owned by Michigan	-	-
Culvert	**1.78**	**99.2%**
NEC Main Line	1.92	99.6%
NEC Branch Line, Owned by Amtrak	2.21	98.0%
NEC Branch Line, Owned by CSX	1.00	100.0%
National Network, Owned by Amtrak	1.00	100.0%
National Network, Owned by Michigan	1.00	100.0%
Tunnel	**1.16**	**92.5%**
NEC Main Line	1.17	92.3%
NEC Branch Line, Owned by Amtrak	1.00	100.0%
NEC Branch Line, Owned by CSX	1.00	100.0%
National Network, Owned by Amtrak	-	-
National Network, Owned by Michigan	-	-
Retaining Walls	**N/A**	**41.0%**
NEC Main Line	N/A	40.0%
NEC Branch Line, Owned by Amtrak	N/A	53.0%
NEC Branch Line, Owned by CSX	N/A	N/A
National Network, Owned by Amtrak	N/A	N/A
National Network, Owned by Michigan	N/A	N/A

The replacement value of B&B assets with a condition rating below 2.5 which are nearing the end of their useful life is estimated to be over $35.3 billion in 2023 dollars. This is Amtrak's SOGR Backlog for bridges and buildings assets. The largest portion of this is attributed to the NEC main and branch-line assets owned by Amtrak, which is estimated to be over $34.5 billion in 2023 dollars. An additional $400 million backlog is present on the CSX leased lines which are capitally funded by the State of New York. The national network accounts for $109 million in backlog, with an additional $244 million backlog on the Michigan-owned infrastructure. **Figure** 5 presents the backlog by B&B asset type.

Figure 15: B&B Estimated SOGR Backlog by Asset Type ($m 2023)[1]



[1] Please note that this is the estimated value of assets that are past their useful life and are in need of replacement. It is not the forecast project costs (i.e., indirect costs) associated with replacing these assets. The total value is based on unit rates (i.e., direct costs) proposed by Amtrak Finance and confirmed by the Deputy Chief Engineer Structures. It is worth noting that many of the highest priorities for SOGR are also identified as opportunities for network performance improvement (i.e., infrastructure assets under various initiatives such as the Gateway Program). These figures do not consider the project-specific costs or constraints of these capital improvement programs.

B&B Asset Strategy

Lifecycle management strategies updated as part of IALP2024 capture the normalized (or steady state) activities necessary to maintain a state of good repair and ensure B&B assets are functional and able to continue to support a safe, efficient, and sustainable national rail network.

Overview

The current B&B lifecycle management approach is determined by engineering judgment, including assessment of risk through inspections, and is focused on maintaining safe rail operations.

Amtrak maintains robust and consistent processes for the lifecycle management of bridges and buildings that are consistent with and, in many areas, go beyond FRA requirements (i.e., more frequent inspections of movable bridges). For facilities, Amtrak has developed a Facilities Maintenance Management Manual.

In I-AMP2017, Amtrak Engineering, currently known as Infrastructure Maintenance and Construction Services, commenced a review of the lifecycle strategies for bridges and buildings assets. The review undertaken is consistent with other infrastructure classes. The purpose is to document and refine Amtrak's long-term infrastructure maintenance and improvement program to support the achievement of its state of good repair objectives. Amtrak IMCS recognizes that to achieve all of its asset objectives (i.e., including those beyond SOGR), a sizeable backlog in infrastructure investment must be addressed before a program of steady state or normalized maintenance can be adopted.

B&B initiated a program to address 3 to 4 small to medium-sized undergrade bridges per division each fiscal year. Design for these bridges is being performed with replacement occurring in 2025. In addition, there is a similar approach for culverts, with 8 currently in the design pipeline, two of which will be replaced in FY24. B&B is also in the process of developing separate strategies for signal bridges, with most divisions (MAD-N, MAD-S, and NYD) to perform two or more signal bridge inspections per year. This systematic approach will help to address the state of good repair backlog.

The lifecycle management strategies for B&B assets laid out in the following sections define the approach adopted for the 2024 program, the revised approach for the years following to address backlog, and the approach to steady state for state of good repair and maintenance expenditures. In several instances, we have laid out specific strategies for an asset – these are considered top priorities and consistent with strategies adopted by our industry partners.

Current Asset Strategies

The current lifecycle management strategies employed by Amtrak to achieve its objectives for B&B assets are described in Table 22. These strategies have been applied to determine the work bank.

The aim of the B&B Department is to maintain and improve the condition of the B&B infrastructure to minimize the risk to safety and train service impact. Work is categorized into the following:

- → *Inspection / Monitoring* activities to confirm the asset can function in its required state and provide a safe operational environment.
- → *Preventive Maintenance* activities to help an asset achieve a required level of performance and maintain a safe operational environment.

- → *Corrective Maintenance* activities to return the asset to its required function and restore a safe operational environment.
- → *Capital Maintenance* to restore the asset to a specified design standard and maintain performance.
- → *Capital Replacement* to renew the asset and maintain performance.
- → *Capital Improvement* to replace the asset and improve performance or network capability.

Table 22: Current Lifecycle Management Strategies

Category	Description
Bridges	
Inspection/ Monitoring *(See Table 20 for more detail)*	→ Annual inspections utilizing a 0-6 scale (i.e., better to worse), identify defects or potential defects at a component level and are used to drive the capital plan. o Comprehensive follow-up and monitoring of all bridges rated at 6, 5 and 4. Inspection programs designed for each asset. → Monthly and quarterly program of comprehensive inspections of all movable bridge components and all movable bridges over waterways. → Special inspections to monitor bridge movements (movable bridges) or following flood events / incidents. → Real time monitoring of critical bridges, including load, vibrations, movement etc. → Established program for annual tunnel and culvert inspections.
Preventive Maintenance	→ Preventive maintenance undertaken as per Amtrak Bridge Maintenance Management Manual.
Capital Maintenance	→ Significant level of capital maintenance undertaken on bridges to maintain the asset in service. Generally accomplished through selective component replacement to maintain safe operation.
Capital Replacement	→ Significant level of capital replacement undertaken on bridges to renew the asset in service. Generally accomplished through selective asset replacement to maintain safe operation. → Capital replacement strategies as detailed in Table 23.
Capital Improvement	→ Significant level of capital improvement undertaken on bridges to replace and improve the asset in service. Generally accomplished through asset component replacement to maintain safe operation and improve performance / network capability. → Capital improvement strategies as detailed in Table 23.
Facilities	
Inspection/ Monitoring	→ Building inspections are scheduled every 5 years utilizing a “Good” to “Very Poor” scale to assess the integrity of the SOGR of the site, building envelope and asset systems and to verify compliance with local codes. → Each building system category is assessed based on overall appearance and condition, and its equipment / components rated accordingly. Additionally, a priority scale is used to assess each component (i.e., in consideration of potential impacts to safety, operations, etc.). → Comprehensive follow-up for poorly rated buildings / building systems. → IMCS is notified of conditions requiring immediate attention.
Preventive Maintenance	→ Preventive maintenance undertaken as per Amtrak Facilities Maintenance Management Manual.
Capital Maintenance	→ Provided for building systems to maintain assets in service. Generally accomplished through a selective process based on the results of building inspections and findings during maintenance procedures. Assets are proposed based on SOGR inspections and selected based on their criticality, such as safety, customer service, and regulatory or code compliance.

Capital Replacement	→ Capital replacement is provided for building systems to replace assets which are no longer in SOGR. Generally accomplished through a selective replacement process whereby assets are initially proposed based on the results of building inspections or maintenance conclusions and are ultimately selected based on criticality such as safety, customer service, and regulatory or code compliance.
Capital Improvement	→ Capital improvement is provided for building systems to replace assets which are either no longer in SOGR or "outdated" and not in compliance with applicable standards or codes. Generally accomplished through a selective improvement process whereby assets are initially proposed based on the results of building inspections and/or compliance and ultimately **selected** based on criticality such as safety, customer service, and regulatory or code compliance.

Moving Towards Normalized or Steady State Maintenance

Overall Approach

For B&B, Amtrak IMCS has undertaken a similar review as taken with other infrastructure asset classes to determine the necessary replacement lifecycle to achieve steady state SOGR. Recognizing the large number of critical B&B assets that require replacement and the significant cost of replacing those assets, the approach defined below includes both useful life benchmark replacement cycles, as well as specific strategies for the replacement of critical assets. It is important to note, that at this time, this approach addresses B&B bridge assets, and the approach for facility assets is still being developed; however, it will likely rely on some of the same keys and principles as outlined in this section for bridge assets.

Consistent with other asset classes, there are four keys to the revised B&B lifecycle management strategy, namely:

Achieve SOGR	Bring B&B assets to a state of good repair and then maintain them in a steady state to ensure sufficient capability to meet operational needs.
Prevent Insidious Decline	While progressing towards steady state SOGR, introduce an enhanced assessment regime to guard against the insidious decline in the condition of any individual elements of a structure and ensure that the asset remains in a safe operational state.
Maintain Performance	Develop a program of work (i.e., work bank) that is prioritized to ensure that the B&B infrastructure can function in its required state, thus minimizing performance loss due to asset faults and failures.
Support Network Capability Improvement	Enhance program of work to ensure that B&B assets contribute to capability targets established through the Amtrak Service Plans, including enabling higher speed operations.

Transition Strategy

The approach taken has been to establish useful life benchmarks (ULBs) to define a program of steady state or normalized maintenance necessary to achieve SOGR. Useful life benchmarks have been established through several sources, including:

- → Previous SOGR reports and studies conducted in the last 5 to 10 years
- → IMCS review and judgement of typical lifecycle of assets on Amtrak property
- → Independent review by outside parties

- International benchmarking against comparable rail networks including those in the United Kingdom and Continental Europe

The concept of a useful life benchmark supports the development of a work bank but cannot drive an asset management strategy on its own. This is because there are other considerations beyond age, and in some cases condition, that may dictate work to be programmed, such as considerations related to safety or network improvements. Additionally, the transition to steady state maintenance requires backlog needs to be addressed first. Therefore, in the short term, asset management strategies will be driven by a combination of focusing on asset needs dictated solely by condition and at other times by other considerations. For B&B, it is also essential that asset configuration (i.e., alignment, capacity, etc.) is considered as part of this strategy. As we move to a steady state replacement cycle, the early iterations need to be *staged* (prioritized) such that the ongoing work program is manageable year over year. Table 23 summarizes the primary lifecycle strategy and the current implementation status by asset. This will be further reviewed and updated through the plan period.

Table 23: IALP2024 Bridges and Buildings Lifecycle Management Strategy

Activity	Primary Lifecycle Strategy & Implementation Status
Inspection/ Monitoring	
General	→ To prevent insidious decline of B&B assets, continue to perform inspection & monitoring activities based on Amtrak standards. → *No significant change to current practice.*
Preventive Maintenance	
General	→ To prevent insidious decline of B&B assets, continue to perform preventive maintenance activities based on Amtrak standards. → *No significant change to current practice.*
Corrective Maintenance	
General	→ To prevent insidious decline of B&B assets, continue to perform corrective maintenance activities based on Amtrak standards. → *No significant change to current practice.*
Capital Maintenance	
General	→ To prevent insidious decline of B&B assets, continue to perform capital maintenance activities based on Amtrak standards. → *No significant change to current practice.*
Capital Replacement	
Movable bridges	→ To return movable bridges to a SOGR and improve network performance, a separate strategy *has been developed* for each bridge. For long-range planning purposes the expected design life of movable bridges is 150 years.
Signal bridges	→ To return signal bridges to a SOGR, a separate strategy *has been developed* for each bridge (roughly 4 per year). For long-range planning purposes the expected design life of movable bridges is 80 years.
Undergrade bridges	→ To return undergrade bridges to a SOGR and improve network performance, a separate strategy *has been developed* for each bridge (roughly 1 medium sized bridge per division per year, so 3 to 4 per corridor). For long-range planning purposes the expected design life of undergrade bridges is 150 years.
Culvert	→ To return culverts to a SOGR and improve network performance, a program of culvert replacement *has been developed* (tentatively 2-4 major rehabs per year, starting on the Mid-Atlantic and New York Divisions). For long-range planning purposes the expected design life of culverts is 80 years.
Tunnel renewal	→ To return tunnels to a SOGR and improve network performance, a separate strategy *has been developed* for each tunnel. For long-range planning purposes the expected design life of tunnels is 150 years.
Retaining wall	→ To maintain SOGR, replace retaining walls every 150 years. → *A program of retaining wall replacement will be developed through this plan period.*

