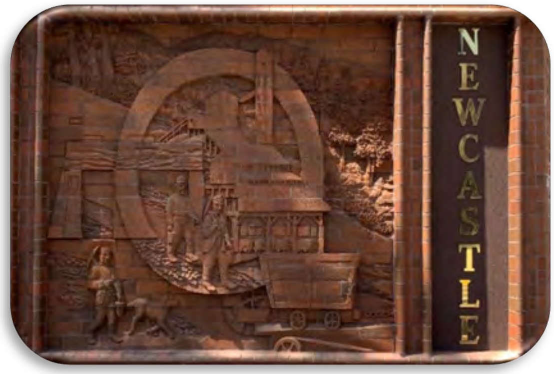

2021 Pavement Management System Update for the City of Newcastle
Final Report

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providing engineering solutions to improve pavement performance

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EXECUTIVE SUMMARY

The City of Newcastle (City) hired Applied Pavement Technology, Inc. (APTech) to survey the City's arterial and collector roadway network, update the pavement management system, and develop a report for the City's paved roadway network. Since the pavement management system was last updated in 2019, this project included reviewing and storing records in PAVER for any work that occurred between 2019 and 2021, surveying the arterial and collector roadway network, updating performance models, and developing a proposed maintenance and street improvement program for a 6-year period.

There are approximately 45 centerline-miles of pavement in the Newcastle pavement network. Of the total pavement area, less than 2 percent is portland cement concrete (PCC) pavement and less than 1 percent is gravel (GR); the remainder consists of asphalt (AC) surfaced roadways.

The road network consists of 520 pavement sections (generally block-to-block) that are managed independently for decisions regarding maintenance and rehabilitation (M&R). Figure ES-1 shows the distribution of the 6.95 million square feet network by surface type.

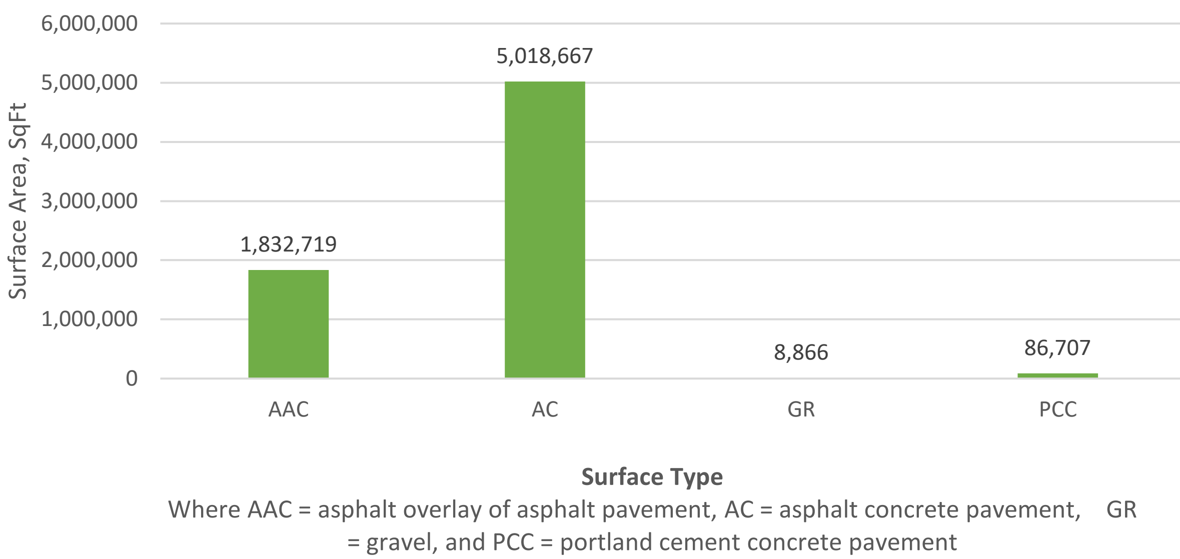
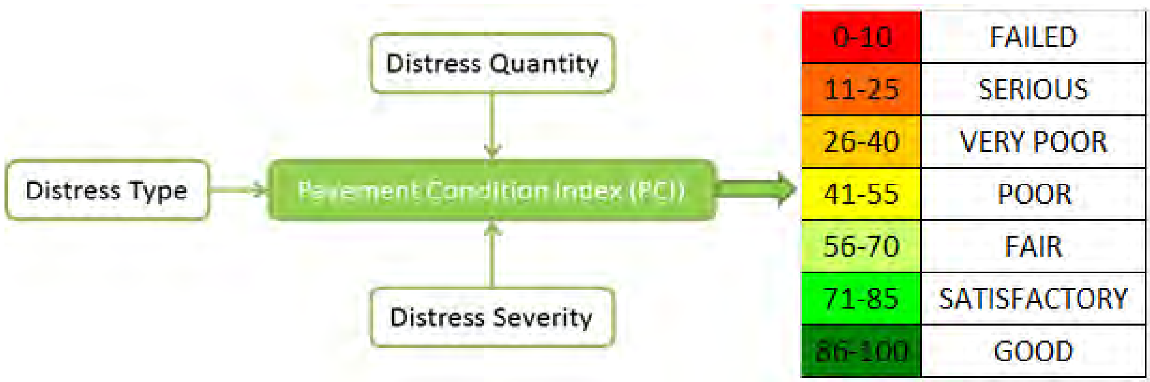


Figure ES-1. Newcastle pavement inventory by surface type.
(Newcastle PAVER Database 2021)

In August 2021, APTech conducted a manual pavement condition survey on the arterial and collector roadways in which visible distress type, severity, and density were recorded to determine the Pavement Condition Index (PCI) for each section. The PCI method follows American Society for Testing and Material (ASTM) guidelines documented in *ASTM D6433 Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys*. The PCI procedure provides a single numerical value representing the pavement condition and is consistent, objective, and repeatable. This data served as the basis for updating the City's Pavement Management System (PMS).

The PCI scale ranges from 0 (representing a pavement in failed condition) to a value of 100 (representing a pavement with no visible distress). Typically, pavements with a PCI above 60 that do not exhibit significant load-related distresses will benefit from preventive maintenance actions, such as crack sealing, surface treatments, and patching. Pavements with a PCI of 35 to 60 are more likely to require major rehabilitation, such as extensive repairs and/or a structural overlay. Often, when the PCI reaches 30 or below, reconstruction is the most viable alternative due to the substantial damage to the pavement structure. These ranges, although typical, are not the same as those used by the City. The City considers pavements with a PCI above 70 to be candidates for preventive maintenance, pavements with a PCI between 70 and 40 are likely to require major rehabilitation, and for pavements below 40 reconstruction is the most cost-effective alternative. Figure ES-2 illustrates how distress findings impact the PCI and the relationship between PCI condition ranges and various pavement ratings.



After the distress survey was completed, the data was analyzed. Overall, City-maintained pavements have an area-weighted PCI of 74. Figure ES-3 shows the 2021 pavement area breakdown associated with each condition category. Over 87 percent of the pavement has a PCI greater than 55, meaning comparatively inexpensive treatments can be used to extend the pavement life on most of the City's pavements.

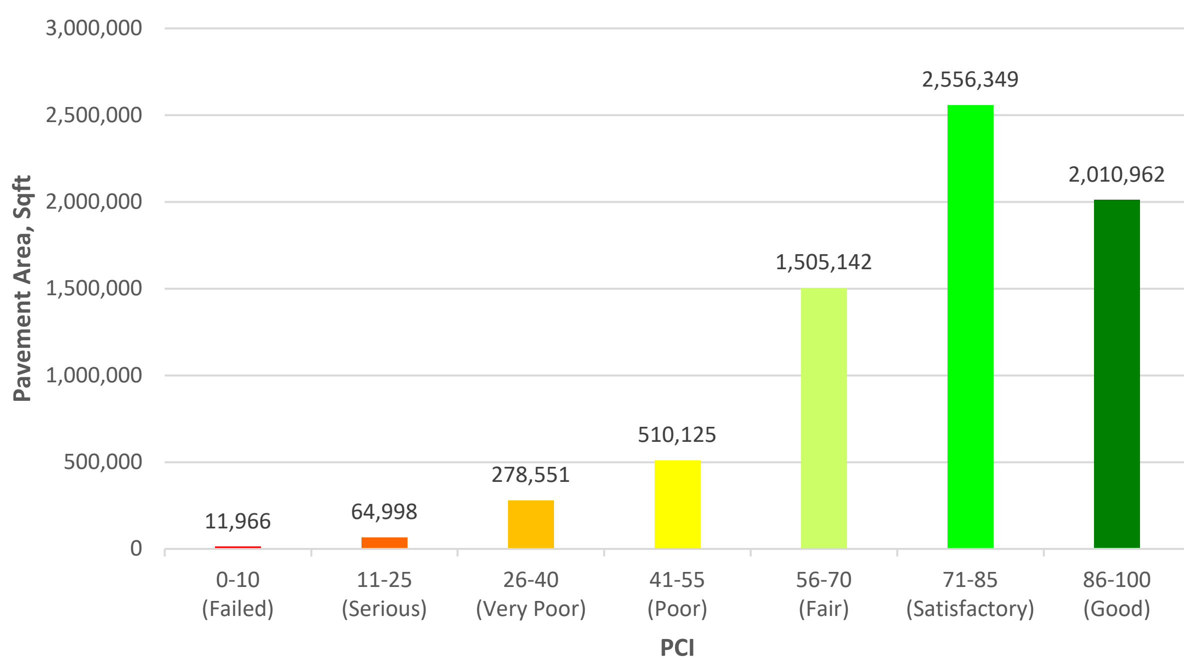


Figure ES-3. Pavement area by condition (2021).

Using the 2021 pavement condition survey of arterials and collectors along with previously collected data, APTech customized pavement performance models for the City. Pavement performance models are relationships between pavement age and observed performance and are used to forecast future conditions. Pavement performance models are critical to a successful pavement management system. They can be used to predict when a major overlay will be needed or determine the optimal timing of a preventive maintenance activity, allowing the City to plan for future expenditures, and to determine the timing of preventive maintenance applications to obtain the maximum pavement life extension using the available (and often limited) funding levels.

The City described their typical process for treating pavements and a plan to introduce additional treatments in their program where appropriate. APTech compiled a list of maintenance and rehabilitation options, developed treatment protocols to determine treatment application maximizing benefits, estimated treatment costs, and performed an analysis of various funding levels.

For purposes of this analysis, pavement repairs were categorized as follows:

- Major rehabilitation – treatments, such as a structural overlay or reconstruction, applied to the entire pavement to correct or improve existing structural capacity.
- Preventive maintenance – localized repair of distressed pavement, including such items as crack sealing and patching.

While maintenance and rehabilitation (M&R) needs are identified based on the current and projected pavement condition and the type of facility, projects ultimately are selected based on the available funding in any given year. M&R programs were developed for the City based on the following funding levels:

- Do nothing, or spending no money on M&R, is used to show the projected effect of performing no work (only safety-related repairs), on overall conditions.
- Unconstrained, used to show the budget needed to fix all the existing issues ($3.87M).
- Maintain current condition (steady state), shows the budget requirement to maintain streets at the current condition levels ($1.96M).
- Maintain current condition with Global (steady state), shows the budget requirement to maintain streets at the current condition levels including surface treatments ($1.52M).
- Constrained annual budgets, used to show variations in budget requirements based on realistic approaches. The following budget levels were evaluated for their ability to maintain the pavement network:
    - Projected condition at current budget expectations ($490,000).
    - Projected budget to reach a pavement condition target of 76 (City council established goal.)