Capital Improvement	
The Northeast Corridor is one of the most complex and heavily used railroads in the world. Much of the corridor is not only in need of urgent rehabilitation but is also approaching the limits of its capacity. Addressing the SOGR backlog therefore provides an opportunity to address these network performance needs and ensure that the NEC corridor can continue to provide safe, reliable, and convenient high-speed rail service into the next century and beyond. A series of network performance improvement projects have been identified that could be advanced within the next five years to the extent funding is available. These projects represent an opportunity to improve network performance while addressing SOGR backlog needs. Therefore, some of the costs associated with these projects should be considered in addition to the SOGR backlog identified previously.	
Baltimore and Potomac Tunnel Replacement	→ Replacement of existing B&P tunnel with a new four track tunnel and an improved alignment would both improve reliability and accommodate demand for future train service.
Susquehanna River Bridge Replacement	→ Replacement of existing Susquehanna River Bridge with two parallel two-track fixed bridges, each high enough to allow boats to pass without opening.
East River Tunnel Rehabilitation	→ Rehabilitation of all four tunnels. The initial plan is to address Tunnels #1 and #2.
Pelham Bay Bridge Replacement	→ Replacement with a new higher-level fixed bridge with improved clearance for marine traffic.
Sawtooth Bridge	→ Replacement of the existing Sawtooth Bridge with a four-track structure, increasing efficiency and network operations.
Portal North Bridge	→ Replacement of the existing Portal Bridge with a new high-level, fixed-span bridge that would eliminate future malfunctions and improve reliability after malfunction.
Hudson Tunnel Project	→ Construction of a new two-track tunnel (Hudson Tunnel), to allow for the existing North River Tunnel to be closed for reconstruction.
Bush River Bridge	→ Replacement of the existing two-track movable Bush River Bridge with new modern high-level, fixed structures with a total of four tracks, increasing efficiency and network operations.
Gunpowder River Bridge	→ Replacement of existing Gunpowder River Bridge with new modern high-level, fixed structures with a total of four tracks, increasing efficiency and network operations.
Springfield Line: Connecticut River Bridge	→ Replacement of the existing single-track Connecticut River Bridge with new double track bridge to increase speeds for both commuter and intercity trains, eliminate bottlenecks, and enhance on-time performance.
Dock River Bridge Rehabilitation	→ Major rehab to be performed, including painting and navigation lights.
Lab Bridge	→ Replacement of existing swing Lab Bridge with a vertical lift bridge over the Hudson River, which will be led by New York State DOT.

Appendix D: Electric Traction Asset Strategy

Appendix D: Electric Traction Asset Strategy

Appendix D provides additional information on Amtrak's Electric Traction (ET) assets and establishes the lifecycle management strategy to achieve a state of good repair (SOGR).

Overview

Pursuant to 49 U.S.C § 24320(a)(2), this appendix captures the *unconstrained funding* needs to adopt a normalized or steady state management strategy necessary to achieve a SOGR. It represents our latest thinking at the time of publication of what work needs to be accomplished based on the proposed use of the asset and its current condition.

The appendix is structured to be consistent with the main body of the IALP2024 with the following sections:

- → Asset Inventory – provides further details on the ET infrastructure assets across all parts of the Northeast Corridor.
- → Asset Condition – presents our current understanding of ET asset condition and our plans for improving our knowledge of the state of the asset.
- → Asset Strategy – presents the lifecycle strategies for the management of ET infrastructure assets and our strategy for moving towards achieving a steady state replacement of such.
- → Additional Funding Needs – provides an assessment of the *unconstrained* steady state program and the forecast SOGR work bank necessary to bring the ET infrastructure assets into a SOGR.

Responsible Official

Pursuant to 49 U.S.C. § 24320(c)(3)(c) the following individual is responsible for ET infrastructure owned or managed by Amtrak:

- → ***Joanna Pardini, Deputy Chief Engineer Electric Traction***

ET Asset Inventory

Amtrak manages ET assets valued at $9.2 billion – consisting of two traction power systems providing power to electric locomotive trains on the Northeast Corridor.

Overview

Amtrak operates two traction systems along the Northeast Corridor, namely:

- → A 25 Hz traction power system along the southern portion of the NEC – commonly referred to as *south end electrification*.
- → A 60 Hz traction power system along the northern portion of the NEC – commonly referred to as *north end electrification*.

South End Electrification

The 25Hz southern portion runs 235 route miles between Washington D.C. and Bowery Bay, New York. The system was constructed between 1926 and 1931 and consists of catenary structures carrying static wires, transmission wires operating at 138KV, signal power wires, and up to six overhead contact systems operating at 12KV. The overhead contact system consists of fixed termination wires where changes in air temperature cause tensions in the wires to fluctuate, limiting the system's ability to provide dependable high-speed service above speeds of 125mph through the region's average temperature range.

Electric power originates at six converter stations, which includes one located at the Safe Harbor hydroelectric plant along the Susquehanna River in Pennsylvania. The overall power capacity of the power system is 404MW with a peak load up to 220MW.

A critical element to operational stability introduced during the 93-year evolution of the south end electrification is the built-in redundancy of critical power infrastructure. Major transportation hubs such as Penn Station in New York are supplied power through two sources that ensure undisturbed service in the event one source should fail. The delivery of power through these redundant sources are provided through underground and aerial transmission lines.

The south end portion also includes 13.5 miles of 60 Hz catenary on the Hellgate Line between Bowery Bay and New Rochelle, New York. This system is similar to the north end electrification.

In addition to the main line assets described above, Amtrak also owns and operates 106 route miles of 25 Hz traction power built in 1938 between Philadelphia and Harrisburg, Pennsylvania. Electrical power is drawn from the same six 25 Hz converter stations on the Northeast corridor – where about a third of the power is supplied by Safe Harbor.

North End Electrification

The northern portion runs 155 route miles between New Haven, Connecticut and Boston, Massachusetts. The system was commissioned in 2000 and consists of catenary structures carrying static wires, negative feeders, and an overhead contact system. The overhead contact system consists of a constant tension catenary and contact wire where weights are employed at the ends of the wires to maintain a constant tension through a specified temperature range. This type of system was designed to provide reliable high-speed service (speeds above 125 mph) through this modern constant tension technology. The power system employs an autotransformer power delivery system where a transmission system similar to the southern corridor is not required to maintain optimum operating voltage between feeding substations. These feeding substations are fed by local utilities throughout the region and step the utility voltages down for railroad use.

Inventory Development

Amtrak acknowledges that the asset registry for ET assets is lacking some data attributes. The focus to date has been to ensure safety critical assets are included. As part of an ongoing program of improvement the following issues will be addressed:

- → Asset records – further develop the asset requirements for asset information, identifying the data attributes and defining data parameters. ET will utilize aerial assessment data to improve the current inventory.
- → Asset surveys – undertake extensive system-wide asset surveys to improve the quality of asset information.

A summary of traction power infrastructure on the Northeast Corridor is shown Table 27 below.

Table 27: NEC Main Line Electric Traction Assets

Asset Component	Count	Units	Av Install Date
Substation	**93**	**Stations**	**1952**
NEC Main Line - South End	54	Stations	1935
NEC Main Line - North End	25	Stations	1999
NEC Branch Line - South End	14	Stations	1933
NEC Branch Line - North End	-	Stations	-
Circuit Breakers	**1,074**	**Each**	**1984**
NEC Main Line - South End	765	Each	1984
NEC Main Line - North End	145	Each	1999
NEC Branch Line - South End	164	Each	1970
NEC Branch Line - North End	-	Each	-
Switches	**4,077**	**Each**	**1962**
NEC Main Line - South End	2,846	Each	1955
NEC Main Line - North End	698	Each	1999
NEC Branch Line - South End	533	Each	1954
NEC Branch Line - North End	-	Each	-
Transformers	**140**	**Each**	**1990**
NEC Main Line - South End	98	Each	1995
NEC Main Line - North End	18	Each	1999
NEC Branch Line - South End	24	Each	1961
NEC Branch Line - North End	-	Each	-
Signal Machines	**34**	**Each**	**1974**
NEC Main Line - South End	29	Each	1978
NEC Main Line - North End	-	Each	-
NEC Branch Line - South End	5	Each	1947
NEC Branch Line - North End	-	Each	-
Frequency Converter Station			
Frequency Converter Unit	**19**	**Stations**	**2004**
NEC Main Line	16	Stations	2003
NEC Branch Line	3	Stations	2011
Switches (FC)	**484**	**Each**	**1972**
NEC Main Line - South End	428	Each	1976

NEC Main Line - North End	-	Each	-
NEC Branch Line - South End	56	Each	1943
NEC Branch Line - North End	-	Each	-
Transformers (FC)	**59**	**Each**	**1993**
NEC Main Line - South End	52	Each	1998
NEC Main Line - North End	-	Each	-
NEC Branch Line - South End	7	Each	1956
NEC Branch Line - North End	-	Each	-
Circuit Breakers (FC)	**87**	**Each**	**1996**
NEC Main Line - South End	87	Each	1996
NEC Main Line - North End	-	Each	-
NEC Branch Line - South End	-	Each	-
NEC Branch Line - North End	-	Each	-
Overhead Contact System			
Catenary Structure[1]	**15,504**	**Each**	**1962**
NEC Main Line - South End	6,310	Each	1942
NEC Main Line - North End	6,014	Each	1999
NEC Branch Line - South End	3,181	Each	1934
NEC Branch Line - North End	-	Each	-
Mainline Wiring	**1,468.3**	**Miles**	**1992**
NEC Main Line - South End	844.0	Miles	1992
NEC Main Line - North End	370.8	Miles	1992
NEC Branch Line - South End	253.5	Miles	1992
Third Rail			
Third Rail	**37.6**	**Miles**	**1992**
NEC Main Line - South End	37.0	Miles	1992
NEC Main Line - North End	-	Miles	-
NEC Branch Line - South End	0.6	Miles	2018
NEC Branch Line - North End	-	Miles	-

1 - Catenary structures are representative of on average of two catenary poles

ET Asset Condition

Amtrak's ET Department conducts a program of condition monitoring activities to identify faults, prioritize intervention and ensure safe operation of the railroad. However, it has recognized a need to improve its condition assessment capability to predict the optimal point of replacement.

Overview

Amtrak Infrastructure Maintenance and Construction Services (IMCS) currently conducts an extensive condition monitoring (inspection) program of ET infrastructure assets at intervals in line with Amtrak catenary inspection and substation inspection manuals. Each of the catenary and substation manuals are further divided into New York & Atlantic and New England division manuals, as well. The current monitoring activities ensure safe operation of the railroad. They are used to identify faults and potential faults which result in prioritized and scheduled maintenance. Additionally, it is worth noting that a Condition Assessment Framework has recently been developed to provide additional context on asset conditions to complement the existing ET Monitoring Program. The following table summarizes the ET Monitoring Program.

Table 28: Summary of ET Condition Monitoring Activities

Activity	Scope / Description
Catenary Lines / Structures	
Catenary Maintenance Vehicle (Cat Car) Inspection (Biennially)	→ Inspection of the overhead contact system including alignment, tensioning and cable diameter (i.e., potential wear). → Visual inspection by engineers riding in the car.
Catenary Geometry Car Inspection (Quarterly)	→ Catenary geometry car records height, stagger, gradient and cable diameter (wear) and creates a suspected defects list.
Visual Inspections	→ Visual inspection by engineers riding at head of train – mainline weekly. → Visual inspection by engineers walking elsewhere on the network – various intervals. → Temperature extremes may necessitate daily inspections in accordance with ET inspection manuals.
Substations / Feeder Stations	
General Inspection (ET-28A/ETS-1) (Monthly)	→ Visual inspection of the general condition of the substation including grounds, fence, buildings, safety devices, structures, and the status of critical grounding equipment.
Semi-Annual Inspection (ET-28C/ETS-2 through ETS-7) (Semi-Annually)	→ Visual assessment of general condition as per above, plus further detailed review and operational checks of switches and disconnects, transformers, circuit breakers, switchgear, signal power machines, and substation batteries.

In 2019, ET commenced a new means of asset condition assessment of catenary structures in partnership with Catalyst Aviation. Helicopters perform aerial assessments of Amtrak's catenary, signal and transmission system structures, electrical lines, and components and system assets along the right of way. Qualified personnel review the baseline assessment and identify defects as well as assign a condition rating based on established thresholds. These defects are created as work orders in Amtrak's enterprise asset management system for assignment to the appropriate division personnel. The work orders are coded a I, II, or III level priority. Priority I and II orders are sent out immediately and addressed within 48 hours or one (1) month, respectively. Priority III orders are sent out weekly and addressed within one (1) year. This initiative has and will continue to result in reliability centered maintenance regimes and improved capital planning for catenary structure renewal or replacement. For instance, the aerial inspections helped prioritize the need to perform catenary wire replacement on the south end of the Mid-Atlantic division, which is set to begin in 2024.

Asset Condition Assessment Methodology

Pursuant to 49 U.S.C § 24904(c), Amtrak is required to undertake a "*condition assessment of those inventoried assets for which a provider has direct responsibility and to level of detail to monitor and predict performance of assets and inform investment prioritization" (U.S. 49 CFR § 625.25(b)(2)).*

In meeting this obligation, Amtrak IMCS has developed an electric traction asset condition assessment guide[5] and plans for its implementation are progressing. The guide provides instruction on the assignment of condition ratings, each graded between zero (asset is non-operable) through five (asset is new or nearly new). The approach results in a condition rating for each asset and will enable assessment of SOGR at the asset and at higher levels (i.e., network or location).

[5] *Infrastructure Asset Condition Guidelines – Electric Traction. Version 2, Issued October 2018.*

Amtrak IMCS considers an asset to be in a SOGR when it is in a condition where it can continue to meet and perform the functional requirements for which it was designed and when the lifecycle investment needs of the asset have been met. This definition is consistent with the definition laid out in *U.S. 49 CFR § 625.* Amtrak IMCS grades an asset in a SOGR if it scores greater than or equal to 2.5 on the condition assessment framework, described above.

For IALP2024, with one exception, the age of the asset is being used to estimate the asset's SOGR, based on the remaining useful life of the asset. The catenary structures asset is scored using established thresholds that consider asset condition, age, and several other factors. This will be updated through the plan period with visual and measured assessments.

IALP 2024 – Assessed ET Asset Condition

For IALP2024, the assessed condition of ET assets, based on useful life of the asset, is summarized in Table 29 below.

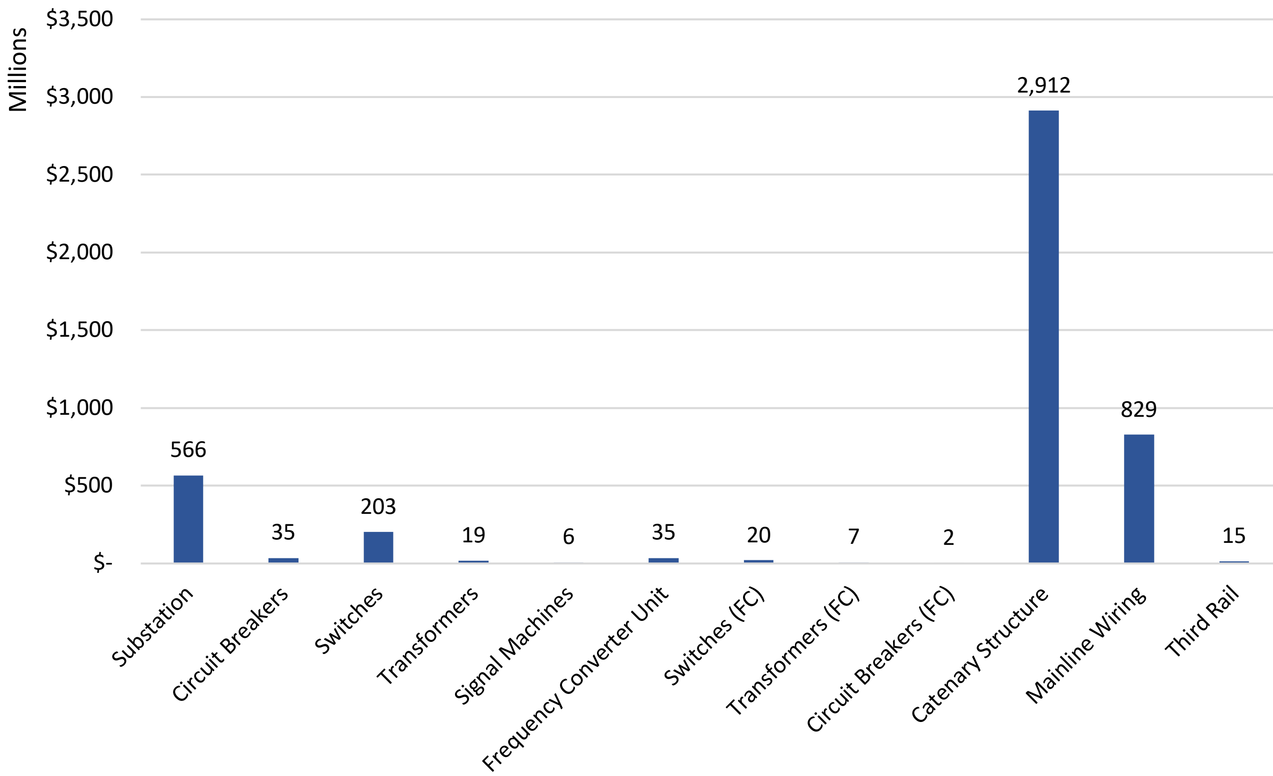
Table 29: 2024 Assessed Condition of ET Assets

Asset Component (ET)	Av SOGR	% of Total NOT in SOGR
Substation	**1.34**	**96.8%**
NEC Main Line - South End	1.11	96.3%
NEC Main Line - North End	2.04	96.0%
NEC Branch Line - South End	1.00	100.0%
NEC Branch Line - North End	-	-
Circuit Breakers	**2.76**	**33.0%**
NEC Main Line - South End	2.76	35.2%
NEC Main Line - North End	3.00	0.0%
NEC Branch Line - South End	2.54	51.8%
NEC Branch Line - North End	-	-
Switches	**1.98**	**62.3%**
NEC Main Line - South End	1.79	74.1%
NEC Main Line - North End	3.01	0.0%
NEC Branch Line - South End	1.64	80.5%
NEC Branch Line - North End	-	-
Transformers	**3.26**	**23.6%**
NEC Main Line - South End	3.56	17.4%
NEC Main Line - North End	3.00	0.0%
NEC Branch Line - South End	2.25	66.7%
NEC Branch Line - North End	-	-
Signal Machines	**1.12**	**97.1%**
NEC Main Line - South End	1.14	96.6%
NEC Main Line - North End	-	-
NEC Branch Line - South End	1.00	100.0%
NEC Branch Line - North End	-	-
Frequency Converter Station		
Frequency Converter Unit	**2.96**	**10.5%**
NEC Main Line	2.81	12.5%
NEC Branch Line	4.00	33.3%
Switches (FC)	**2.22**	**51.5%**

NEC Main Line - South End	2.34	46.3%
NEC Main Line - North End	-	-
NEC Branch Line - South End	1.27	91.1%
NEC Branch Line - North End	-	-
Transformers (FC)	**3.07**	**22.0%**
NEC Main Line - South End	3.23	15.4%
NEC Main Line - North End	-	-
NEC Branch Line - South End	1.86	71.4%
NEC Branch Line - North End	-	-
Circuit Breakers (FC)	**2.94**	**23.0%**
NEC Main Line - South End	2.94	23.0%
NEC Main Line - North End	-	-
NEC Branch Line - South End	-	-
NEC Branch Line - North End	-	-
Overhead Contact System		
Catenary Structure	**2.96**	**44.2%**
NEC Main Line - South End	2.38	67.0%
NEC Main Line - North End	4.00	0.0%
NEC Branch Line - South End	2.13	82.5%
NEC Branch Line - North End	-	0.0%
Mainline Wiring	**1.51**	**75.0%**
NEC Main Line - South End	1.00	100.0%
NEC Main Line - North End	3.00	0.0%
NEC Branch Line - South End	1.00	100.0%
NEC Branch Line - North End	-	-
Third Rail		
Third Rail	**2.02**	**98.4%**
NEC Main Line - South End	2.00	100.0%
NEC Main Line - North End	-	-
NEC Branch Line - South End	5.00	0.0%
NEC Branch Line - North End	-	-

The replacement value of ET assets with a condition rating below 2.5, which are assessed as nearing the end of their useful life, is estimated to be **over $4.6 billion in 2023 dollars**. This is Amtrak's SOGR Backlog for ET assets. Almost $3.2 billion of the backlog is on the NEC Main Line with nearly $1.5 billion on the NEC Branch Lines. Figure 17 presents the backlog by ET asset type. The largest portion of the backlog is the catenary structures which accounts for over $2.9 billion.

Figure 17: ET Estimated SOGR Backlog by Asset Type ($m 2023)



ET Asset Strategy

Lifecycle Management Strategies developed as part of IALP2024 capture the normalized or steady state activities necessary to achieve a steady state of good repair and ensure ET assets are functional and able to continue to support a safe, efficient, and sustainable national rail network.

Overview

The current ET lifecycle management approach is largely reactive, determined by engineering judgment, and focused on maintaining safety. ET undertakes flow studies to predict and plan the construction of new power systems. However, there is currently no approach in place for predicting and prioritizing future investment needed in existing assets based on the condition, or assessment of likely future performance. This is partially driven by the bigger question and challenge for how to modernize the existing infrastructure – a program which would have significant impact on service.

ET has no FRA mandated inspections but does undertake several inspections as described in the *ET Asset Condition* section above. Maintenance strategies are defined in procedure manuals, which were all updated within the past year to include standardized language across the division.

ET acknowledges that preventive maintenance activities are not consistently completed due to limited resource availability and a need to provide ET staff to support other asset classes (i.e., for isolation) or capital projects. This has resulted in a growing maintenance backlog, which is becoming a major priority.

Further, capital replacement strategies are not well-defined. To date, the limited information to support long-term decisions and identify the issues with available resources results in a program focused on replacing high risk assets only (i.e., to improve reliability). ET acknowledges that there are competing demands for staff for capital improvement projects (for example Penn Access.

In I-AMP2017, Amtrak Engineering, currently known as IMCS, commenced a review of the lifecycle strategies for all infrastructure assets. Its purpose was to develop the long-term infrastructure maintenance and improvement program to reach a state of good repair. For ET, this represented the start of developing a network wide view of the capital investment needed for electric traction infrastructure to meet current and future demands. This strategic review identified the initial priorities: implementation of more reliable catenary wires for higher speed operations (moving from fixed to constant tension cables), decreasing risks associated with transmission on some parts of the network, and replacement of at-risk structures.

The lifecycle management strategies for ET assets, laid out in the following sections, define the approach adopted for the 2024 program, the revised approach for the years following to address backlog, and the approach to steady state for state of good repair and maintenance expenditures.

It is recognized that the overall strategy needs further work – particularly related to changes in asset configuration to improve performance and reliability. This work will, therefore, continue through the planning period.

Current Asset Strategies

The current lifecycle management strategies employed by Amtrak to achieve its ET asset objectives are described in Table 30. Few assets have lifecycle strategies developed, and the run-to-fail approach is generally used. Engineering judgement has been used to determine the work bank for 2024 and beyond.

The aim of the ET Department is to maintain and improve the condition of the ET infrastructure to minimize safety risks and train service impacts. Work is categorized into the following:

- *Inspection Monitoring* activities to confirm the asset can function in its required state and provide a safe operational environment.
- *Preventive Maintenance* activities to help an asset achieve a required level of performance and maintain a safe operational environment.
- *Corrective Maintenance* activities to return the asset to its required function and restore a safe operational environment.
- *Capital Maintenance* to restore the asset to a specified design standard and maintain performance.
- *Capital Replacement* to renew the asset and maintain performance.
- *Capital Improvement* to replace the asset and improve performance or network capability.

Table 30: Current Lifecycle Management Strategies

Category	Description
Catenary Lines / Structures	
Inspection/ Monitoring	→ Automated inspections by catenary car and catenary geometry car. → Visual inspections by engineers in rail car and on foot. → Aerial assessment of catenary structures.
Preventive Maintenance	→ Corrosion treatment and painting of catenary structures (limited use due to resource constraints).
Capital Replacement	→ Corrective maintenance of failed components treated as capital replacement. → Limited replacement of catenary structures – based on failed or high risk of failure. → Limited replacement of catenary/transmission lines – based on failed or high risk of failure. Catenary wire replacement is based on wear measurements from catenary car and catenary geometry car.
Capital Improvement	→ Limited modernization of overhead catenary wires to constant tension along a 23-mile section of track in New Jersey to accommodate operating at speeds up to 160 mph and increase reliability.
Substations / Feeder Stations	
Inspection/ Monitoring	→ Monthly visual safety inspection. → Visual assessment of all asset conditions.
Preventive Maintenance	→ Programs require revisiting. Currently, not consistently applied. → Little to no maintenance is carried out on off corridor transmission lines.
Capital Replacement	→ Focused on transformers, breakers, and switches – to reduce risk of failure. → Transmission lines – replacement of insulators on an as-needed basis.
Capital Improvement	→ Whole-scale replacement of motor generator sets with static frequency converters.

Moving Towards Normalized or Steady State Maintenance

Consistent with other asset classes, there are four keys to the revised ET lifecycle management strategy, namely:

Achieve SOGR	Bring ET assets to a state of good repair and then maintain them in a steady state to ensure sufficient capability to meet operational needs.
Prevent Insidious Decline	While progressing towards steady state SOGR, introduce an enhanced assessment regime to guard against the insidious decline in the condition of any individual sections of electric traction network and ensure that the asset remains in a safe operational state.
Maintain Performance	Develop a program or work (i.e., work bank) that is prioritized to ensure that the ET infrastructure can function in its required state, thus minimizing performance loss due to asset faults and failures.
Support Network Capability Improvement	Enhance program of work to ensure that ET assets contribute to capability targets established through the Amtrak Service Plans, including enabling higher speed operations.