The predicted pavement network conditions under these scenarios are summarized in figure ES-4.

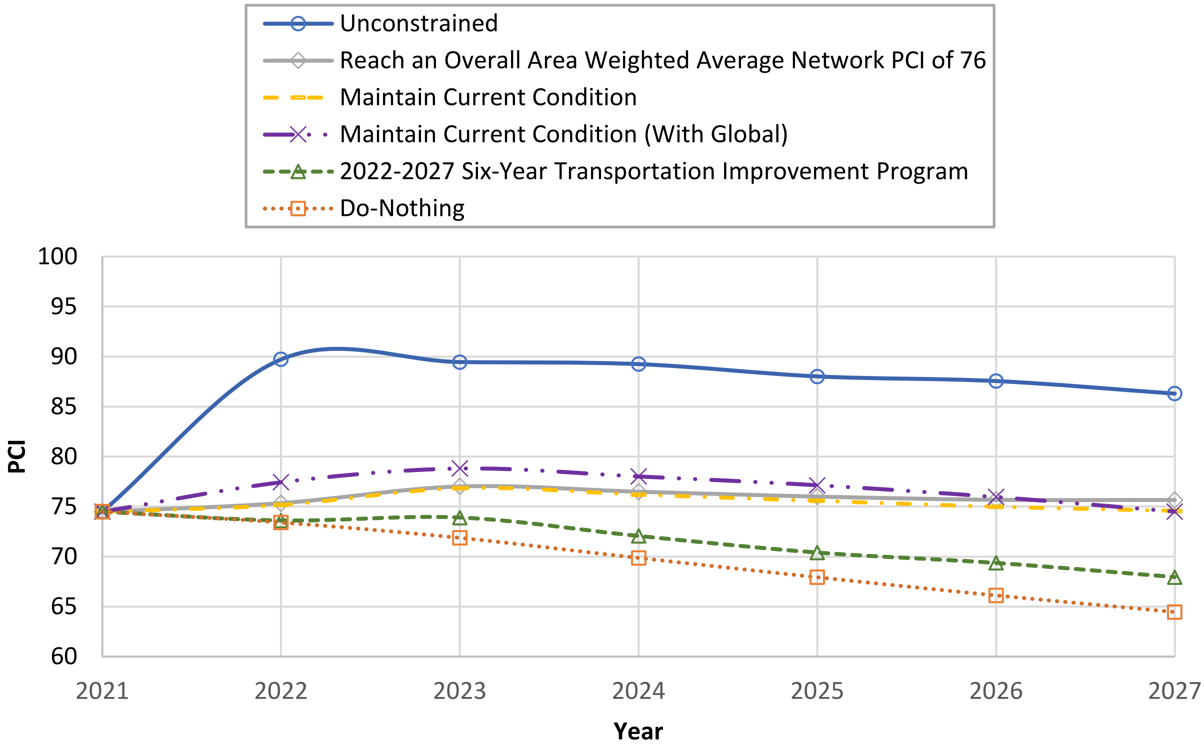


Figure ES-4. Estimated future area-weighted network conditions under analyzed budget scenarios (Newcastle PAVER Database 2021).

For each of the scenarios considered, a 6-year analysis period (2022 through 2027) and a 3 percent annual inflation rate were used. Resulting total funding levels and the overall network area weighted PCI at the end of the analysis period are shown in Table ES-1.

Table ES-1. Summary of maintenance and rehabilitation scenarios. (Newcastle PAVER Database 2021)

Scenario	Total Funding (Millions)	Condition at Year 6
Unconstrained ($3.87M/year)	$23.2	86
Reach target condition of 76 ($2.1M/year)	$12.6	76
Maintain Current Condition ($1.96M/year)	$11.7	75
Maintain Current Condition with Global ($1.52M/year)	$9.2	75
2022-2027 Six Year Transportation Improvement Program ($490k/year in average)	$2.9	68
Do-Nothing	$0.0	64

The recommended M&R plan was developed based on the proposed funding in the *2022-2027 Six-Year Transportation Improvement Program* using a combination of maintenance, preservation, and rehabilitation treatments to address the pavement conditions. If the recommended M&R plan is implemented, the City's pavement network PCI is forecasted to be 68 in 2027.

NEWCASTLE PAVEMENT MANAGEMENT SYSTEM UPDATE

Project Background

The City of Newcastle (City) is approximately 4.46 square miles in size and located in King County, 12 miles east of Seattle. The City updated their PMS with a collector and arterial network inspection to improve the existing performance models and their forecasting for street maintenance and improvements. To achieve this, an evaluation of their 10 centerline miles of arterial and collector pavement infrastructure was carried out in accordance with *ASTM D6433 Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys*. The overall pavement network is comprised of 3.85 centerline miles of arterial streets (12.1 percent of the network), 6.13 centerline miles of collector streets (11.6 percent of the network), 35.03 miles of residential or local access streets (76.2 percent of the network), and unpaved gravel roads (less than 1 percent of the network). The City hired APTech to update their pavement management system and refine their existing comprehensive, multi-year program for street maintenance and improvements.

Scope of Work

The scope of work consisted of the following tasks:

Task 1 – Project Management: The primary objective of this task was to conduct a project kick-off meeting and discuss project details, scope, and work schedule with the City staff. The kick-off call was held on August 4, 20201 and during the phone conference, APTech obtained key information related to the City’s pavement network and became more familiar with the City’s goals for the update of their pavement management system.

Task 2 – Data Collection and Review: Using the 2019-2021 work history information provided by the City and a PCI distress survey for all City collectors and arterials with a sampling rate of 10 percent, APTech updated the existing PAVER database. Quality assurance checks were performed as a part of this task to verify consistency of the collected data. Because this was the second pavement condition effort conducted by APTech in accordance with ASTM D6433, the observed pavement condition was in better alignment with anticipated pavement condition.

Task 3 – Re-Evaluate the 2017 Maintenance Program: APTech updated the PAVER database for the City by adjusting the performance models, GIS shapefile, maintenance policies, and unit costs. The impacts of several budget scenarios were investigated and a draft M&R plan for the City was developed.

Task 4 – PMS Report and Presentation: A final report was prepared that discusses the project process, provides an introduction to pavement management, summarizes network conditions, presents the maintenance and rehabilitation scenarios, and offers budget requirements for achieving condition targets. After review by the City staff, the draft report has been finalized and APTech has prepared a presentation of the key information and findings of the project for the City. The project deliverables include the pavement management database, a pavement condition map, this report, and a PowerPoint presentation that City staff may use at their discretion.

INTRODUCTION TO PAVEMENT MANAGEMENT

Cities and towns are responsible for maintaining their pavement infrastructure. Careful management of the pavements has become increasingly important as competition for scarce resources and public expectations for government accountability have increased. Faced with this daunting task, cities may find themselves seeking answers to questions such as the following:

- How are our pavements performing over time?
- What pavements should we spend money on first?
- On what pavements is our money best spent?
- What annual budget do we need to keep our pavement network at its current condition over the next few years?
- Are we better off spending our money on pavements in very poor condition, or letting those bad pavements deteriorate while we concentrate on keeping good roads in good condition?

To answer questions such as these, the first pavement management systems (PMS) were developed in the 1970s. In simple terms, a PMS is a systematic process that: 1) incorporates periodic assessments of current pavement conditions, 2) predicts future pavement conditions, 3) determines maintenance and rehabilitation needs, and 4) prioritizes these needs to make the best use of anticipated funding levels (i.e., maximizing benefit while minimizing costs). The remainder of this section introduces some of the history of pavement management, provides definitions for common pavement management-related terms, and discusses the different components of a modern-day PMS in more detail.

Historical Perspective of Pavement Management

The concept of pavement management has evolved significantly since its inception in the 1970s. As standardized condition survey techniques came into practice, more information regarding the cause of pavement deterioration became available. This information was then used to readily assess available repair alternatives and select appropriate repair strategies. This approach greatly improved the effectiveness of selected rehabilitation treatments since they were now being chosen to address existing deficiencies and prevent their recurrence.

As computerized pavement management systems became available, an even more sophisticated level of analysis became possible. With today’s systems, results from pavement condition surveys are used to assess current pavement conditions and identify pavement deterioration trends. This capability enables an agency to forecast future pavement conditions. As a result, agencies can assess the long-term impacts of decisions on network conditions and identify the optimal time for repair so that funding can be scheduled in advance of the forecasted need.

The importance of identifying not only the best repair alternative but also the optimal time of repair has been documented in U.S. Army Corps of Engineers, Construction Engineering Laboratory (USACERL) Technical Report M-90/05 and is summarized in figure 1 (Shahin and Walther 1990). This figure shows that over the first 75 percent of the pavement life, approximately 40 percent of the pavement condition deterioration takes place. After this point, the pavement deteriorates much faster, with the next 40 percent drop in pavement condition occurring over the next 12 percent of the pavement life. The financial impact of delaying repairs until the second drop in pavement condition can mean repair expenses four to five times higher than repairs triggered over the first 75 percent of the pavement life.

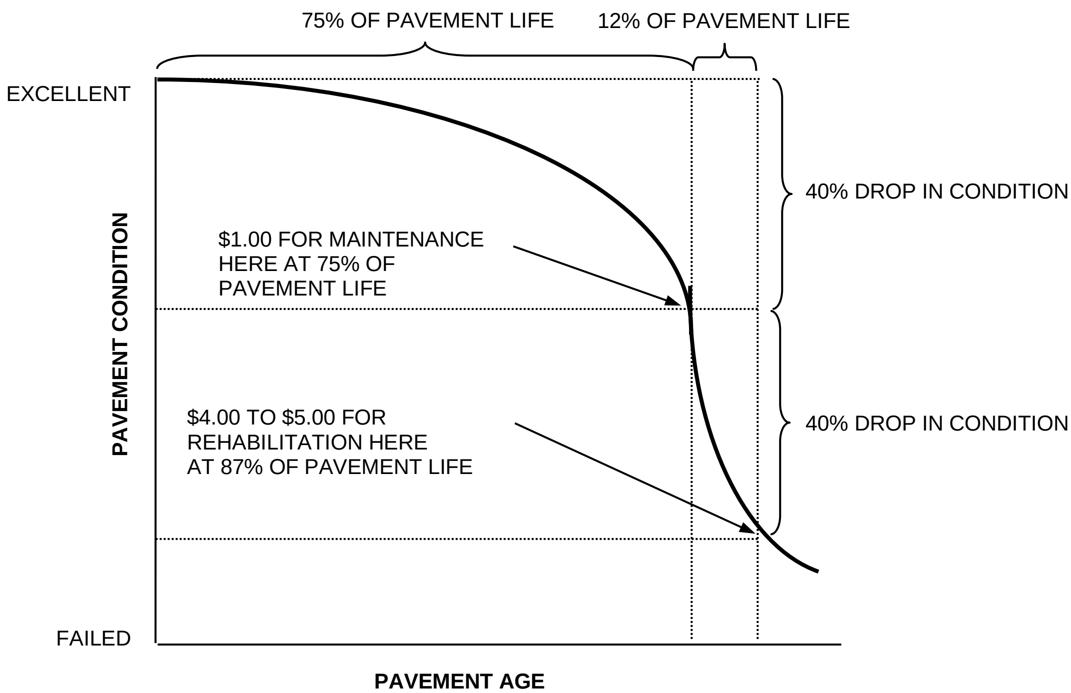


Figure 1. Typical pavement condition life cycle (Shahin and Walther 1990)[1].