Transition Strategy

Amtrak's ET Department utilizes a top-down approach to establish its normalized or steady state program. Assets are initially assessed at the highest level – substations, frequency converters, and overhead catenary system. Upon determining the oldest or least reliable location, the systems that are impacting performance are assessed next. The aerial assessment data is also being used for catenary structures to not only improve the condition assessment data beyond the use of age, but to also assist in identifying future projects. This will help establish a state of good repair standard for each catenary structure. These systems include, but are not limited to, circuit breakers, transformers, switches, catenary structures, and catenary wires.

Factors such as age, obsolescence, new technology, and design standardization are considered when evaluating repair versus replacement options. Depending on the failing components, ET may determine a component be replaced in-kind and result in an extension of the life of the location and improved SOGR score. If enough systems and/or components are aging, obsolete, or unreliable, a project for a full renewal will be initiated.

As we move to a steady state replacement cycle, the early iterations need to be *staged* (prioritized) such that the ongoing work program is manageable year over year. Table 31 summarizes the primary lifecycle strategy and the current implementation status by asset. As highlighted in the main body of this document the transition strategy also needs to consider:

- Track access – current outage availability restricts efficient project delivery. This will need to be reviewed to economically address the backlog. One piece of the strategy includes scheduling more work simultaneously during planned outages, and in particular ET is working to get dedicated outages (i.e., to address its own backlog vs. outages where they have to provide support for other disciplines).
- Labor resources – current manpower constraints continue to impact productivity. Recent hiring and training efforts have increased dramatically and should eventually reduce productivity impacts; however, training takes considerable time so the relief will not be experienced in the short-term.
- Equipment – current equipment capacity is insufficient. New catenary cars have been delivered, and more are on order to help alleviate equipment shortages. This is addressed in Appendix F.
- Funding – the backlog identified is significant. Design efforts have increased significantly in anticipation of receiving the Infrastructure Investment and Jobs Act (IIJA) funding.

Table 31: IALP2024 ET Lifecycle Management Strategy

Activity	Lifecycle Strategy / Benefit	Implementation Strategy
Inspection/ Monitoring		
General	→ To ensure safe ET operations and prevent insidious decline, introduction of a general condition assessment of all ET infrastructure assets to support predictive analysis and investment planning/ prioritization.	→ Condition assessment framework rolled-out through plan period. → Aerial assessment of catenary structures (the first generation of condition ratings for nearly 90 of structures will be available by the end of 2023).
Preventive Maintenance		
	→ N/A	→ An initiative to derive SOGR scores from condition data and other attributes instead of only age.
Corrective Maintenance		
General	→ To ensure safe ET operations and prevent insidious decline, continue to perform corrective maintenance activities on ET assets as required.	→ No significant change to current practice.
Capital Replacement – Distribution		
Catenary Structure	→ To maintain reliability and prevent insidious decline, perform a mid-life rehabilitation of the catenary structure every 38 years (estimated to cost 20% of capital replacement cost). → To achieve SOGR, replace catenary structure every 75 years.	→ A program of catenary structure rehabilitation will be developed and introduced through this planning period on a whole life cost justification basis. The program will be informed by the condition assessment being rolled-out through the planning period. → A program of catenary structure replacement is being introduced through this planning period. To manage the backlog of renewals, and provide a levelled work program, delivery of the work bank is spread over a 15-year period. This is to allow a production workforce to be established and continually utilized.
Catenary Hardware	→ To achieve SOGR, replace catenary hardware every 30 years.	→ A program of catenary hardware replacement is being introduced through this planning period. The program will be scheduled to align with the mid-life rehabilitation of the structure.
Catenary Wire	→ To achieve SOGR and maintain reliability, replace the catenary wire when the wire reaches 25% of the installed cross section (estimated to cost 30% of initial capital cost). For planning, wire is estimated to last 50 years.	→ A program of catenary wire replacement is being introduced through this planning period. The program will be scheduled to align with the catenary structure/ hardware replacement.

Third Rail	→ To achieve SOGR and maintain reliability, replace third rail every 40 years.	→ A program of third rail replacement is being introduced through this planning period. To manage the backlog of renewals, and provide a levelled work program, delivery of the work bank is spread over a 5-year period. This is to allow a production workforce to be established and continually utilized. The replacement of third rail will coincide with the replacement of running rail or ties if either of these expire within six years of the third rail.
Capital Replacement – Transmission		
Transmission Lines	→ To achieve SOGR and maintain reliability, replace transmission lines every 50 years.	→ The program focuses on off-corridor transmission lines which present a high risk. → Replacement of on-corridor lines will coincide with catenary structure replacement.
Underground Cable	→ To achieve SOGR and maintain reliability, replace underground cable every 60 years based on insulation.	→ Replacement of underground cables will be undertaken during this plan period.
Transformers / Insulators	→ To achieve SOGR and maintain reliability, replace transformers/insulators every 40 years.	→ A program of transformer/insulator replacement will be developed and introduced through this planning period.
Substations	→ To maintain reliability and prevent insidious decline, perform a mid-life rehabilitation of substations every 20 years (estimated to cost 25% of capital replacement cost). → To achieve SOGR, replace individual components of substations every 30 years.	→ Rehabilitation of substations and replacement of control houses will be introduced during this plan period. → A program of substations rehabilitation and replacement will be developed and introduced through this planning period.
Capital Improvement		
Off-Corridor Transmission Line Replacement	→ To maintain reliability and support network capability improvement, replace the off-property transmission lines.	→ Program developed during the planning period.
New Jersey High Speed Program	→ To maintain reliability and support network capability improvement, upgrade the catenary and power systems on the NEC.	→ Program underway and continuing during the planning period.
Zoo to Paoli Catenary Replacement	→ To maintain reliability and support network capability improvement, replace the overhead catenary system and the off-property transmission lines.	→ Program developed during the planning period.

River Towers	→ Replacement of transmission poles to support transmission infrastructure crossing the Passaic River, improving the safety and reliability of the NEC.	→ Program underway and continuing during the planning period.
Bridge to Hanson	→ SAP assembly replacement.	→ Program underway and continuing during the planning period.
County to Newark, Bridge to Landover, and Brill to Landlith Catenary Replacements	→ To maintain reliability and support network capability improvement, replace the overhead catenary system, and improve ability to support higher operating speeds.	→ Program developed during the planning period.
New Static Frequency Converters to Replace Motor Generators	→ Improve stability of signal power.	→ Program developed during the planning period.
Substation Rehab and Control House Replacement Program	→ Address critical SOGR backlog.	→ Program developed during the planning period (~one per division per year).

AMTRAK

Appendix E: Communications and Signals Asset Strategy

Appendix E: Communications and Signals Asset Strategy

Appendix E provides additional information on Amtrak's communications and signals (C&S) assets and establishes the lifecycle management strategy to achieve a state of good repair (SOGR).

Overview

Pursuant to 49 U.S.C § 24320(a)(2), this appendix captures the *unconstrained funding* needs to adopt a normalized or steady state management strategy necessary to achieve a SOGR. It represents our latest thinking at the time of publication of what work needs to be accomplished based on the proposed use of the asset and its current condition.

The appendix is structured to be consistent with the main body of the IALP2024 with the following sections:

- → Asset Inventory – provides further details on the C&S infrastructure assets across all parts of the passenger rail network.
- → Asset Condition – presents our current understanding of C&S asset condition and our plans for improving our knowledge of the state of the asset.
- → Asset Strategy – presents the lifecycle strategies for the management of C&S infrastructure and our strategy for moving towards achieving a steady state replacement of such.
- → Additional Funding Needs – provides an assessment of the unconstrained steady state program and the forecasted SOGR work bank necessary to bring the C&S infrastructure assets into SOGR.

Responsible Official

Pursuant to 49 U.S.C. § 24320(c)(3)(c), the following individual is responsible for Communications and Signals infrastructure owned or managed by Amtrak:

- → ***Nicholas Croce, Deputy Chief Engineer Communications and Signals***

C&S Asset Inventory

Amtrak manages C&S assets valued at $8.7 billion – including signaling equipment that controls train movements through 296 interlockings and 11,432 track circuits nationwide.

Overview

As with other modern rail networks, Amtrak operates a tiered system to enable safe and efficient train movements, making full use of the available track paths, consists of the assets as follows:

- The first tier is centralized traffic control (CETC) through which train dispatchers control train movements. Movement is controlled through (1) trackside signals of Automatic Block Signaling (ABS), which signal the engineer to take needed actions but do not override him or her if no action is taken; and (2) interlockings which consist of signals and appliances that enable safe train movement across tracks.
- The second tier is Cab Signals, which duplicate the indications of the trackside signals.
- The third tier is Automatic Train Control (ATC), which automatically slows or stops a train if the engineer fails to comply with speed reductions required by the cab signal. Amtrak has used ATC since it took over operations in 1976.
- The fourth tier is Positive Train Control (PTC). On the NEC, Amtrak's PTC system is known as the Advanced Civil Speed Enforcement System (ACSES). ACSES builds on the protection provided by ATC and can automatically bring a train to a stop at a red signal or slow it on a sharp curve. Amtrak also operates PTC, known as the Incremental Train Control System (ITCS), on the Michigan line and the Interoperable Electronic Train Management System (I-ETMS) on the NEC main line for hosted rail users – primarily Norfolk Southern.
- Radios – including both locomotive and portable units (limited data available).
- Network – fiber loop converters, High-bit-rate Digital Subscriber Line (HDSL) equipment units, and other network equipment (limited data available).
- Telecommunications – Telephone switching equipment, voicemail systems, equipment houses, and cables (limited data available).

Inventory Development

Amtrak Infrastructure Maintenance and Construction Services (IMCS) acknowledges that the current asset registry for C&S assets lacks some data attributes. The focus to date has been to ensure that safety critical assets are included. As part of an ongoing program of improvement, the following issues will be addressed:

- Data Gaps – several gaps exist in the C&S data sets – particularly off-corridor. These will be addressed during the plan period.
- Communications Data – there is limited communication asset data available. This will be improved through the plan period.
- Centralized Traffic Control (CETC) – asset data is currently lacking. This will be added through the plan period.
- Age Records – were initially compiled and validated as part of I-AMP2017 (NEC and NEC Branch Lines) and IALP2019 (National Network). Updates to asset ages (i.e., through renewals) have been captured in subsequent IALP updates, and otherwise. Remaining gaps will be resolved during further inventory updates in this plan period.

A summary of key Signals infrastructure features is shown in Table 35 below.

Table 35: Signals Assets

Asset Component	Count	Units	Av Install Date
Remote Switch Operation			
Switch Machines	**3,755**	**Each**	**1992**
NEC Main Line	2,687	Each	1991
NEC Branch Line, Owned by Amtrak	483	Each	1990
NEC Branch Line, Owned by CSX	92	Each	1991
National Network, Owned by Amtrak	33	Each	1997
National Network, Owned by Michigan	460	Each	2002
Switch Heater Cabinets	**492**	**Each**	**1988**
NEC Main Line	272	Each	1987
NEC Branch Line, Owned by Amtrak	88	Each	1982
NEC Branch Line, Owned by CSX	36	Each	1994
National Network, Owned by Amtrak	36	Each	1976
National Network, Owned by Michigan	60	Each	2006
Logic System			
Signals - INT	**2,102**	**Each**	**1993**
NEC Main Line	1,569	Each	1994
NEC Branch Line, Owned by Amtrak	306	Each	1985
NEC Branch Line, Owned by CSX	87	Each	1982
National Network, Owned by Amtrak	9	Each	2013
National Network, Owned by Michigan	131	Each	2014
Signals - ABS	**1,153**	**Each**	**1995**
NEC Main Line	640	Each	1991
NEC Branch Line, Owned by Amtrak	148	Each	1985
NEC Branch Line, Owned by CSX	102	Each	1991
National Network, Owned by Amtrak	87	Each	2013
National Network, Owned by Michigan	176	Each	2014
Houses			
Central Instrument House (CIH)	**292**	**Each**	**1993**
NEC Main Line	173	Each	1991
NEC Branch Line, Owned by Amtrak	59	Each	1992
NEC Branch Line, Owned by CSX	22	Each	2000
National Network, Owned by Amtrak	17	Each	1976
National Network, Owned by Michigan	21	Each	2014
Instrument Building Houses	**2,800**	**Each**	**1988**
NEC Main Line	1,615	Each	1987
NEC Branch Line, Owned by Amtrak	556	Each	1982
NEC Branch Line, Owned by CSX	195	Each	1994
National Network, Owned by Amtrak	159	Each	1976
National Network, Owned by Michigan	275	Each	2006
Train Detection			
Track Circuits - INT	**3,363**	**Each**	**1992**
NEC Main Line	2,808	Each	1991
NEC Branch Line, Owned by Amtrak	550	Each	1992

Asset Component	Count	Units	Av Install Date
NEC Branch Line, Owned by CSX	-	-	-
National Network, Owned by Amtrak	1	Each	1976
National Network, Owned by Michigan	4	Each	2014
Track Circuits - ABS	**8,069**	**Each**	**1993**
NEC Main Line	2,110	Each	1991
NEC Branch Line, Owned by Amtrak	1,220	Each	1992
NEC Branch Line, Owned by CSX	879	Each	2000
National Network, Owned by Amtrak	920	Each	1976
National Network, Owned by Michigan	2,940	Each	2014
Positive Train Control (PTC)	**5,798**	**Miles**	**2013**
NEC Main Line	3,902	Miles	2011
NEC Branch Line, Owned by Amtrak	1,896	Miles	2016
Grade Crossing	**316**	**Each**	**2010**
NEC Main Line	11	Each	1995
NEC Branch Line, Owned by Amtrak	39	Each	1995
NEC Branch Line, Owned by CSX	17	Each	1995
National Network, Owned by Amtrak	83	Each	2013
National Network, Owned by Michigan	166	Each	2014
Defect Detection	**318**	**Each**	**2008**
NEC Main Line	229	Each	2010
NEC Branch Line, Owned by Amtrak	57	Each	2005
NEC Branch Line, Owned by CSX	8	Each	2005
National Network, Owned by Amtrak	4	Each	2000
National Network, Owned by Michigan	20	Each	2000
Movable Bridge Detection	**14**	**Each**	**1928**
NEC Main Line	10	Each	1937
NEC Branch Line, Owned by Amtrak	1	Each	1909
NEC Branch Line, Owned by CSX	1	Each	1901
National Network, Owned by Amtrak	1	Each	1901
National Network, Owned by Michigan	1	Each	1909

Amtrak Owned – Communications Assets

Table 36: Summary of Communications Assets for NEC and Branch Lines

Asset Component	Count	Unit	Av Install Date
Radio			
Base Control Radio Module	121	Units	-
Network			
DSL Modem	8	Units	-
IP Gateway	14	Units	-
Miscellaneous Network Drive	107	Units	-
Network Switch	1,965	Units	-
Telecommunications			
Protocol Converter	26	Units	-
Remote Terminal Unit (RTU)	457	Units	-
Server	205	Units	-
Site Monitor	120	Units	-
Transponder	121	Units	-
Voice Over IP (VoIP) Radio	51	Units	-
Wayside Interference Unit (WIU)	253	Units	-

C&S Asset Condition

Amtrak's C&S Department conducts a program of condition monitoring activities to identify faults, prioritize intervention and ensure safe operation of the railroad. However, it has recognized a need to improve its condition assessment capability to predict the optimal point of replacement.

Overview

Amtrak IMCS currently conducts an extensive condition monitoring (inspection) program of its C&S infrastructure. The monitoring activities described below ensure safe operation of the railroad. They are used to identify faults and potential faults which result in prioritized and scheduled maintenance. There is, however, little predictive analysis conducted to determine asset-deterioration rates and predict future C&S conditions.

For Signals, asset inspections are conducted at intervals in line with the Amtrak AMT-27 standard[6]. AMT-27 is fully compliant with all federally mandated tests and inspections applicable to Amtrak, in accordance with 49 CFR § 236 and 49 CFR § 234. It is noted that while inspections ensure safe operation of the railroad, they are not an assessment of conditions for predictive analysis purposes.

For communications, there is limited assessment of the state of the assets.

[6] AMTRAK AMT-27, "*Instructions for Testing Signal Apparatus and Signal Systems.*"- Rev May 8, 2023.

Asset Condition Assessment Methodology

Pursuant to 49 U.S.C § 24904(c), Amtrak is required to undertake a "*condition assessment of those inventoried assets for which a provider has direct responsibility and to level of detail to monitor and predict performance of assets and inform investment prioritization" (U.S. 49 CFR § 625.25(b)(2)).*

In meeting this obligation, Amtrak IMCS has developed a C&S asset condition assessment guide[7] and plans for its implementation are progressing. The guide assesses a series of condition factors, each graded on a scale of zero (asset is non-operable) through five (asset is new or nearly new). The approach will result in a condition index for each asset and will enable assessment of SOGR. For Signals assets, Amtrak IMCS considers an asset to be in a SOGR when it meets maintenance limits described in AMT-27, when it is in a condition where it can continue to meet and perform the functional requirements for which it was designed, and when the lifecycle investment needs of the asset have been met, including all scheduled maintenance. This is consistent with the definition laid out in *U.S. 49 CFR § 625.* Amtrak IMCS grades an asset in a SOGR if it scores greater than or equal to 2.5 on the condition assessment framework, described above.

For IALP2024, the age of the asset is being used to estimate the asset's SOGR based on the remaining useful life of the asset. This will be updated through this plan period with visual and measured assessments.

IALP 2024 – Assessed C&S Asset Condition

For IALP2024, the assessed asset condition of C&S, based on useful life of the asset, is presented in Table 37.

Table 37: 2024 Assessed Condition of Signals assets – Amtrak Owned

Asset Component	Av SOGR	% of Total NOT in SOGR
Remote Switch Operation		
Switch Machines	**2.31**	**61%**
NEC Main Line	2.22	67%
NEC Branch Line, Owned by Amtrak	2.35	55%
NEC Branch Line, Owned by CSX	2.14	61%
National Network, Owned by Amtrak	2.48	52%
National Network, Owned by Michigan	2.83	34%
Switch Heater Cabinets	**2.43**	**64%**
NEC Main Line	2.28	67%
NEC Branch Line, Owned by Amtrak	2.46	66%
NEC Branch Line, Owned by CSX	2.49	75%
National Network, Owned by Amtrak	1.00	100%
National Network, Owned by Michigan	4.05	23%
Logic System		
Signals - INT	**2.52**	**60%**
NEC Main Line	2.53	59%
NEC Branch Line, Owned by Amtrak	1.72	77%
NEC Branch Line, Owned by CSX	1.60	100%
National Network, Owned by Amtrak	4.00	0%
National Network, Owned by Michigan	4.51	0%
Signals - ABS	**2.58**	**70%**

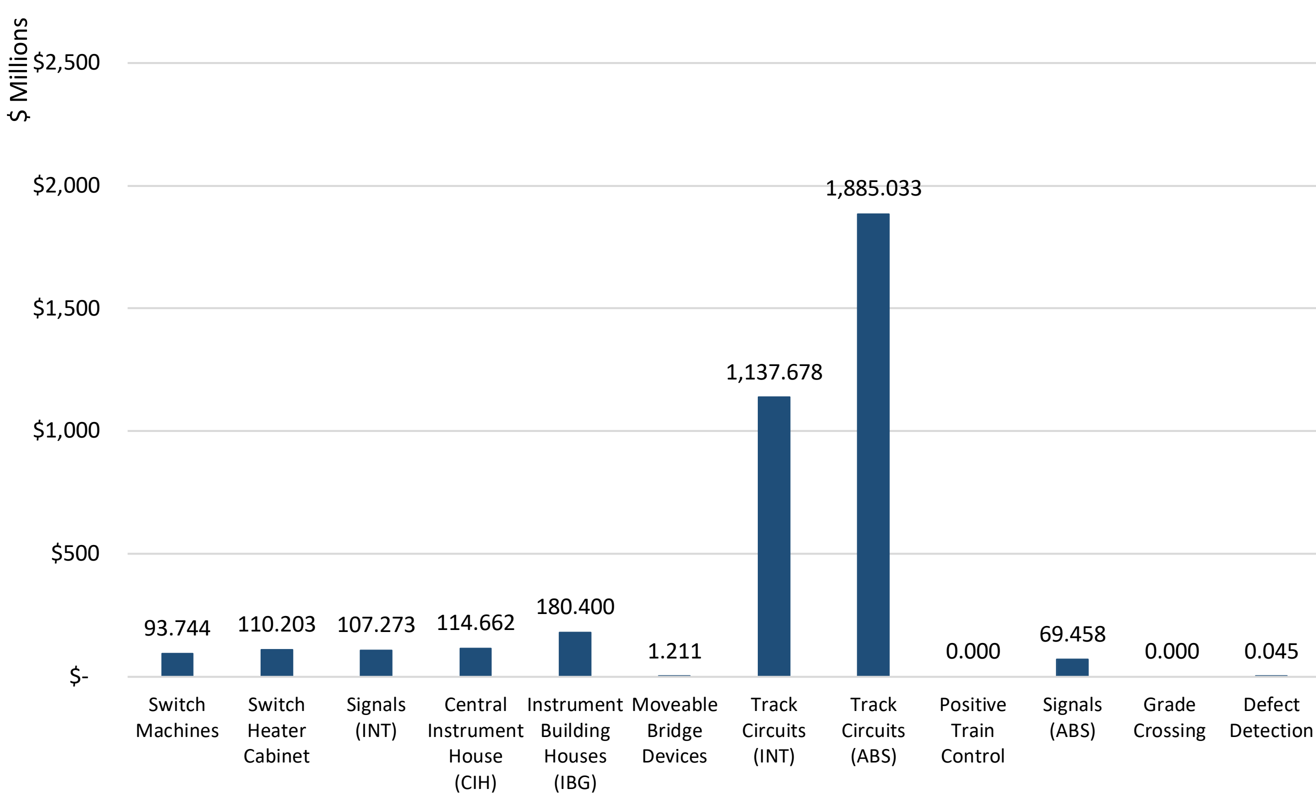
[7] *Infrastructure Asset Condition Guidelines – C&S. Version 6, Issued April 2, 2019.*

Asset Component	Av SOGR	% of Total NOT in SOGR
NEC Main Line	2.18	90%
NEC Branch Line, Owned by Amtrak	1.66	89%
NEC Branch Line, Owned by CSX	2.00	100%
National Network, Owned by Amtrak	4.00	0%
National Network, Owned by Michigan	4.46	0%
Houses		
Central Instrument House (CIH)	**2.72**	**54%**
NEC Main Line	2.46	59%
NEC Branch Line, Owned by Amtrak	3.02	46%
NEC Branch Line, Owned by CSX	3.27	50%
National Network, Owned by Amtrak	1.00	100%
National Network, Owned by Michigan	4.90	0%
Instrument Building Houses	**2.43**	**64%**
NEC Main Line	2.28	66%
NEC Branch Line, Owned by Amtrak	2.46	66%
NEC Branch Line, Owned by CSX	2.49	74%
National Network, Owned by Amtrak	1.00	100%
National Network, Owned by Michigan	4.05	23%
Train Detection		
Track Circuits - INT	**2.68**	**54%**
NEC Main Line	2.46	59%
NEC Branch Line, Owned by Amtrak	3.02	46%
NEC Branch Line, Owned by CSX	-	-
National Network, Owned by Amtrak	1.00	100%
National Network, Owned by Michigan	4.90	0%
Track Circuits - ABS	**2.72**	**54%**
NEC Main Line	2.46	59%
NEC Branch Line, Owned by Amtrak	3.02	46%
NEC Branch Line, Owned by CSX	3.27	50%
National Network, Owned by Amtrak	1.00	100%
National Network, Owned by Michigan	4.90	0%
Positive Train Control (PTC)	**4.29**	**0%**
NEC Main Line	4.00	0%
NEC Branch Line, Owned by Amtrak	5.00	0%
Grade Crossing	**4.17**	**0%**
NEC Main Line	3.00	0%
NEC Branch Line, Owned by Amtrak	3.00	0%
NEC Branch Line, Owned by CSX	3.00	0%
National Network, Owned by Amtrak	4.00	0%
National Network, Owned by Michigan	4.73	0%
Defect Detection	**3.90**	**<1%**
NEC Main Line	3.97	1%
NEC Branch Line, Owned by Amtrak	4.00	0%
NEC Branch Line, Owned by CSX	4.00	0%
National Network, Owned by Amtrak	3.00	0%
National Network, Owned by Michigan	3.00	0%
Movable Bridge Devices	**1.36**	**93%**

Asset Component	Av SOGR	% of Total NOT in SOGR
NEC Main Line	1.50	90%
NEC Branch Line, Owned by Amtrak	1.00	100%
NEC Branch Line, Owned by CSX	1.00	100%
National Network, Owned by Amtrak	1.00	100%
National Network, Owned by Michigan	1.00	100%

The replacement value of C&S assets with a condition rating below 2.5, which are considered to be nearing the end of their useful life, is estimated to be **$3.7 billion** in 2023 dollars. This is Amtrak's SOGR backlog for C&S assets. The largest portion of this is the NEC main- and branch-line assets owned by Amtrak, which is estimated to be nearly $3.4 billion in 2023 dollars. An additional $312.5 million backlog is present on the CSX-leased lines, which are capital funded by the State of New York. The national network accounts for $609 million total in backlog, with $18.1 million backlog on the Michigan owned infrastructure. Figure 19 presents the backlog by C&S asset type.

Figure19: C&S Estimated SOGR Backlog by Asset Type ($m 2023)



C&S Asset Strategy

Lifecycle management strategies updated as part of IALP2024 capture the normalized or steady state activities necessary to maintain a steady state of good repair and ensure C&S assets are functional and able to continue to support a safe, efficient, and sustainable national rail network.