Definition of Terms

This section provides definitions of some of the more general terms used in this report.

- **Branch –** A part of a roadway network that is a distinct entity and has a unique function. Each road and parking lot in the pavement network is considered a separate branch. Note that a branch does not need to have consistent characteristics throughout its area, such as surface type or age.
- **Cartegraph –** A proprietary asset management software package.
- **Condition analysis –** Determination of current pavement condition in terms of amount of deterioration present, cause of deterioration, and deterioration rate.
- **Critical PCI –**The pavement condition level used to distinguish between preventive and stopgap approaches. It represents the condition level below which major rehabilitation work should be triggered.
- **Deterioration rate –** Drop in pavement condition in terms of PCI points per year.
- **Effect on pavement life –** The effect that a treatment has on the remaining life of a section. For example, complete reconstruction yields an essentially new pavement with all of its life (as defined by the performance model assigned to the section) remaining.

[1] Shahin, M.Y. and J.A. Walther. 1990. Pavement Maintenance Management for Roads and Streets Using the MicroPAVER System. Technical Report M-90/05. Army Corps of Engineers Construction Engineering Laboratory (USACERL), Champaign, IL.

- **Family –** Group of pavement sections that perform in a similar manner.
- **Impact analysis –** A comparison of different M&R plans and their associated funding levels to determine the effect that different decisions will have on the pavement network.
- **M&R –** This is an abbreviation for "maintenance and rehabilitation," but generally refers to any pavement work activities, such as localized maintenance, preservation, rehabilitation, and reconstruction.
- **Needs analysis –** The determination of M&R requirements, associated costs, and scheduling subject to constraints (e.g., funding levels or desired network condition) for a specified period of time (typically 1 to 6 years).
- **Network –** A broad grouping of pavements within a specified physical area, sometimes managed separately (such as districts within a city, or subdivisions within a town).
- **Pavement Condition Index (PCI) –** A numerical indicator between 0 and 100 that reflects the surface condition of a pavement. PCI inspections are performed in accordance with ASTM D-6433, *Standard Test Method for Roads and Parking Lots Pavement Condition Index Surveys*[2].
- **Pavement maintenance –** Work that is performed to maintain the condition of the transportation system or to respond to specific conditions or events that restore the highway system to a functional state of operation. Maintenance is a critical component of an agency's asset management plan that is comprised of both routine and preventive maintenance.
- **Pavement rehabilitation –** Structural enhancements that extend the service life of an existing pavement and/or improve its load carrying capacity. Rehabilitation techniques include restoration treatments and structural overlays. Treatments can be either described as minor rehabilitation, where an overlay increases the pavement thickness by less than 2.0 inches, or as major rehabilitation, where significant structural enhancements both extend the service life of an existing pavement and improve its load-carrying capability.
- **PAVER –** A pavement management system developed by the U.S. Army Corps of Engineers. It consists of a Microsoft Access database for storing inventory and condition information and some analysis tools.
- **Performance –** An indication of a pavement's ability to serve both the functional and structural purpose for which it is intended. Performance can be viewed in context of a PMS as the change in pavement condition over time, and the increase in distress severity and/or extent observed.
- **Performance model –** Mathematical description relating pavement condition to age for a given family or grouping of pavements.
- **Preservation –** Work that is planned and performed to improve or sustain the condition of the transportation facility in a state of good repair. Preservation activities generally do not add capacity or structural value, but do restore the overall condition of the transportation facility.
- **Preventive maintenance –** Preventive maintenance is a cost-effective means of extending the useful asset life. Also referred to as pavement preservation, preventive

[2] American Society for Testing and Materials (ASTM). 2007. *Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys.* ASTM D6433-07. American Society for Testing and Materials, West Conshohocken, PA.

maintenance includes activities performed with the primary objective of slowing the rate of pavement deterioration.

- **Prioritization –** Technique used to determine which M&R activities should be performed when there is insufficient funding to perform all required M&R.
- **Regression analysis –** Statistical tool that is used to relate two or more variables in a mathematical equation.
- **Sample unit –** A subdivision of a pavement section for PCI inspection purposes.
- **Section –** A part of a branch that has consistent characteristics throughout its area. The PMS analyzes pavement information at the section level; therefore, a section is considered the management unit. This means that pavement condition is analyzed at the section level and that pavement M&R recommendations are made at the section level.
- **Stopgap Maintenance –** Maintenance activities (usually temporary, or shorter lived) typically performed by city staff to a pavement requiring rehabilitation or reconstruction in order to keep the pavement operational in a safe condition. This type of maintenance is carried out on pavement sections that are under the critical PCI when there are insufficient funds to perform the proper rehabilitation or reconstruction and the distresses identified are a safety hazard (e.g. pothole repairs).
- **Treatment trigger –** A set of conditions that must exist in order for a treatment to be considered.

General PMS Components

A PMS is comprised of six basic components, as shown in figure 2. To illustrate the general concepts of the PMS approach, each of these different components are discussed in more detail.

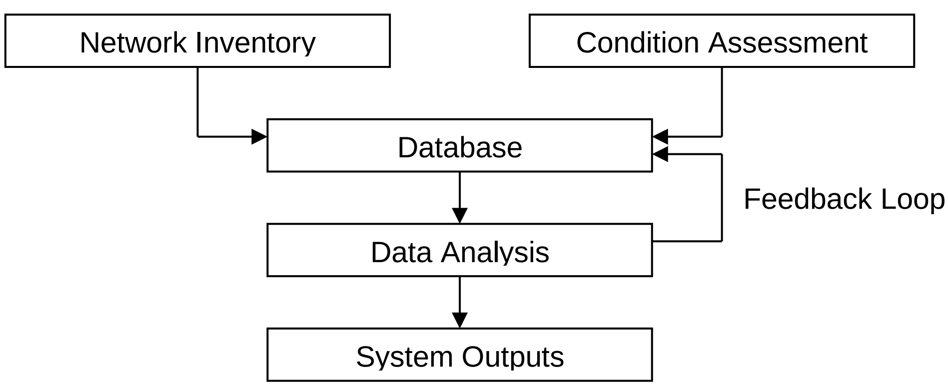


Figure 2. Basic components of a PMS.

Network Inventory

Network inventory is used to define the physical characteristics of the pavements being managed. Typically, the collected inventory information includes location information, pavement characteristics (such as length, width, and surface type), construction and maintenance histories, and traffic data. The network inventory is the foundation for the PMS.

The first decision that an agency should make with respect to network inventory is which pavement areas to include in the PMS. While it is probable that major pavement areas—such as driving lanes, parking lanes and lots, and intersections—will be included in the database, the actual selection of the pavement facilities to be included in the PMS is up to the agency. The pavement areas in the database are usually those for which the City has M&R responsibility.

Once a decision has been made about which pavements to include in the database, information about these pavements must be collected. It is important to keep three guidelines in mind when determining the extent of historical information to include in the inventory. First, the data should be accessible so that large quantities of time are not invested in a records search. Second, the collected information should serve a purpose. Third, the information must be chosen to ensure that the PMS is capable of meeting the analysis needs of the agency.

Although there is flexibility in the amount of information that must be collected and the manner in which it is stored in a PMS database, there are some types of information that are mandatory. The following list outlines the types of information that must be collected for the system to operate correctly:

- *Pavement location* – Physical locations of the pavements need to be identified.
- *Pavement dimensions* – Length, width, and/or area of the pavement sections.
- *Surface type* – Pavement surface/structure; for the City, the following surface types are identified:
    - AAC: Asphalt concrete overlay over existing asphalt concrete pavement.
    - AC: Asphalt concrete pavement.
    - PCC: Portland cement concrete pavement.
    - GR: Gravel road.
- *Last construction date* – Date of original construction or last major rehabilitation, such as reconstruction or an overlay.

Examples of other information that is beneficial to record in a PMS database are included in the following list (note that this list is not comprehensive):

- *Pavement cross-section* – Information on the thicknesses and material type of each pavement layer.
- *Traffic* – Types and levels of traffic.
- *Maintenance history* – Date, type, and cost of maintenance activities performed on the pavements.
- *Testing data* – Coring, boring, deflection, roughness data, and so on.
- *Drainage facilities* – Type and location of drainage facilities.
- *Shoulders or curbs* – Type and location of shoulders or curbs.

In addition to there being mandatory types of information included in a PMS, there are also organizational requirements for building a database, as follows:

- Each network must have one or more branches.

- Each branch must have one or more sections.
- Each branch must have a defined use (i.e. roadway or parking lot).
- Each section must be contained within a single branch.
- Each section must have a last construction date, area, and surface type.

Since pavement maintenance and rehabilitation recommendations, pavement deterioration rates, and cost estimates are determined at the section level, a section's characteristics should be as consistent as possible in terms of pavement design and construction, traffic, and condition. There should also be a systematic method for assigning branch and section names and identifiers.

Condition Assessment

Pavement management decisions are based on the current and projected future performance of pavement sections. This performance information is generated by some method of pavement evaluation. The method selected to evaluate pavement condition is extremely important because it is the basis of all recommendations. For that reason, it is critical to select an objective and repeatable procedure so that PMS recommendations are reliable.

Pavement managers must evaluate their needs when determining not only the type of condition data to collect, but also how often to collect the data. For example, an agency experiencing rapid deterioration rates may elect to survey its pavements more frequently than the average organization, or to survey high-priority pavements on a more frequent basis than low-priority areas. Each agency must carefully evaluate its own circumstances to ensure that the data collection aspects of their PMS match both its needs and financial means. The PCI method is one of the most commonly used methods to evaluate pavement conditions.

Database

Once the network inventory and pavement condition data have been collected, a database can be established to store and use the information. Although a manual filing system may be possible for a small network, the efficiency and cost-effectiveness of storing data on a computer makes an automated database the most practical alternative, especially when a comprehensive PMS is desired. Although the City owned Cartegraph OMS software program, the OMS software modeling module was not activated in the City's version, and therefore could not be used to model pavement conditions. In 2017, PAVER, which is distributed by the American Public Works Association (APWA), was selected to evaluate pavement data collected by Cartegraph in 2015 and contained in the City's OMS system. Distress data was exported from OMS and imported into PAVER for this purpose. In 2019 and 2021, pavement condition data collected by APTech was also loaded into PAVER for subsequent pavement analysis.

Data Analysis

Data analysis can occur at the network or project level. At the network level, potential M&R treatments for the entire network are evaluated and prioritized for planning and scheduling budget needs over a multi-year period. The objective of network-level analysis is to evaluate rehabilitation needs for a future time period and prioritize project lists so that the agency makes the best use of the limited funds available for M&R. After the planning and programming decisions have been made during the network-level analysis, the information in the database can be used to supplement a project-level analysis. At the project-level, each individual project is investigated in detail to determine the appropriate rehabilitation treatment.

System Outputs

There are many different ways of presenting the results of the analyses, including tables, reports, graphs, and maps. Because of the volume of information obtained from a PMS, graphical reports are generally more effective than comprehensive project reports for people who need to quickly evaluate large amounts of data.

Many agencies have found value in linking their PMS and geographic information system (GIS) shapefiles to display information through color-coded graphics. As with the graphical display, this capability has greatly enhanced the usefulness of the PMS to agencies that need to quickly and efficiently convey a lot of information. Map links are perhaps most useful in displaying the funded projects in each year of the analysis and for displaying pavement condition results.