Overview

The current C&S lifecycle management approach is reactive, determined by IMCS judgment (including assessment of risk through inspections) and focused on maintaining safe rail operations. The overall program is largely driven by the opportunity to access the asset and, as such, the signals program is often closely aligned to the Track program. As part of its strategy, Amtrak aims to improve coordination with the Track division inspections to avoid multiple track occupancies. Coordination between these two disciplines can help increase awareness of closely related track and C&S issues and failures. Current resourcing levels are also a key consideration with improvement projects utilizing the majority of signal resources.

Amtrak continues to hire personnel to staff its field crews and to train as qualified maintainers. The training programs are continually being evaluated and updated so that sufficient field experience can be provided as part of training. Also, Amtrak has increased class size capacity with the addition of a new Groton facility and invested in improving its Lancaster facility. The Lancaster School is currently offering classes during multiple shifts to improve the number of qualified Maintainers. Additionally, the school is exploring the option of reducing required in-class training time during Module 1 to allow for more time for on-the-job training. Amtrak continues to evaluate additional educational partnerships to improve the quality of its training program and the size of its training cohorts.

Currently, there is no established approach for predicting and prioritizing future investment needs. A capital replacement strategy or plan is not in place. The limited information to support long-term decisions and the number of issues with available resources results in a program that is focused on replacing high-risk assets only. The program is also focused on capitalizing on opportunities for replacements through other efforts, such as switch replacement during turnout renewals.

In I-AMP2017, Amtrak IMCS commenced a review of the lifecycle strategies for all infrastructure assets. Its purpose was to develop the long-term normalized or steady state infrastructure maintenance and improvement program. Amtrak IMCS recognized that to achieve this requires addressing a sizeable backlog in infrastructure investment before a program of steady state or normalized maintenance can be adopted.

The recent passage of the Infrastructure Investment and Jobs Act (IIJA), now signed into law as the Bipartisan Infrastructure Law (BIL) provides $66 billion for intercity passenger and freight rail. This funding provides an outstanding opportunity for Amtrak to reinvest in its infrastructure to continue progress toward addressing its backlog and achieving its SOGR objectives. Projects and initiatives that may potentially benefit from this funding will be discussed in this appendix; however, this additional funding is not expected to enable Amtrak to achieve the overall goal of steady state asset replacement.

C&S assets benefit from generally not requiring extended outages during which to perform much of their asset maintenance, rehabilitation, and replacement work. Additionally, there are currently a few challenges associated with furnishing the specialized equipment needed for these activities. However, C&S assets face material constraints that may stem from supply chain issues or fabrication issues (i.e., requires substantial lead-time). Additionally, C&S department crews often are needed to support the activities of other department asset activities, which can take time away from their own priorities. Similarly, often the material and signal configuration specifications developed as part of third-party design efforts are not provided to the C&S department with sufficient enough lead time, requiring them to shuffle their internal project priorities, as well as fabrication plans.

The lifecycle management strategies for C&S infrastructure laid out in the following sections define the approach adopted for the 2024 program, and the revised approach for the years following to address backlog and approach steady state for state of good repair and maintenance spend.

Current Asset Strategies

The current lifecycle management strategies employed by Amtrak to achieve its C&S asset objectives are described in Table 38. Few assets have lifecycle strategies developed, and the run-to-fail approach is generally used. IMCS engineering judgment has been used to determine the work bank.

The aim of the C&S Department is to maintain and improve the condition of the C&S infrastructure to minimize safety risks and train service impacts. Work is categorized into the following:

- → *Inspection/Monitoring* activities to confirm the asset can function in its required state and provide a safe operational environment.
- → *Preventive Maintenance* activities to help an asset achieve a required level of performance and maintain a safe operational environment.
- → *Corrective Maintenance* activities to return the asset to its required function and restore a safe operational environment.
- → *Capital Maintenance* to restore the asset to a specified design standard and maintain performance.
- → *Capital Replacement* to renew the asset and maintain performance.
- → *Capital Improvement* to replace the asset and improve performance or network capability.

Table 38: Current Lifecycle Management Strategies

Category	Description
Inspection/ Monitoring	→ Signals – federally mandated inspections as detailed in AMT-27 are always completed. → Communications – Amtrak-specified regular inspection program.
Preventive Maintenance	→ Preventive maintenance is limited due to available resources. AMT-23[8] establishes standards for asset general maintenance.
Corrective Maintenance	→ Focus is on corrective maintenance to ensure safe operations – correcting faults and issues identified in the AMT-27 standard.
Capital Maintenance	→ Capital maintenance (rehabilitation) includes spot replacement of instrument house components (e.g., microprocessors, battery track circuits, etc.).
Capital Replacement	→ Replacement of right-of-way infrastructure, which is more often driven by the Track capital program. → Targeted replacement to remove air switch machines and replace with electric switches, again driven by the Track capital program (opportunity).

[8] AMTRAK AMT-23, "*Special Instructions Governing Construction and Maintenance of Signals and Interlockings.*"- Revised Date October 1, 2022.

	→ Targeted renewal of one (1) ABS location and one (1) Interlocking per division per year.
Capital Improvement	→ Major system upgrades to improve capacity and introduce more modern technology includes: o Complete interlocking replacements of instrument house. o ABS upgrades driven by enhancement (i.e., New Jersey high speed).

Moving Towards Normalized or Steady State Maintenance

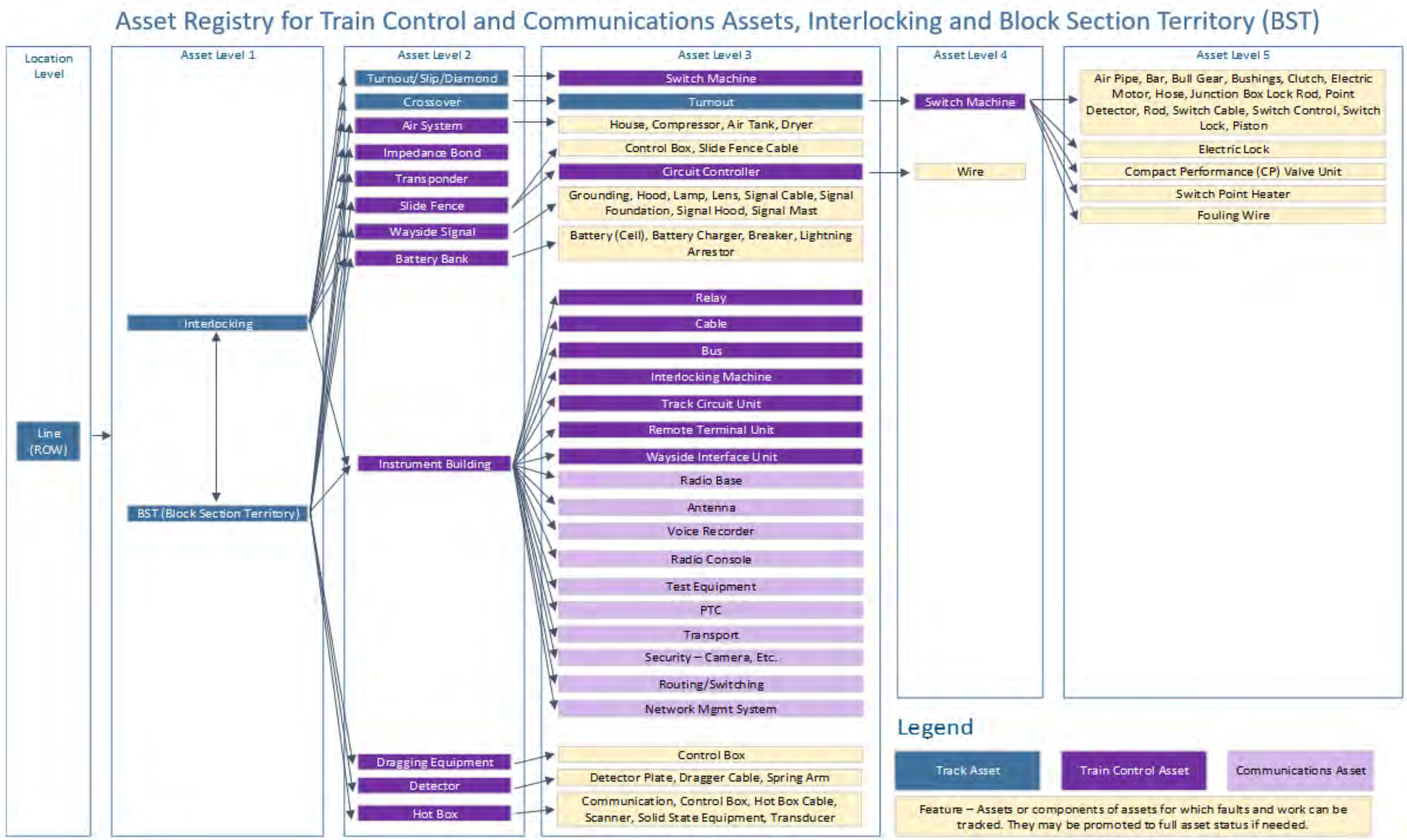
As reported in IALP2022, there are four key elements to the C&S lifecycle management strategy, namely:

Achieve SOGR	Bring C&S assets to a SOGR and maintain them in a steady state, to ensure sufficient capability to meet operational needs.
Prevent Insidious Decline	While progressing towards steady state SOGR, the inspection and monitoring regime documented in AMT-27 standard will guard against the insidious decline in the condition of any individual C&S assets and ensure that the asset remains in a safe operational state.
Maintain Performance	Develop a program of work (i.e., work bank) that is prioritized to ensure the ability of C&S infrastructure can function in its required state, thus minimizing performance loss due to asset faults and failures, temporary speed restrictions or extended outages.
Support Network Capability Improvement	Enhance the program of work to ensure that C&S assets contribute to capability targets established through the Amtrak Five-Year Service Line Plans and exploit opportunities to enable higher speeds and improved network capacity.

Transition Strategy

Amtrak's C&S Department utilizes a top-down approach to establish its normalized or steady state program. Assets are initially assessed at the highest level – interlocking, ABS section, grade crossing, and defect detection. Upon determining the oldest or least reliable location, the systems which are impacting performance are next assessed. These systems include, but are not limited to, train detection, remote switch operation, logic system (signal), power, and positive train control. Figure 20 is a sample registry, showing asset hierarchies and relationships, to demonstrate the top-down decision model. Factors such as age, obsolescence, new technology, and design standardization are considered when evaluating repair versus replace options. Depending on the failing components, C&S may determine the component may be replaced in kind and result in an extension of the life of the location and improved SOGR score. If enough systems and/or components are aging, obsolete, or unreliable a project for wholesale renewal will be initiated. Currently, C&S is targeting one interlocking and one ABS section per division per year for renewal to close the gap to SOGR.

Figure 20: Interlocking Registry



As we move to a steady state replacement cycle, the first iteration needs to be *staged* (prioritized) such that the ongoing work program is manageable year-over-year. Table 39 and Table 40 summarize the proposed replacement cycles and implementation strategies for signals and communications assets, respectively.

Table 39: IALP2024 Signals Lifecycle Management Strategy

Activity	Lifecycle Strategy / Benefit	Implementation Strategy
Inspection/ Monitoring		
General	→ To ensure safe Signals operations and prevent insidious decline, continue to perform inspection and monitoring activities on signals assets based on AMT-27 standard.	→ No significant change to current practice. However, greater coordination effort will be made with Track department, particularly during interlocking inspections (they are already coordinating well for switches).
Preventive Maintenance		
General	→ To ensure safe Signals operation and prevent insidious decline, continue to perform preventive maintenance activities on signals assets based on AMT-27 standard. → To provide a more reliable Signals asset, introduce additional preventive maintenance to ensure signals assets remain in the required standard established in AMT-23.	→ No significant change to current practice. → Further preventive maintenance activities to be introduced to remove common causes of asset failures. Analysis of failures to be conducted in 2023/24, followed by implementation plan development in this plan period.
Corrective Maintenance		
General	→ To ensure safe Signals operation and prevent insidious decline, continue to perform corrective- maintenance activities on signals assets based on AMT-27 and AMT-23 standards.	→ No significant change to current practice.
Capital Maintenance		
Switch Heaters	→ To maintain reliability and prevent insidious decline, refurbish switch machines by replacing heating element and other components every 10 years.	→ Consistent with current practices. A program of switch heater replacement will reduce whole-life costs.
ABS	→ To maintain reliability and prevent insidious decline, selectively refurbish ABS components every 20 years – including replacing microprocessors and batteries.	→ A program of ABS-section rehabilitation is introduced through this plan period based on whole-life-cost justification.
ACSES (i.e., PTC)	→ To maintain reliability and prevent insidious decline, refurbish PTC system, including replacing in-ground components every 10 years and back-office servers every 7 years.	→ A program of PTC-system rehabilitation is introduced through this plan period based on whole-life-cost justification. → An onboard software release was recently rolled out to meet FRA requirements.