Feedback Loop

An often-overlooked component of a PMS is the development of a feedback loop. The feedback loop establishes a process by which actual performance and cost data are input back into the models used in the pavement management analysis. For example, the PMS may use models that estimate the life of an asphalt overlay at 12 years. Actual performance data may show that the life of the agency’s overlays is closer to 8 to 10 years. This type of information should be used to update the pavement management models so that the system recommendations remain reliable and improve with time. Optimally, a feedback loop should inform the agency on which treatments work and those that do not so that design and M&R practices can improve.

PAVEMENT INVENTORY AND EVALUATION RESULTS

Systems Inventory and Network Definition

The City's pavement network was initially transferred to PAVER in 2017 using information obtained from the OMS software, work-history records made available from the City, a GIS shape file, and discussions with City officials. If detailed information on construction history for a section was not available, APTech estimated construction dates based on the current condition of the pavement. The construction history entries can be easily updated in the PAVER database as new or additional information becomes available.

Network definition is the process of dividing a collection of roadways into a logically organized system. A pavement management system requires that network definition activities be conducted to facilitate the storage and reporting of information and to provide a sound engineering basis for making M&R recommendations. The procedures outlined in ASTM D6433, *Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys*, were followed during the network definition process.

Pavement divisions are established by creating an organizational hierarchy of the pavement network. The pavement network for the City consists of branches, sections, and sample units. A branch consists of the entire length of a road. A section is a subdivision of a branch containing pavement with the same design, construction history, traffic, and condition. Finally, random sample units (relatively small areas) are identified within the sections. Within selected sample units, distress types and severities are identified and quantified to estimate repair needs and to calculate PCIs for the sections they represent.

Approximately 10 centerline-miles (over 1.6 million ft^2) of pavement, which consists of 77 pavement sections, were evaluated on the City network as part of the 2021 arterial and collector pavement condition evaluation. Pavement sections not inspected during this cycle remained in the analysis using previous inspection data and inspection dates. The network pavement sections were divided into four pavement types: asphalt concrete (AC), asphalt overlay over asphalt concrete (AAC), portland cement concrete (PCC), and gravel (GR). Figure 3 shows the distribution of pavement area by pavement type. The database included a gravel road which was not inspected during this cycle and is not included in the various analyses conducted for this project.

A records review for any construction and overlay work that occurred between 2019 and 2021 as well as known work planned for the analysis period was also carried out. The City delivered a series of maps and records in PDF format showing pavement sections that had been overlaid and areas where new developments had affected or are to affect the road network. Sections that were planned to receive work in 2024 had their work history updated and their PCI brought up to 100 for future maintenance and rehabilitation analyses. These sections were modeled in the analyses to reflect the overall condition increase of the network in the model year when the work is set to be carried out. Sections that have work scheduled to be performed after the 2021 inspection are summarized in table 1.

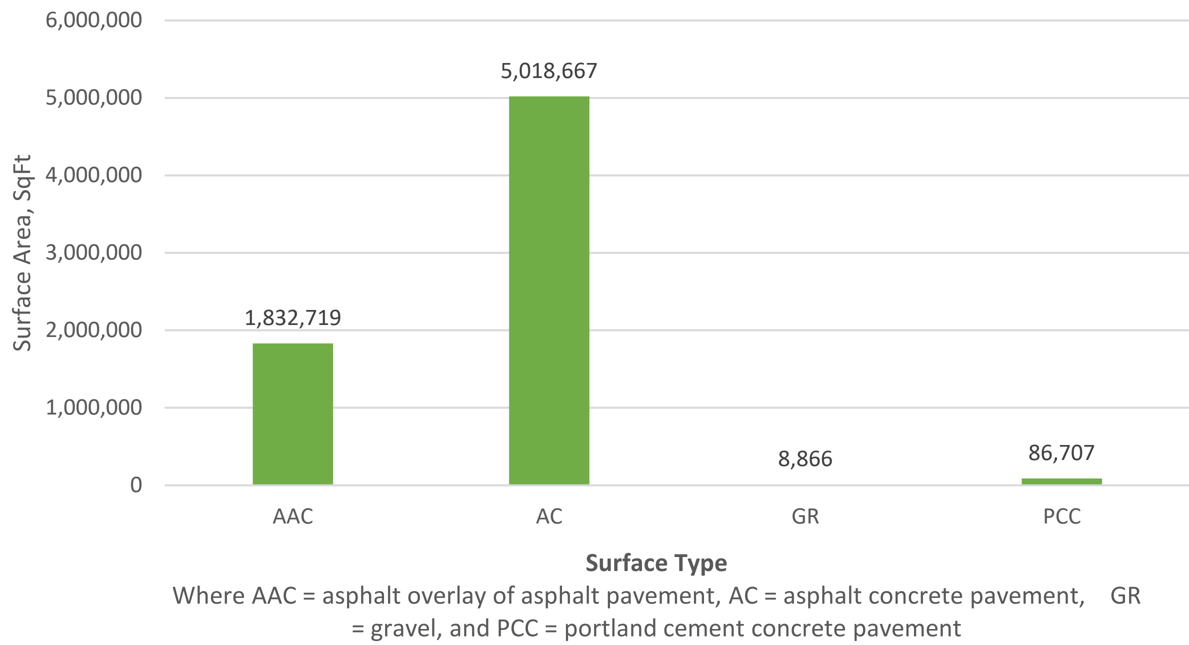


Figure 3. Pavement inventory by surface type.

Table 1. Sections planned to receive rehabilitation after 2021 inspection (2024 Newcastle Pavement Overlay Program).

Branch ID	Section ID	Branch ID	Section ID
000004-050	112THAVESE	000147-040	MAYCREEKPK
000004-060	112THAVESE	000147-010	MAYCREEKPK
000004-040	112THAVESE	000147-090	MAYCREEKPK
000013-150	116THAVESE	000147-100	MAYCREEKPK
000013-130	116THAVESE	000147-110	MAYCREEKPK
000013-140	116THAVESE	000147-080	MAYCREEKPK
000147-070	MAYCREEKPK	000147-050	MAYCREEKPK
000147-030	MAYCREEKPK	000147-020	MAYCREEKPK
000147-060	MAYCREEKPK	000148-010	MONTEREYPL

Pavement Condition Assessment Procedure

One of the most important components of a pavement management system is the methodology for the systematic assessment of pavement conditions, since pavement condition data are used to identify current M&R needs, predict future needs, and assess the impact on overall network conditions of alternative M&R strategies. Because of its importance to the pavement management system, the approach used to evaluate pavement condition must not only provide the level of detail required for the data analysis needs, but must also be repeatable among inspectors.

APTech rated the City's arterial and collector roadway network August 25 to August 27, 2021. The PCI procedure described in ASTM D6433, *Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys,* was used to assess pavement condition. The PCI procedure is one of the standard approaches used by the pavement management industry to assess pavement condition. It was developed to provide a consistent, objective, and repeatable tool to represent the overall pavement condition. This methodology involved walking the pavement, visually identifying the type and severity of existing distress, and measuring the quantity (length, area, or number of slabs affected) of distress. Because manual collection methods were employed, it was not cost-effective, or necessary, to inspect every sample unit in a section to make network-level planning decisions. The City agreed with APTech's recommendation that a sampling rate 10 percent (minimum) of a representative area would be surveyed for each section.

Previous pavement condition collection surveys have been collected in different ways. Data collected in 2011 is reported to have been done in accordance with the PCI process, but the 2015 data was collected using a windshield survey and only a subset of distresses and extent categories. When different collection processes are used, variability can be seen in the resulting pavement scores and should be considered when developing performance models.

Figure 4 illustrates PCI condition ranges. The PCI scale ranges from a value of 0 (representing a pavement in a completely failed condition) to a value of 100 (representing a pavement with no distress). In general terms, pavements with a PCI above 60 that are not exhibiting significant amounts of load-related distress (e.g., alligator cracking in the wheel-path of an AC pavement) will benefit from preventive maintenance actions. Surface treatments such as micro surfacing and slurry seals are a cost-effective way to extend pavement life when the pavement surface is still in good condition, generally when the PCI is between 70 and 85. A slurry seal consists of well graded fine aggregate, mineral filler (e.g., lime, portland cement), and slow-setting asphalt emulsion. The purpose of a slurry seal is to stop raveling and loss of matrix, reduce stripping potential, and improve surface friction. Micro surfacing is a mixture of polymer-modified emulsion binder and high quality aggregates (1/4" to 1/2" maximum aggregate size) that is used in high traffic volume roads. This treatment is attractive due to its ability to improve surface friction, fill minor ruts and surface irregularities, and seal the pavement surface to avoid water infiltration. Furthermore, its rapid setting capability allows opening to traffic in approximately an hour. Figures 5 and 6 show an example of a slurry seal and a micro surfacing project respectively. Pavements with a PCI between 30 and 60 are more likely candidates for major rehabilitation activities such as a structural hot-mix asphalt (HMA) overlay. Often, when the PCI is less than 30, reconstruction is the most viable alternative due to the presence of substantial damage to the pavement structure.

Although typical, these ranges are not those used by the City. The City considers pavements with a PCI above 70 to be candidates for preventive maintenance, pavements with PCIs between 70 and 40 are likely to require major rehabilitation, and for pavements below 40 reconstruction is the most cost-effective alternative.

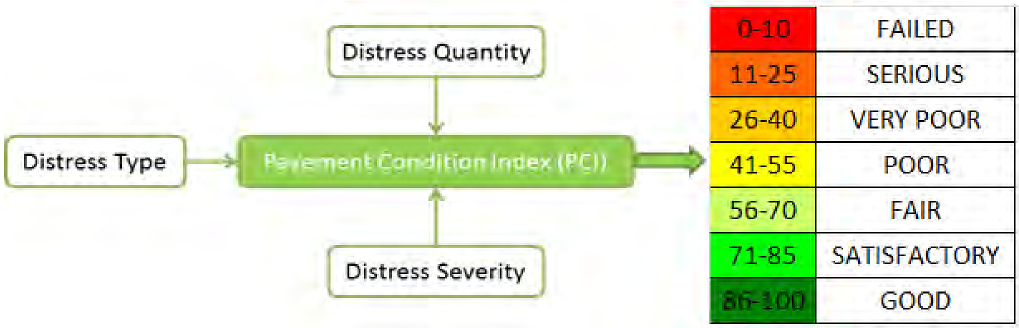


Figure 4. PCI condition ranges.

Figure 5. Example of slurry seal applied in nearby Kirkland, WA.

Figure 6. Example of micro surfacing application.

Although PCI ratings can be used as a general guideline for identifying the repair type, examining the individual distresses measured during the inspection is often more useful in assessing the cause(s) of deterioration. The PCI procedure divides distresses into three categories based on the typical cause of the distress. By knowing the cause(s) of the pavement deterioration, appropriate repair and rehabilitation alternatives can be identified.

The three categories of distress types are load-related distresses (such as alligator cracking, rutting, or corner breaks), climate-related distresses (such as block cracking or blowups), and other distresses (which include distresses that are not directly related to load or climate, such as lane/shoulder drop-off). Load-related distresses are defined as being caused by vehicular traffic and may provide an indication of a structural performance deficiency. Climate-related distresses often signify the presence of aged and/or environment-susceptible materials. Asphalt and PCC pavement distresses are summarized in table 2. No PCI procedure exists for gravel roads.

Table 2. Asphalt pavement distresses by category (as categorized in PAVER).

Load-Related	**Climate-Related**	**Other**
Asphalt Pavement		
• Fatigue (Alligator) Cracking • Edge Cracking • Potholes • Rutting	• Block Cracking • Joint Reflection Cracking • Longitudinal and Transverse (L&T) Cracking • Raveling • Weathering	• Bleeding • Bumps and Sags • Corrugation • Depression • Lane/Shoulder Drop-off • Patching • Polished Aggregate • Railroad Crossing • Shoving • Slippage Cracking • Swelling
PCC Pavement		

• Corner Break • Divided Slab • Linear Cracking • Punchout	• Blow Up • Durability Cracking • Joint Seal Damage • Shrinkage Cracking • Corner Spalling • Joint Spalling	• Faulting • Lane/Shoulder Drop Off • Large Patch • Small Patch • Polished Aggregate • Popout • Pumping • Railroad Crossing • Scaling

The data collection process followed by APTech included the following steps.

- Export the shapefile data from PAVER.
- Align the shapefile to aerial imagery to increase section area accuracy. This area serves as a basis for sample unit sizes and budget forecasting, hence the importance of this process.
- Split each section into valid 2500 ± 1000 square feet sample units and randomly select the sample unit(s) to inspect. During this process, the sampling rate is verified so that every section meets the 10 percent inspection criteria. For consistency purposes, the same sample units inspected in 2019 were inspected in 2021.
- Plan field inspections. If during inspection a pre-selected sample unit was not representative of the overall condition of the section, the inspected sample unit would shift to the sample unit that was representative. Also, in areas where disproportionate distresses were observed to be confined to a specific area of the pavement, an additional sample unit would be added to avoid extrapolating these distresses to the entire section.
- Import the GIS shapefile into both PAVER and APTech's proprietary Distress Data Collection (DDC) tool. The DDC tool was developed by APTech to improve field data collection efficiency. The tool allows APTech surveyors to interact with geo-located polygon shapes that represent the roadway segments while inspecting and make useful section annotations such as section breaks and/or geometrical changes. Figures 7 and 8 provide examples of the configuration of the software. Figure 7 shows the blue circle which is the GPS reference of the location of the surveyors. The pane to the right provides options for any edits necessary or to add new data points. Figure 8 shows an example of the input screen used to enter data for the existence or absence of the roadway curb and gutter.

Figure 7. DDC tool interface.

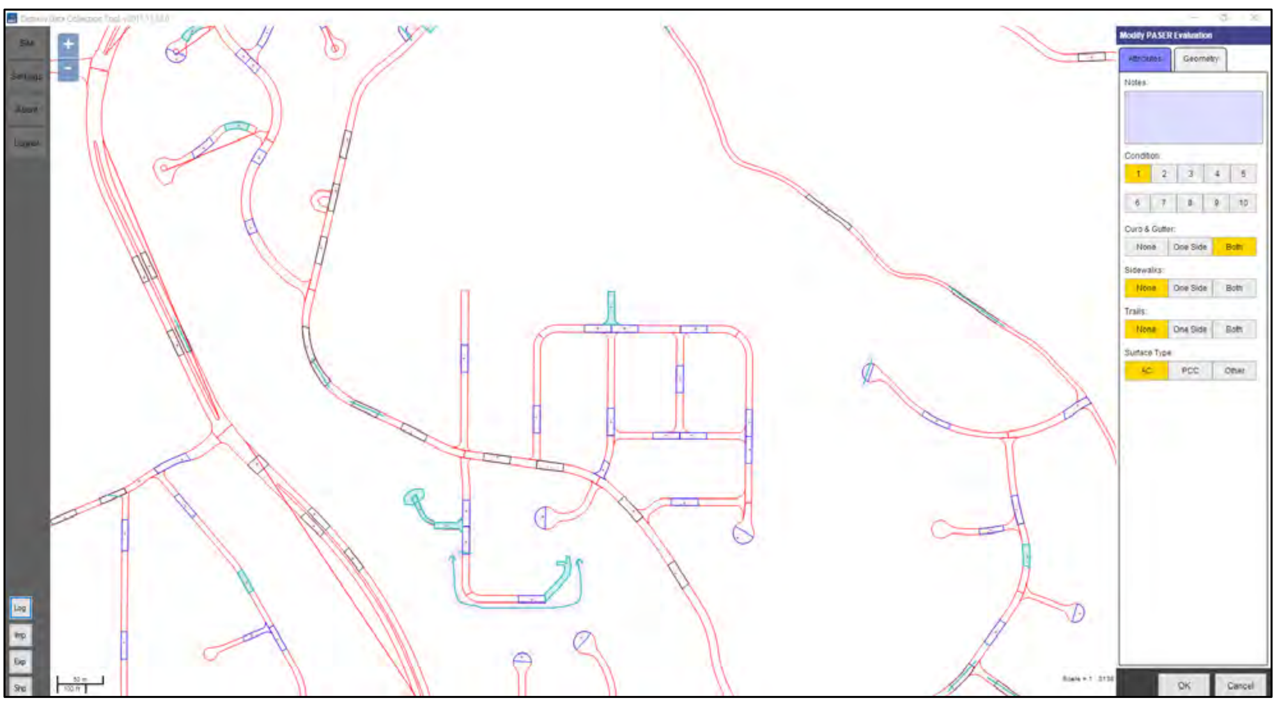


Figure 8. DDC attributes input screen.

- Conduct PCI inspections. Distress type, severity, and quantity (by linear feet, square feet, or number of occurrences) were recorded according to *ASTM D6433* and directly into the PAVER software using a hand-held tablet.
- Maintain Quality Control. The database was reviewed to ensure every section was inspected and that distresses recorded were properly input at the time of inspection.

Pavement Condition Analysis Results

According to the pavement surveys conducted in 2021, the area-weighted PCI of the City-maintained roadways is 74. Figure 9 shows the 2021 area-weighted PCI by pavement type, which ranges from a PCI of 79 for overlaid pavements to 73 for asphalt concrete pavements. Figure 10 shows the 2021 weighted average condition by functional classification and the breakdown in pavement area in each condition category. Figure 11 shows the pavement area by condition.

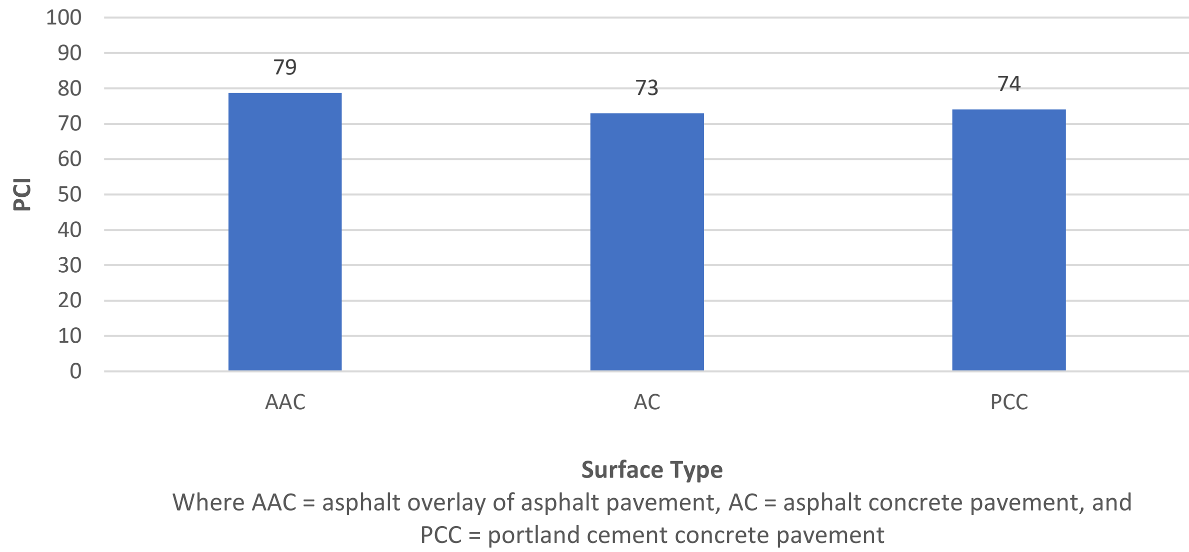


Figure 9. 2021 area-weighted condition by surface type.

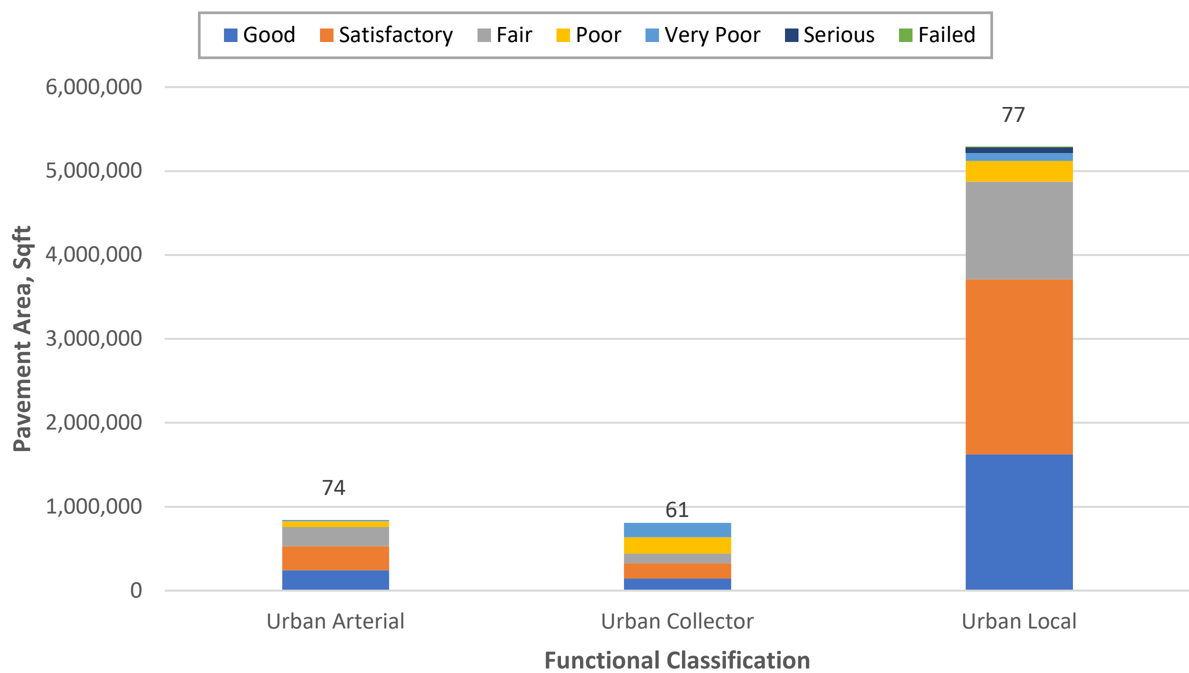


Figure 10. 2021 area-weighted PCI by functional classification.