Central Instrument House	→ To maintain reliability and prevent insidious decline, selectively refurbish instrument housing components every 20 years – including micro-processors and equipment with reduced reliability or obsolescence issues.	→ A program of central-instrument-house rehabilitation is introduced through this plan period based on whole-life-cost justification.
Capital Replacement		
Switch Machines	**Track Class 1-4:** → To achieve SOGR, replace switch machines operating on class 1-4 tracks every 35 years. **Track Class 5-8:** → To achieve SOGR, replace switch machines operating on class 5-8 tracks every 35 years.	→ A program of switch-machine replacement is introduced through this plan period. To manage the backlog of renewals and provide a levelled work program, delivery of the work bank is spread over a 10-year period. This allows establishment and continual use of a production workforce. → A program of switch-machine replacement is introduced through this plan period. To manage the backlog of renewals and provide a levelled work program, delivery of the work bank is spread over a 5-year period. For efficient use of track access, replacement of the switch machine will coincide with other interlocking hardware.
Switch Heaters	→ To achieve SOGR, replace the full switch heater cabinet and other components every 40 years.	→ Replacement will be conducted based on whole-life-cost justification and will coincide with Interlocking maintenance/replacement.
ABS	**Track Class 1-4:** → To achieve SOGR, replace trackside equipment, such as impedance bonds, on class 1-4 tracks every 50 years. This is typically consistent with the track renewal program. → To maintain performance, replace signals cable as required. **Track Class 5-8:** → To achieve SOGR, replace trackside equipment, such as impedance bonds, on class 5-8 tracks every 40 years. This is typically consistent with the track renewal program.	→ A program of ABS replacement is introduced through this plan period. To manage the backlog of renewals and provide a levelled work program, delivery of the work bank is spread over a 10- year period. This is to allow a *production workforce* to be established and continually utilized. → Signals cable will be replaced—as required—based on whole-life-cost justification. → A program of ABS replacement is introduced through this plan period. To manage the backlog of renewals and provide a levelled work program, delivery of the work-bank is spread over a 5-year period. For efficient use of track access, replacement will include all cables and other 'system hardware'.
ACSES (Positive Train Control)	→ To maintain SOGR or support network capability improvement, replace system-wide PTC assets every 25 years or based on whole-life-cost justification of new technology.	→ For budget purposes, we are assuming whole system replacement every 25 years. However, system replacement will be based on whole-life-cost justification of replacement or introduction of new technology to support network capability improvements.

Central Instrument House	→ To achieve SOGR, replace central instrument housing assets every 40 years.	→ A program of central-instrument-house replacement is introduced through this plan period.
Grade Crossing	→ To achieve SOGR, wayside assets including gate mechanisms, flashes and instrument houses should be replaced every 40 years. Micro-processor-based components should be replaced every 20 years. Other components as required.	→ A program of grade crossing replacement is introduced through this plan period.
Movable Bridge	→ To achieve SOGR, replace movable bridge detection systems every 40 years.	→ Detection system replacement will coincide with other movable components.
Capital Improvement		
General	→ To improve network performance, establish a program to replace one interlocking and one ABS section per Division per year. The introduction of new technologies will be considered based on whole-life-cost justification.	→ A program of complete signal system upgrades is introduced through this plan period. This includes Fitter Interlocking, Veltri Interlocking, Garden & Grey, BWI Station Signals Improvement, and 562 Territory on the Harrisburg Line.
PTC	→ To improve network performance, maintain wayside PTC equipment on Empire and Springfield lines (NEC Branch Lines).	→ Equipment introduced in FY2018 and onwards capital programs, and recently completed in FY2023 – now the focus is on maintaining.
Wayside Signals Modernization	→ To improve network performance, program replacement of the wayside signals between interlockings with modern cab-based systems.	→ A program of wayside signals replacement is to be designed. This is to address reliability issues and remove old, obsolete technology. Examples include the 562 Program from Baltimore to Washington.
Air Switch Machines Modernization	→ To improve network performance, establish a program to replace older air switch machines with more modern electric switch machines (with the exception of Penn Station due to operational reasons).	→ An established program of air-switch-machine replacement, with the majority of air switches replaced over the next 5-year period. For efficient use of track access. Replacement will coincide with the track renewal program.
Interlocking Renewal Work	→ To improve network performance and reliability, maintain the program of interlocking renewals, as informed by regular inspection and coordination with Track.	→ Burgos Interlocking 9/15/2023

Table 40: IALP2024 Communications Lifecycle Management Strategy

Activity	Lifecycle Strategy/Benefit	Implementation Strategy
Inspection/Monitoring		
General	→ To ensure safe Communications operations and prevent insidious decline, continue to perform inspection activities on communications assets based on Amtrak standard.	→ No significant change to current practice.
Preventive Maintenance		
	→ N/A	
Corrective Maintenance		
General	→ To ensure safe Communications operations and prevent insidious decline, continue to perform corrective maintenance activities on communications assets based on Amtrak standard.	→ No significant change to current practice.
Capital Maintenance		
Shelters, Cabinets, Towers, Duct banks, etc.	→ To maintain reliability and prevent insidious decline, rehabilitate all communication facilities—shelters, cabinets, towers and ducts—every 15 years.	
Radio Systems	→ To maintain reliability and prevent insidious decline, rehabilitate the radio systems every 7 years (batteries etc.).	→ Delivery of radio system rehabilitation is spread over a 2-year period to level the work bank.
Capital Replacement[9]		
Shelters, Cabinets, Towers, Duct Banks, etc.	→ To achieve SOGR, replace all communication structures—shelters, cabinets, towers and ducts— every 30 years.	
Radio Systems	→ To achieve SOGR, replace complete radio system every 15 years.	→ Delivery of radio systems replacement is spread over a 5-year period to level the work bank.
WAN / Other Network Devices	→ To maintain SOGR, replace WAN and other network devices every 10 years.	→ Network devices are estimated to be over 20 years old. There is an urgent need to address the backlog over the next 10 years and replace all wayside equipment with fiber.

[9] Some assets that were previously listed as the responsibility of C&S are now the responsibility of DT.

Application Systems (CCTV, Intrusion Detection, Access, etc.).[10]	→ To maintain SOGR, replace access control devices every 15 years. → To maintain SOGR, replace CCTV every 10 years. →	→ Delivery of access control replacement is spread over a 5-year period to level the work bank. → CCTV replacements are typically driven by changes to technology and often funded by grants. Replacement decisions are based on whole-life-cost justification. →
CNOC Servers	→ To maintain SOGR, replace CNOC servers every 5 years.	→ Delivery of server replacement is spread over a 2-year period to level the work bank.
Capital Improvement		
Radio Program	→ Voice radio upgrade program for all voice radio infrastructure aside from portable radio communication,	→ Delivery of server replacement is spread over a 2-year period to level the work bank.
OTN (Optical Transport Network)[11]	→ Improve overall bandwidth and functionality of fiber-optic network.	→ Install new fiber optic lines in existing right-of-way and renew existing fiber-optic lines. More equipment will be installed in local hubs for increased capacity to increase bandwidth.

[10] Under current operational model, C&S is no longer the owner of PA systems; ownership has been shifted to DT.
[11] Under current operational model, C&S is no longer responsible for OTN devices and fiber transport systems; ownership has been shifted to DT.

Appendix F: Equipment Asset Strategy

Appendix F: Equipment Asset Strategy

Appendix F provides additional information on Amtrak's Roadway Equipment assets and establishes the lifecycle management strategy and consequent work plan to achieve a state of good repair (SOGR).

Overview

Pursuant to 49 U.S.C § 24320(a)(2), this appendix captures the asset strategy for equipment assets to support the transition to normalized or steady state infrastructure replacement and the work necessary to achieve a SOGR of Amtrak's infrastructure. This asset strategy represents our current thinking and enables Amtrak to address the challenges we face from outmoded, unproductive, and insufficient equipment and facilities to maintain current and future equipment inventory. This asset strategy sets out a plan for the acquisition of equipment that will help Amtrak achieve its business goals.

The appendix is structured to be consistent with the main body of the IALP2024 with the following sections:

- Asset Inventory – provides further details on the equipment assets and their maintenance facilities.
- Asset Strategy – presents the strategy for addressing the current equipment challenges and those faced by facilities to maintain current and future equipment inventory. This section also presents strategy for supporting the move towards steady state replacement of the infrastructure.

Responsible Official

Pursuant to 49 U.S.C. § 24320(c)(3)(c), the following individual is responsible for equipment assets owned or managed by Amtrak:

- ***J.P. Miller, Director of Roadway Equipment***

Asset Inventory

Amtrak owns and manages over 3,200 units of Maintenance of Way (M/W) Equipment, Trucks, and Freight Rolling Stock assets supporting maintenance and capital programs across its network. Amtrak also leases over 100 assets to supplement its inventory. Approximately 2,900 assets directly support the four principal asset strategies outlined in this document.

Inventory Description

Amtrak owns and manages a wide variety of roadway equipment assets that support any and every activity performed by Amtrak crews on the roadway from inspections to maintenance all the way up to track bed rehabilitation and other major projects. Table 44 summarizes these assets by key functional group, and indicates the average acquisition date (month and year) and average purchase price (in year of acquisition dollars):

Table 44: Amtrak Roadway Equipment Assets

Category and Subcategory	Count	Av Acquisition Date
Equipment Handling/ Motive Power	96	2007
Freight Rolling Stock	154	2013
Large Roadway Maintenance Power Tools	37	2010
Mobile Lighting	68	2014
Other	36	2019
Rail Bound or HY-RAIL Roadway Maintenance Machinery (RMM)	501	2013
Rubber Tire Roadway Maintenance Machinery (RMM)	333	2014
Specialty Vehicle	1	2011
Storage / Utility	83	2012
Vehicle	20	2001
OVERALL AVERAGES / TOTAL	3,209	2013

Inventory by Principal Asset Strategy

A selected summary of equipment assets is shown in Table **Error! Reference source not found.**45 below. The equipment is divided into the four principal asset strategy elements described in the subsequent sections of this appendix, as these groupings generally reflect the type of work performed by equipment. The following list provides the groupings and example asset types, along with some noteworthy timelines for additional asset deliveries.

1. Life Cycle of Track – includes the following:
    a. Rail: Track Laying Machine (expected FY25), tie cars (expected calendar year 2023), cranes, declipper, tie-handling equipment, rail positioner and ballast regulators, rail stretchers, rail saws and cranes, tampers (rotating stock with more on order), and stabilizers.
    b. Undercutting: Undercutters (one in inventory, a second one arrived in 2023, and a third one is expected calendar year 2024), ballast regulators, loaders, excavators, compactors, and backhoes.
    c. Surfacing: Tampers, switch tampers, ballast management, stabilizers.

   d. Reference Surfacing: Tampers, switch tampers, ballast management, stabilizers, and catenary wire renewal train.
2. Equipment Acquisition for Major SOGR Projects – NY Penn Station Reliability Program
   a. Turnout Replacement: 125T crane (recently delivered), two tilt cars, and lifting beam.
3. Infrastructure Maintenance & Repair – includes the following:
   a. Equipment: Stabilizers, rail heater sets, speed swings, tampers, tie inserters, regulators, backhoes, loaders, tie cranes, bulldozers and excavators.
   b. Truck: Thermite and EA welding trucks, grapple trucks, knuckleboom/boom trucks, dump trucks, fuel/lube trucks, Brandt trucks.
4. Logistics Support – includes the following:
   a. Freight Car: Ballast hopper, concrete tie cars, side dump cars, 60', 70' and 89' flat cars (already being delivered).
   b. Motive Power: HP Locomotive (10 currently in inventory, with one (1) working and nine (9) in shop).

Table 45: Amtrak Roadway Equipment Assets by Asset Strategy Element

Asset Type	Count	Unit	Av Acquisition Date	Average Replacement Cost
Life Cycle of Track				
Rail	399	Each	2021	$ 635,500
Undercutting	388	Each	2022	$ 442,000
Surfacing	88	Each	2021	$ 2,204,000
Reference Surfacing	100	Each	2022	$ 2,412,000
Equipment Acquisition for Major SOGR Projects *NY Penn Station Reliability Program*				
Turnout Replacement	10	Each	2020	$ 2,410,000
Infrastructure Maintenance & Repair				
Equipment	523	Each	2021	$ 795,000
Trucks	203	Each	2021	$ 385,500
Logistics Support				
Freight Car	1,168	Each	2021	$ 154,500
Motive Power	24	Each	2021	416,500
TOTAL	2,903	Each	2021	-

Notes: Includes equipment by primary asset strategy it supports, not all Amtrak equipment is included, Leased equipment is not included.

Asset Condition

Amtrak's equipment assets are key in maintaining SOGR for other assets such as mainline track; however, our ability to deliver the best travel experience to customers is constrained by outmoded, unproductive and insufficient equipment, and insufficient facilities to maintain current and future equipment inventory. Equipment asset conditions are not formally assessed, but it is acknowledged that a lack of qualified equipment maintenance and repair personnel and facilities with which to perform such work has resulted in an equipment asset inventory that urgently requires investment.