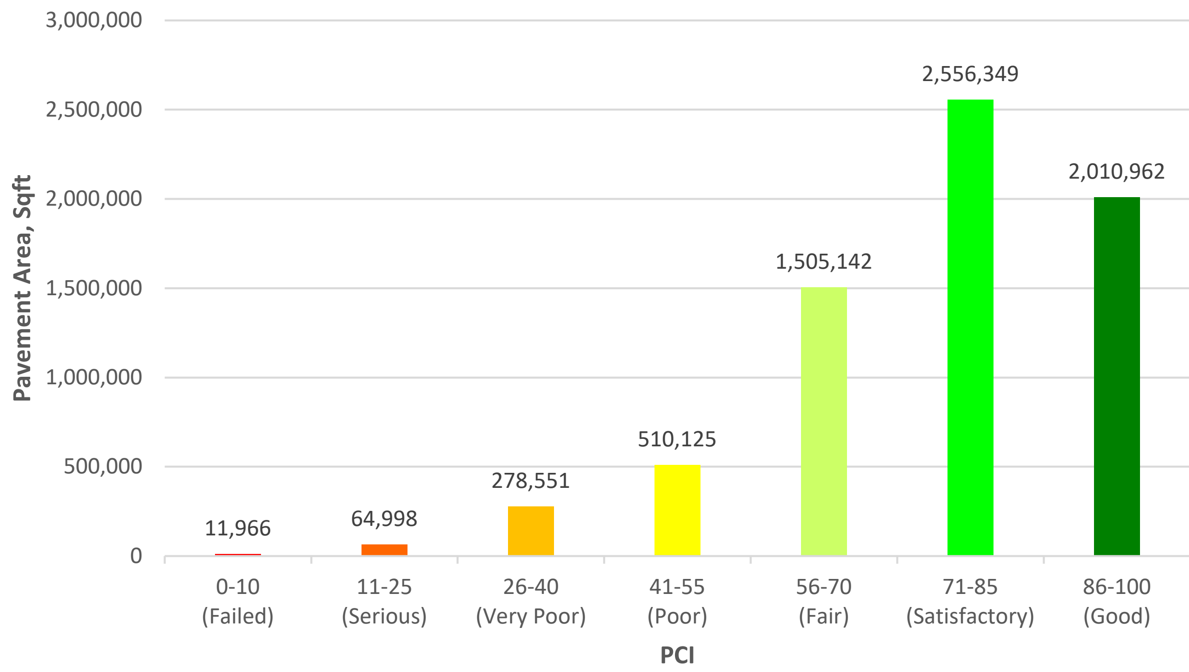


Figure 11. 2021 pavement area by condition.

While the area-weighted PCI of the City roadway network is 74, conditions vary throughout the network. The results of the 2021 pavement condition inspection of the arterial and collector roads and the predicted values for the local roads indicated that approximately 12.5 percent of the pavement area (865,640 ft^2) has PCIs below 56; however, more than 65 percent of the area (4,567,311 ft^2) is in satisfactory or good condition, with PCIs above 71.

The summary of the 2021 PCI results (inspected and predicted) for each pavement section is provided in Appendix A. A map summarizing the entire 2021 PCI condition assessment is presented in Appendix B. Figure 12 shows a current pavement condition map.

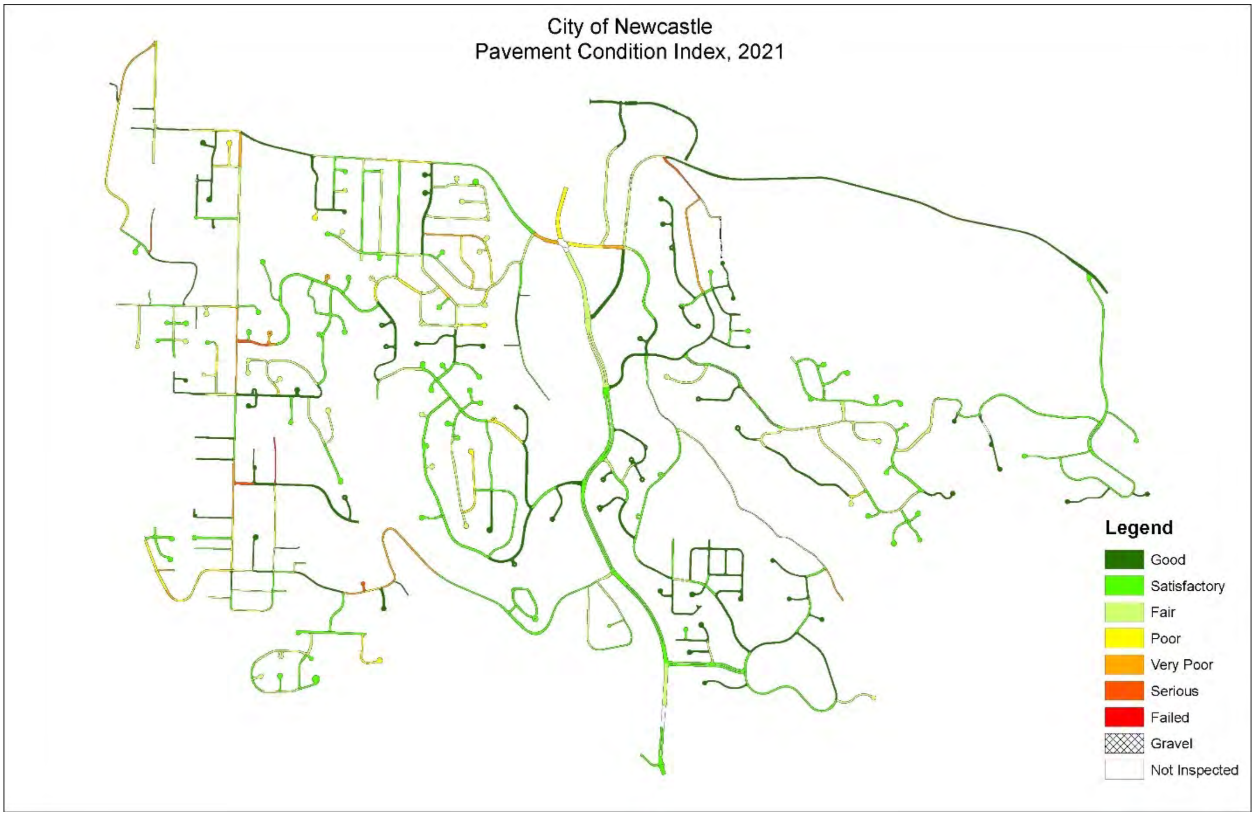


Figure 12. 2021 Newcastle pavement condition map.

PAVER CUSTOMIZATION

Background

PAVER is a pavement management software tool that stores pavement inventory information, calculates pavement conditions using visual assessment data, develops models to predict future pavement performance, stores past performance data, and develops basic M&R plans. The software was configured to reflect the specific conditions and needs for maintaining the City's pavements. Customizing PAVER is essential to ensure the analysis results are meaningful and applicable to the City's needs. APTech defined the PAVER inputs using past pavement management experience and work history information received from the City.

PAVER permits the user to define many database fields to meet specific requirements. This customization occurs at three levels: the network level (e.g., all City-maintained roads), the branch level (e.g., entire street length), and the section level (e.g., portions of each street with the same surface and condition). The City's pavement system is represented by a single network, where each road is a unique branch. Sections are used to further break each branch into smaller areas with common attributes (such as pavement type and general condition). Sample units are also identified within each section, as required by the inspection process.

The customization of the City's pavement management system can be broken down into the following activities:

- Database-related customization: The GIS shapefile and corresponding section areas were updated.
- User defined field for existence of Curb and Gutter on arterial and collector roads.
- Performance modeling update.
- M&R alternatives.

Performance Modeling

A PCI assessment provides the condition of the pavement at the time of the inspection. However, for developing future M&R plans, it is also valuable to be able to predict the future PCI of the pavement sections. This can be done in PAVER through the development and application of performance models. Performance models play an essential role in developing pavement M&R programs. The performance models are used within a pavement management system to predict pavement performance over time, helping to determine the appropriate time to apply maintenance or rehabilitation to maximize the benefits from the expenditure. In addition, by projecting the rate at which the pavement condition will change over time, a meaningful life cycle cost analysis can be performed to compare the costs of different rehabilitation alternatives.

By using the actual pavement condition data from all inspections and the known age at the time of inspection, it is possible to develop database-specific performance models for groups of pavements. First, the pavement network is divided into groups of pavements called "families," which are comprised of sections that are expected to perform in a similar manner over time. For example, AC-surfaced roadway pavements that receive heavy traffic might be grouped into one family, whereas AC-surfaced pavements that primarily carry residential traffic might comprise another family.

Figure 13 illustrates the application of performance model prediction. In this example, a pavement family model was developed using past pavement condition data (shown as black points) and statistically fitted through the data to develop the performance model (shown as the blue curve). For a given pavement section, if the pavement is performing better (or worse) than the rest of the pavement family (for example, see PCI value at 10 years), the model is "shifted" horizontally within PAVER to represent the improved pavement condition (shown as the orange modified family model). In this example, the model shift results in an extension of predicted future pavement condition from the original pavement family model.

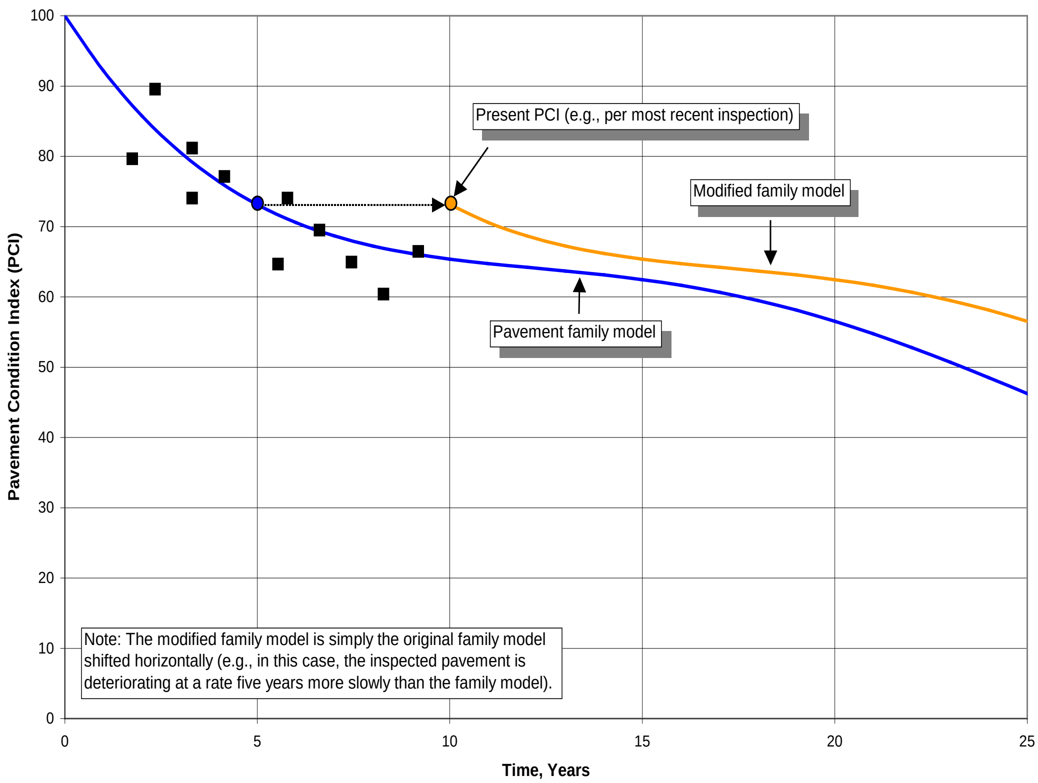
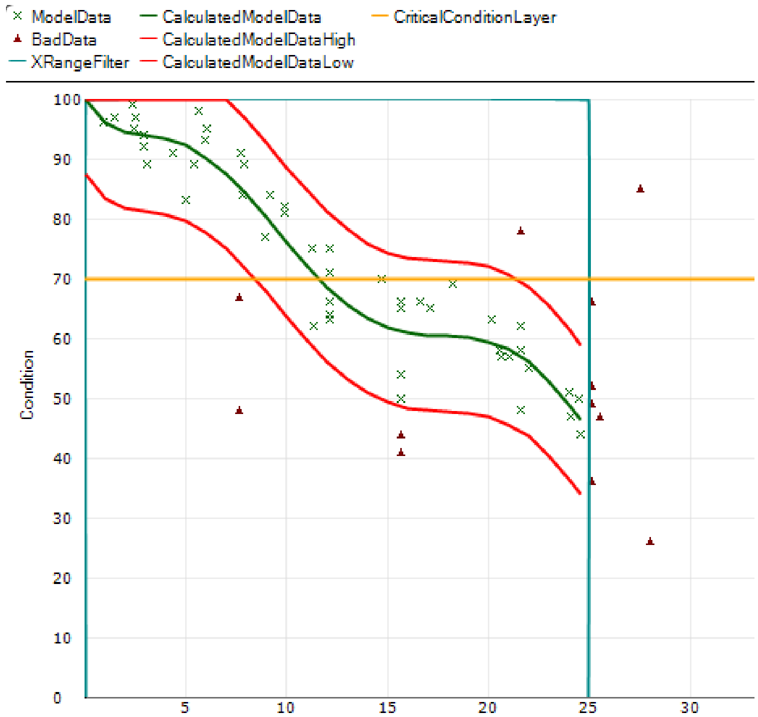


Figure 13. Example of pavement performance model application.

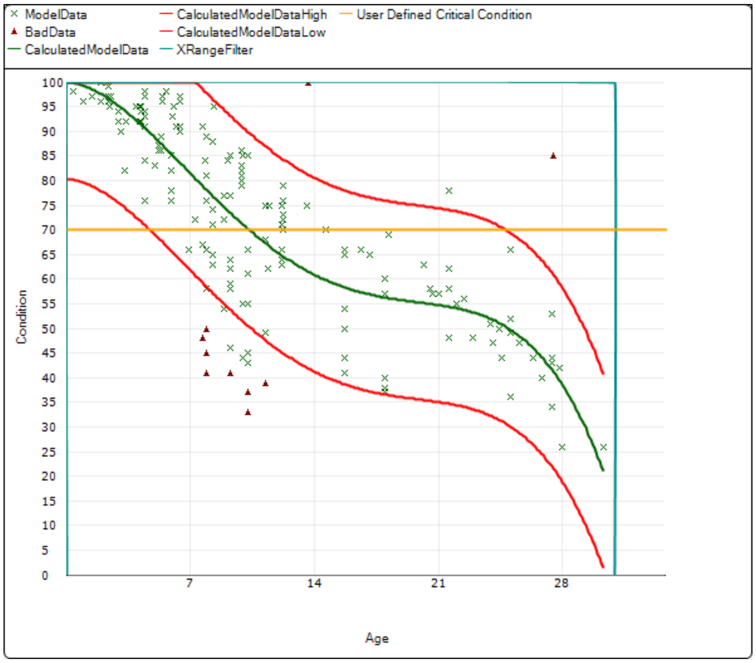
Attributes such as pavement use, pavement type, surface type, and traffic level can be investigated to determine their impact on pavement performance. For the City, existing pavement family definitions were maintained, and the arterial and collector performance model was updated to take into account the data collected during the 2021 condition survey. Updated and pre-existing performance curves for arterial and collector pavements along with their respective statistics are shown in figures 14(a) and 14(b). Overall, adding new data to the performance model caused slight changes in how distresses are predicted for the network. As shown in figure 14 (c), in the first seven years of service life, the rate of deterioration increased, while in the following nineteen years the rate of deterioration either held steady or slightly decreased. Additionally, because pavement age has increased, the age boundary was shifted from 25 to 31. Previously developed local and PCC pavements performance models are shown in figures 15 and 16, respectively. As additional pavement condition data is gathered in future years, the models will be refined and confidence in their predictive capability will increase.



PCI = 100 - 5.8886 * (Age) + 2.2385 * (Age)^2 - 0.4006 * (Age)^3 + 0.0298 * (Age)^4 - 0.0010 * (Age)^5 + 1.1830E-5 * (Age)^6

Coeff of correlation	0.936
Approximate R^2	0.876
Standard deviation of error	6.392
Absolute Mean of error	4.57
Arithmetic Mean of error	0.034

Figure 14(a). 2019 Asphalt (HMA) arterial and collector roads performance model.



PCI =100 - 5.8886 (Age)^1 + 2.2385 (Age)^2 - 0.4005 (Age)^3 + 0.02978 (Age)^4 - 0.00098 (Age)^5 + 1.18296E-05 (Age)^6

Coeff of correlation	0.936
Approximate R^2	0.876
Standard deviation of error	6.392
Absolute Mean of error	4.57
Arithmetic Mean of error	0.034

Figure 14(b). 2021 Asphalt (HMA) arterial and collector roads performance model.

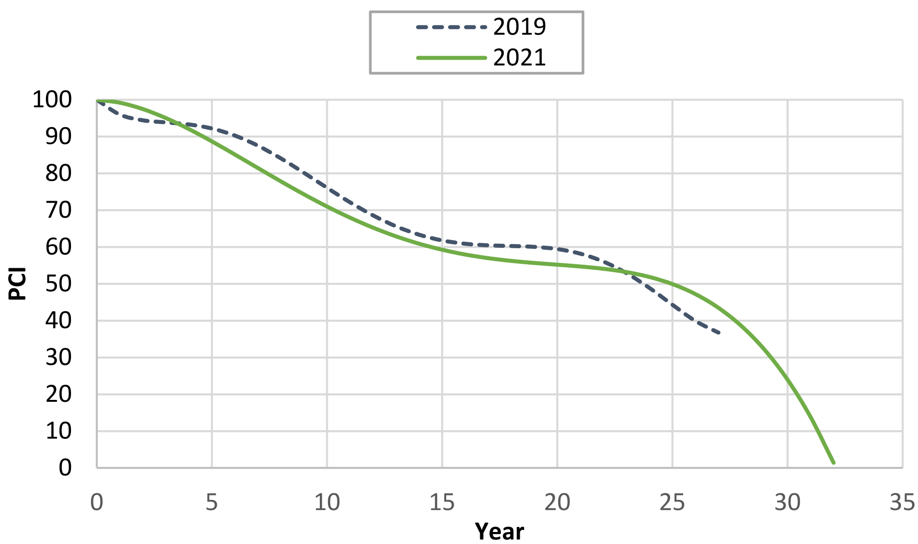
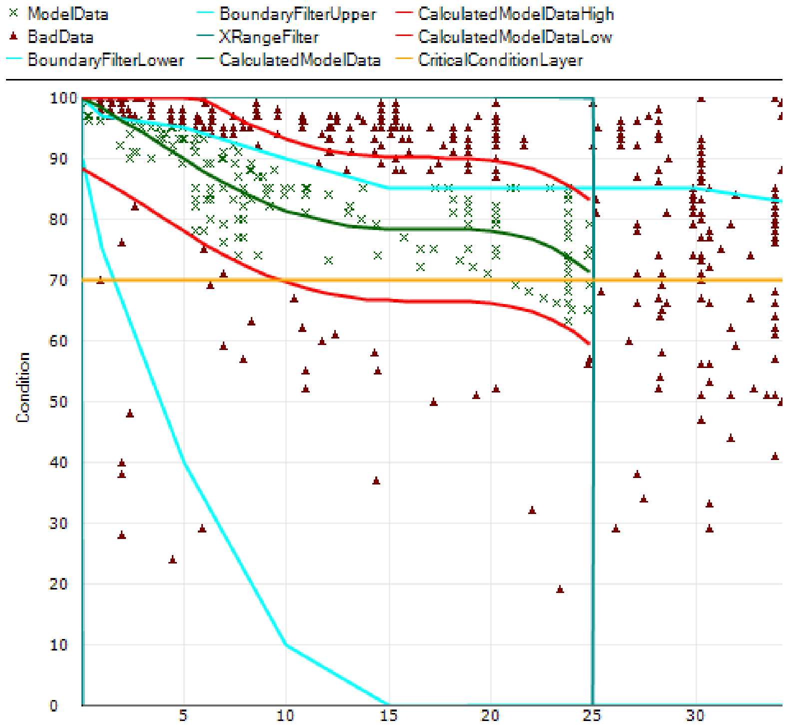


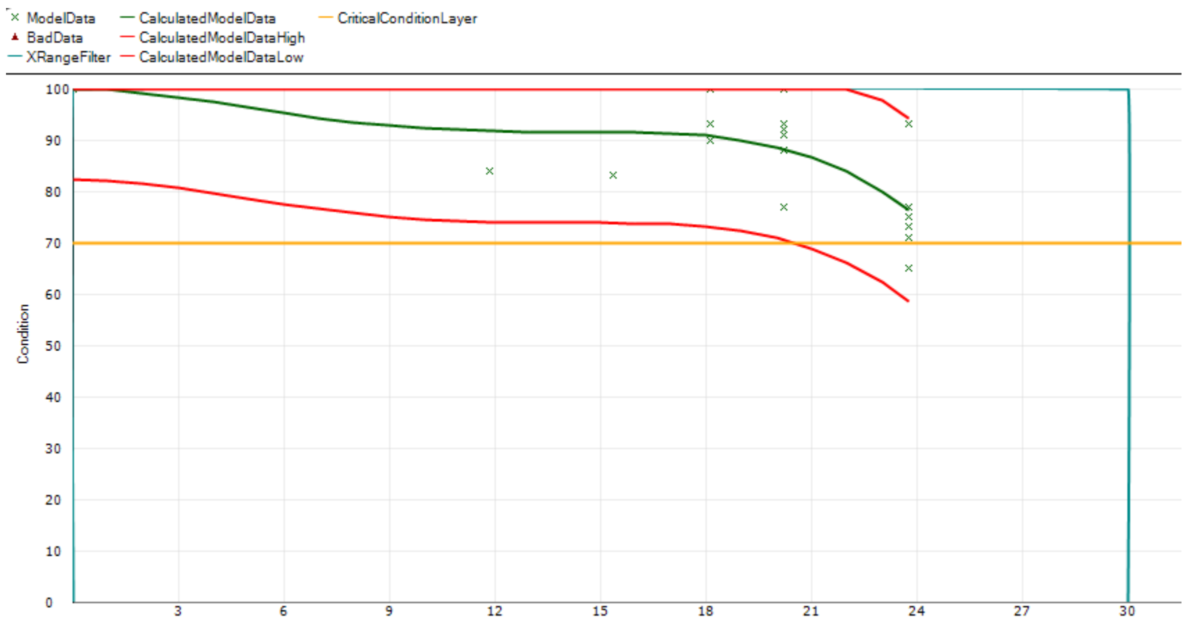
Figure 14(c). 2021 and 2019 Asphalt (HMA) arterial and collector roads performance model comparison.



PCI = 100 - 1.6515 * (Age) - 0.1587 * (Age)^2 + 0.0181 * (Age)^3 - 0.0004 * (Age)^4

Coeff of correlation	0.766
Approximate R^2	0.587
Standard deviation of error	6.012
Absolute Mean of error	4.623
Arithmetic Mean of error	-0.051

Figure 15. Asphalt (HMA) local roads performance model.