Depreciation rates are generally 25 years for large equipment and 18 years for smaller equipment. New equipment is typically assigned to large production gangs (i.e., assigned to a dedicated asset renewal program or significant project) and old equipment is provided to the subdivisions to address regional priorities and any other local issues as they arise. Subdivision gangs can manage unreliable equipment better than production gangs; however, the overall decline in condition of Amtrak's equipment, as well as limited redundancy puts all gangs at significant risk of equipment and/or project failure.

The safety and productivity of Amtrak employees is directly tied to the equipment they use. Engineering leadership has an obligation to provide equipment that will keep employees safe while maximizing productivity. Unlike Class I railroads, Amtrak field personnel may work in areas adjacent to tracks with speeds approaching 125 miles per hour. While some gangs have 24/7 possession of the tracks, others may only receive a brief four-hour nightly window for work activities. Therefore, it is important that the equipment operate efficiently and enable productivity to address maintenance backlogs while maintaining a low safety risk.

The Wilmington shop in Delaware is currently the primary hub for equipment maintenance. While this centralization fosters a collaborative learning environment among personnel, it also necessitates hauling equipment to this key location when repairs cannot be handled by smaller, satellite facilities. This shop, however, grapples with multiple issues. Condemned areas within the building limits workspace, while the propensity for flooding disrupts operations. The existing transfer table is also not long enough to be able to service all available tracks in the shop (i.e., equipment can only be moved within current limits of the table), restricting mobility. Moreover, the shop's design – featuring a single entry and exit point – complicates equipment logistics, demanding considerable labor and inadvertently driving up costs.

A challenge in servicing rail equipment where needed is exemplified in New England, where there are several shops, however, only the Providence shop can accommodate trains as it has one track in the shop, whereas all the others cannot (e.g., Boston, Hamden, and Groton). With the upcoming operation of equipment like the Track Laying Machine (TLM) and undercutters in this region, expanding a facility such as the Groton, by adding shop tracks could significantly improve maintenance capabilities for urgent or planned repairs. Similarly, maintenance teams would welcome the addition of a covered track area in the Perryville, Adams, and Thorn shops to facilitate larger repairs in the Mid Atlantic South, New York, and Mid Atlantic North divisions, respectively. These potential facility upgrades could support shorter periods of equipment downtime and maximize production. Additionally, equipment is becoming more technologically advanced and relies on many computerized components, as well as mechanical components, increasing the number of skillsets required to perform a repair. While there are existing training programs to expand skillsets, which ultimately provide for higher wages, expanded training programs and partnerships with trade schools are needed.

Equipment Asset Strategy

The performance of Amtrak's Equipment has a direct impact on our ability to achieve Steady State Maintenance of Infrastructure. Amtrak's equipment strategy is designed to support Engineering's transition to Normalized or Steady State Maintenance.

Overview

To remain competitive and grow market share for intercity passenger travel, Amtrak must be able to provide a comfortable customer experience, including ride quality and a low risk of unplanned service interruptions. Accelerating SOGR work is an integral part of providing customers with a superior experience.

Amtrak is unable to deliver the railroad our customers require with the available resources we have. To address the challenges faced from outmoded, unproductive, and insufficient equipment, the IMCS Department has prepared an equipment asset strategy that proposes acquisition of equipment, in addition to maintenance, overhaul and storage, that will help Amtrak achieve its business goals. The strategy is designed based on our current production capacity and our forecast production capacity – to address SOGR needs and transition to steady state or normalized maintenance. Taken together, the asset strategy allows for Amtrak to make progress in closing the current SOGR gap; however, some additional investment and steps need to be taken in order to fully close the SOGR gap.

This asset strategy is divided into four parts: life cycle of track; Equipment Acquisition for Major SOGR Projects (NY Penn Station reliability program); infrastructure maintenance and repair; and logistics support.

Life Cycle of Track

Context

Achieving and maintaining a SOGR is accomplished by replacing capital components in accordance with an agreed upon annual rate of deterioration (i.e., as measured by age and/or condition) called steady state.

Replacing assets is accomplished with large machines in a consist with an assembly line of smaller support machines. The pace of replacement work is determined by factors including track possession efficiency, where successive blocks of work are driven by both the speed of the large machine and the finish of smaller machines. Pace is also determined by the logistics of materials fed and removed from the process by work trains, the reliability of the equipment to work without failure, and the skill of the qualified personnel operating the equipment.

Under the present production configuration, steady state levels of capital work cannot be achieved. Simply stated, we do not have enough equipment readily available to achieve a SOGR**.** While Amtrak continues to grow its inventory of necessary equipment for a SOGR, there are insufficient qualified personnel and facilities to maintain all necessary equipment.

Constraints

The performance of each machine in each production consist, whether executing tie and rail replacement undercutting, or surfacing, has a direct impact on the productivity of the entire consist. The functioning of each consist plays a significant role in marginal productivity. Current equipment conditions result in breakdowns and unplanned downtime, which impacts overall productivity.

Another part of achieving SOGR is the critical relationship of each of the processes within a larger process. Track assets have varying asset lifecycles (see Appendix B), and each cycle frequency must be followed to avoid upsetting other asset lifecycles. Failure to deliver one asset lifecycle can have a material impact on other asset lifecycles and may result in accelerated deterioration. For example, track surfacing has a 3-4 year cycle, undercutting a 15-18 year cycle, and rail and tie replacement a 40-55 or 25-45 year cycle, respectively. Achieving the full projected useful life of track at lowest economic cost, an essential objective for Amtrak, requires the continuous performance of these three processes.

Strategy

Therefore, an emphasis is now placed on overcoming the current qualified personnel and facility deficiency as it relates to annual steady state production to eventually eliminate the existing backlog identified in this asset line plan. Some of the key equipment asset acquisitions, initially listed in the inventory are repeated below:

- Track Laying Machine (TLM) (expected FY25)
- Tie cars (on order in FY23)
- Tampers (on order in FY23)
- Undercutters (one arrived in May 2023, second expected early FY24)

Another key element of Amtrak's strategy to support the lifecycle of track work is leased equipment. Commonly leased equipment includes excavators, wheel loaders, lifts, backhoes, saws, anchor applicators and booms. While leasing equipment may come at a slight cost premium, there are also some advantages. For instance, leasing equipment eliminates the burdens typically associated with ownership and maintenance, a challenge that Amtrak currently faces. Avoiding the need to repair the equipment also comes with lower liability if, for example, there is a defective component in the equipment. Amtrak mechanics cannot perform repairs on leased equipment per the agreements, which can cause delays up to 48 hours while waiting for the leasing company mechanics to repair the equipment. The mean time to repair over the last 12 months for leased equipment is slightly under 6 days though, whereas the average for Amtrak repairs is closer to 4 weeks.

Amtrak has a process for groups to request equipment leases. The requests are vetted based on cost, project purpose, anticipated lease duration, and a few other considerations. Overall, in FY23, Amtrak spent approximately $1.2 million on leases for almost 100 different pieces of equipment. This has allowed the steady progress of key projects, at an arguably manageable cost, without the significant responsibilities related to ownership and repair. This especially true in instances of very specialized equipment or in distant project locations.

Equipment Acquisition for Major SOGR Projects

In addition to its scheduled asset maintenance and rehabilitation plans, larger infrastructure renewal projects along key parts of the Amtrak network are often ongoing, and especially along the Northeast Corridor. The following section details how one of those programs demonstrates Amtrak's ability to properly equip the projects to ensure their completion as planned.

NY Penn Station – Reliability Program

Context

Daily, NY Penn Station handles over 1,300 train moves, carrying 300,000 people on Amtrak, New Jersey Transit, and Long Island Railroad trains. The track structure consists of 120 turnouts, including 35 slip switches, each equivalent to four conventional turnouts, as well as 45 miles of individual track segments. Given this high level of usage, some of these assets require either component or complete replacement within a period as short as five years.

Constraints

Reliable track assets require that they be maintained to a SOGR and inspected frequently enough to determine when they are at risk of falling below a SOGR. Asset reliability generally decreases with age, and if replacement of an asset is delayed, frequent inspections may not guarantee reliability.

In recent years, Amtrak has been unable to keep pace with neither the required nor historical steady state replacement levels. For example, between 2009 and 2011 Amtrak invested between $4 and $6 million annually. In 2012 and 2013, investment fell to a $2 million annual level. A major barrier to achieving these higher levels of investment was obtaining sufficient track time to install switch and slip panels.

Strategy

Given the unique conditions at NY Penn Station, a conventional turnout replacement process will not work. Turnouts must be built outside Penn Station and transported on flat cars in three panels for installation. To install, the existing turnout is removed in three panels, ballast is delivered, and the new installation is surfaced before being returned to service. This unique process can occur within a 55-hour window versus the typical three weekend-long schedule for this task at other turnout locations. Specialized equipment well-suited to this kind of work is required to achieve a SOGR without outages to major segments of the station. Each track panel, which weighs 35 tons, must be travelled and spotted under a crane boom that is limited to a 15 ft clearance above rail due to overhead wires to ensure minimum disruption to train service.

Specialized equipment capable of performing this work within the limited time window consists of a 125-ton adjustable counter-weight crane that utilizes switch tilter flat cars capable of raising the panels to clear obstacles between the assembly area and the work site. Once in the station, the crane lifts the panels and walks them to the work site, where they are spotted using on-ground mobile controls.

Maintenance and Repair

Context

The task of performing planned and corrective maintenance, as well as re-capitalization (i.e., replacement) of assets, is not solely the work of large production gangs using complex equipment consists. Small subdivision gangs generally accomplish a large portion of the work in in extremely short operating windows; however, the equipment used is typically provided by production gangs instead of being their own due to limited equipment inventory and/or unreliability of their own equipment.

Constraints

Each of the twelve subdivisions is responsible for the condition of their section of the infrastructure. Each subdivision gang repairs and replaces catenary hardware, bridge ties, switch machines, rail, ties, and many other components. Unlike production gangs, subdivision gangs do not have 24/7 or 55-hour outages for accomplishing these tasks. Most work is performed with overnight track possessions rarely exceeding four to five hours. Available and reliable equipment is crucial to completing subdivision work to allow large production units to operate within normal cycles. Most subdivision equipment is secondhand, and much is outside the lifespan of equipment SOGR.

Strategy

The equipment acquisitions necessary to bring subdivision equipment into steady state is handled outside this Plan.

Production Logistic Support

Context

Appendices B through E outline the annual volumes of assets that require replacement. For each new asset, such as rail, tie, ballast, or switch, new assets must be transported to the work site, and used assets must be picked up and taken to a recycling location. Additionally, many assets are going to age out of a SOGR soon, for instance, flat cars in the SES program, side dumps, as well as rolling stock assets such as ballast cars and locomotives.

Constraints

Dirty ballast must be transported to a disposal site. Rarely are these sites near the work site. Currently, there is an insufficient number of Amtrak-owned freight cars and motive power to transport these used assets. To compensate, hopper cars as well as motive power are often leased. Scheduling and dispatching material trains is further complicated by the limited number of sidings where loaded and empty cars can be staged. The current process requires loaded ballast unit trains to be broken up and staged at sidings based on the current construction program provided by Engineering. When stone is needed, the freight group selects loaded ballast cars stored at various locations and schedules the necessary locomotive power and work train crews; however, this process is inefficient.

Additional constraints include a limited inventory of sidings at which equipment can be stored, requiring it to be stored further from where it is needed. Similarly, there is not always sufficient storage for newly purchased equipment. If certain sidings were extended or their switches were renewed, some of them would be more usable (e.g., West Yard, Philly Yard, Barrack's Yard).

Strategy

One area where Amtrak has actively made improvement in efficiency is with rail cars. For continuous welded rail (CWR), Amtrak leased 11 trains to transport a total of 880,000' (fifty 1,600' strings per train) in FY19. The rail is purchased free on board (FOB) Amtrak property, so the price includes the cost at the mill plus transportation. New rail is dropped where Engineering schedules replacement of existing rail. Vendors typically cut up used rail and remove it from the replacement site. All rail trains drop rail, but no current Amtrak-owned cars can pick up rail. Amtrak recently received a new rail train that can pick up used rail and move it to other locations to be re-used, such as in yards and sidings. Additionally, Amtrak's new rail train will be assigned to load new rail at the mill, hence taking advantage of FOB pricing (and 7 additional rail trains are on order). We believe this will result in a lower cost per foot delivered, including the cost of Amtrak's rail train, compared to the current pricing where the mill and transport prices are consolidated into one price.

Amtrak's freight fleet was acquired when Amtrak was formed, thus has high maintenance needs and introduces the risk of car shortages occur when overhauls are delayed. Critical sub-fleets supporting SOGR repair programs include ballast hoppers, concrete tie cars, a rail train, and, to a lesser extent, general purpose flat cars and gondolas. The rail industry has a benchmark of 50 years of age for the general life expectancy of freight equipment as well as approved interchange with other railroads. Interchange is necessary because large quantities of rail and ballast come from suppliers located on other railroads. Amtrak also routes cars between projects over other railroads, such as New York to New Haven via CSX or Metro North Railroad.

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