PCI = 100 - 3.5255E-05 * (Age) - 0.2499 * (Age)^2 - 0.0234 * (Age)^3 + 0.0006 * (Age)^4

Coeff of correlation	0.717
Approximate R^2	0.514
Standard deviation of error	9.046
Absolute Mean of error	5.656
Arithmetic Mean of error	0.1

Figure 16. PCC pavement performance model.

Maintenance and Rehabilitation Alternatives

While considering maintenance and rehabilitation alternatives, it is important that agency maintenance policies be developed for distresses encountered, treatment costs be well established, and guidelines for prioritization reflect agency desires. This section discusses the process for evaluating maintenance needs.

Maintenance Policies

Pavement maintenance includes routine maintenance actions that are applied to address a specific distress, such as crack sealing linear cracks, or patching a pothole. A slight increase in PCI is typically realized by the application of maintenance treatments, but the age of the pavement does not reset to zero and would still be based on the year of last major work (either original construction or overlay). In general, pavement maintenance is divided into two approaches depending on the overall condition of the pavement being considered for maintenance: preventive and stopgap. Characteristics of each maintenance approach are provided below, along with the following definitions:

- Preventive maintenance: treatments applied to a pavement generally in good condition with the primary objective of slowing the rate of pavement deterioration.
- Stopgap maintenance: maintenance activities performed to keep the pavement operational and in a safe condition.

The goal of preventive maintenance is to preserve the pavement system by slowing the rate of deterioration through proactive treatments or improving the surface condition. Since preventive maintenance treatments are usually very low in cost, their use is a cost-effective strategy for preserving network conditions. Preventive maintenance policies are established to define the type of maintenance action needed to correct each distress type observed during the pavement evaluation.

Stopgap maintenance is recommended when rehabilitation activities are warranted but funding is insufficient to perform the needed level of work. The goal of stopgap maintenance is to keep the pavement operational through the repair of distress type and severity level combinations that could create hazardous situations like the potential for tire damage, hydroplaning, or other safety concerns.

The critical PCI is the pavement condition level that is used to distinguish between preventive and stopgap approaches, and it represents the condition level below which major rehabilitation work should be triggered. Preventive maintenance actions are only recommended for roadway sections above the critical PCI level. Below the critical PCI, stopgap maintenance could be applied but ideally the pavement is being considered for major M&R in the near future. Major M&R is typically defined as a global activity such as an overlay or reconstruction that would return the pavement to basically "new" condition and would result in a PCI of 100 (no distress) if implemented.

According to standard pavement management practice, a critical PCI of 70 is set for all City road types as shown in table 3. A map is provided in Appendix B which identifies each road by functional classification.

Table 3. Critical PCIs for City road classifications.

Critical PCI	Road Type
70	Urban Arterials
70	Urban Collector
70	Urban Local

Tables 4 and 5 present localized preventive and stopgap maintenance policies that were used in PAVER for AC and PCC pavements, respectively. The localized preventive and stopgap maintenance policies primarily consist of crack sealing, and partial and full-depth patching to address isolated areas of distresses to slow down the rate of deterioration of the pavement section. Items identified in tables 5 and 6 as "monitor" are not recommended for a specific maintenance action at this time but should be checked periodically for further deterioration. The distresses that have been identified in the City's inspections are highlighted in tables 5 and 6. The maintenance activities recommended for the City will be discussed in later sections of this report.

Table 4. Localized preventive and stopgap maintenance policies for AC pavements.

Distress Type	Severity Level	Preventive Maintenance Action	Stopgap Maintenance Action
Alligator Cracking	Low	Monitor	Monitor
	Medium	Patching – AC Full Depth	Monitor
	High	Patching – AC Full Depth	Patching – AC Full Depth
Bleeding	Low	Monitor	Monitor
	Medium	Spread Sand	Monitor
	High	Milling – 1/2" inch (localized)	Milling – 1/2" inch (localized)
Block Cracking	Low	Monitor	Monitor
	Medium	Crack Sealing – AC	Monitor
	High	Crack Sealing – AC	Monitor
Bumps and Sags	Low	Monitor	Monitor
	Medium	Patching – AC Partial Depth	Monitor
	High	Patching – AC Partial Depth	Patching – AC Partial Depth
Corrugation	Low	Monitor	Monitor
	Medium	Milling – 1/2" inch (localized)	Monitor
	High	Patching – AC Full Depth	Patching – AC Partial Depth
Depression	Low	Monitor	Monitor
	Medium	Patching – AC Partial Depth	Monitor
	High	Patching – AC Full Depth	Patching – AC Partial Depth
Edge Cracking	Low	Monitor	Monitor
	Medium	Crack Sealing – AC	Monitor
	High	Patching – AC Full Depth	Patching – AC Full Depth
Joint Reflection Cracking	Low	Monitor	Monitor
	Medium	Crack Sealing – AC	Monitor
	High	Crack Sealing – AC	Crack Sealing – AC
Lane/Shoulder Drop-off	Low	Monitor	Monitor
	Medium	Patching – AC Leveling	Monitor
	High	Patching – AC Leveling	Patching – AC Leveling
Longitudinal and Transverse Cracking	Low	Monitor	Monitor
	Medium	Crack Sealing – AC	Monitor
	High	Crack Sealing – AC	Crack Sealing – AC
Patching	Low	Monitor	Monitor
	Medium	Monitor	Monitor
	High	Patching – AC Full Depth	Patching – AC Full Depth
Polished Aggregate	N/A	Milling – 1/2" inch (localized)	Milling – 1/2" inch (localized)
Potholes	Low	Patching – AC Full Depth	Patching – AC Partial Depth
	Medium	Patching – AC Full Depth	Patching – AC Full Depth
	High	Patching – AC Full Depth	Patching – AC Full Depth
Rutting	Low	Monitor	Monitor
	Medium	Patching – AC Full Depth	Monitor
	High	Patching – AC Full Depth	Patching – AC Full Depth
Shoving	Low	Monitor	Monitor
	Medium	Milling – 1/2" inch (localized)	Monitor
	High	Patching – AC Full Depth	Patching – AC Full Depth
Slippage Cracking	Low	Monitor	Monitor
	Medium	Patching – AC Partial Depth	Patching – AC Partial Depth
	High	Patching – AC Partial Depth	Patching – AC Partial Depth
Swelling	Low	Monitor	Monitor
	Medium	Patching – AC Full Depth	Monitor
	High	Patching – AC Full Depth	Milling – 1/2" inch (localized)
Raveling	Medium	Monitor	Monitor
	High	Patching – AC Partial Depth	Patching – AC Partial Depth
Weathering	All	Monitor	Monitor

Table 5. Localized preventive and stopgap policies for PCC pavements.

Distress Type	Severity Level	Preventive Maintenance Action	Stopgap Maintenance Action
Blow-Up	Low	Patching – PCC Partial Depth	Patching – PCC Partial Depth
	Medium	Patching – PCC Full Depth	Patching – PCC Full Depth
	High	Patching – PCC Full Depth	Patching – PCC Full Depth
Corner Break	Low	Monitor	Monitor
	Medium	Patching – PCC Full Depth	Monitor
	High	Patching – PCC Full Depth	Patching – PCC Full Depth
Divided/Shattered Slab	Low	Monitor	Monitor
	Medium	Slab Replacement – PCC	Monitor
	High	Slab Replacement – PCC	Slab Replacement – PCC
Durability Cracking	Low	Monitor	Monitor
	Medium	Patching – PCC Partial Depth	Monitor
	High	Patching – PCC Full Depth	Patching – PCC Partial Depth
Faulting/Settlement	Low	Monitor	Monitor
	Medium	Grinding (Localized)	Monitor
	High	Grinding (Localized)	Grinding (Localized)
Joint Seal Damage	Low	Monitor	Monitor
	Medium	Monitor	Monitor
	High	Joint Seal (Localized)	Monitor
Lane/Shoulder Drop off	Low	Monitor	Monitor
	Medium	Patching – AC Leveling	Monitor
	High	Patching – AC Leveling	Patching – AC Leveling
Linear Crack	Low	Monitor	Monitor
	Medium	Crack Sealing – PCC	Monitor
	High	Patching – PCC Full Depth	Patching – PCC Full Depth
Patch (Large)	Low	Monitor	Monitor
	Medium	Monitor	Monitor
	High	Patching – PCC Full Depth	Patching – PCC Full Depth
Patch (Small)	Low	Monitor	Monitor
	Medium	Monitor	Monitor
	High	Patching – PCC Full Depth	Patching – PCC Full Depth
Polished Aggregate	N/A	Grinding (Slab)	Grinding (Localized)
Popouts	N/A	Monitor	Monitor
Pumping	N/A	Monitor	Monitor
Punchout	Low	Monitor	Monitor
	Medium	Patching – PCC Full Depth	Monitor
	High	Patching – PCC Full Depth	Patching – PCC Full Depth
Scaling	Low	Monitor	Monitor
	Medium	Monitor	Monitor
	High	Slab Replacement – PCC	Monitor
Shrinkage Cracks	N/A	Monitor	Monitor
Spalls (Joint and Corner)	Low	Monitor	Monitor
	Medium	Patching – PCC Partial Depth	Monitor
	High	Patching – PCC Partial Depth	Patching – PCC Partial Depth

Unit Costs

APTech used the cost data for maintenance activities in tables 6 and 7 to estimate the cost of maintenance and major rehabilitation and reconstruction needs, respectively. The cost data is based on information summarized from City contracts, RS MEANS, and APTech experience.

Table 6. Unit costs for localized maintenance activities.

Maintenance Item	Cost	Work Unit
Crack Sealing - AC	$0.71	ft
Crack Sealing - PCC	$6.63	ft
Joint Seal (Localized)	$5.08	ft
Undersealing - PCC	$3.34	ft
Grinding (Localized)	$4.92	ft
Cold Milling (Localized)	$0.61	ft^2
Spread Sand	$0.32	ft^2
Patching - AC Deep	$6.43	ft^2
Patching - AC Shallow	$5.82	ft^2
Patching - AC Leveling	$5.82	ft^2
Patching - PCC Full Depth	$36.21	ft^2
Patching - PCC Partial Depth	$14.50	ft^2
Slab Replacement - PCC	$15.56	ft^2

Table 7. Unit costs for major rehabilitation and reconstruction activities.

Maintenance Item	Cost	Work Unit
Complete Reconstruction - AC	$7.30 - $10.43	ft^2
Complete Reconstruction - PCC	$19.48 - $27.83	ft^2
Cold Mill and Overlay - 3 in	$2.52 - $3.21	ft^2
Surface Reconstruction - AC	$4.70 - $6.72	ft^2
Surface Reconstruction - PCC	$16.14 – $23.05	ft^2

Using the unit cost and maintenance policies shown above, a cost by PCI table was developed for preventive, stopgap, and rehabilitation activities. These costs were used during the preliminary budget scenario analysis and comparison. The preliminary budget scenario analysis allows for a simple comparison of different budgets and condition targets.

In general, the costs for rehabilitating pavements with a PCI below 40 represent the cost of reconstruction. For PCIs between 40 and 70, the costs generally represent the cost of patching or the cost of an asphalt overlay with varying amounts of pre-overlay repairs. Finally, costs for pavements with PCIs above 70 are for preventive maintenance and repairs. Table 8 shows the cost by PCI ranges of preventive and stopgap maintenance for asphalt and PCC roads. PAVER will use the cost by PCI in table 8 to estimate the costs for applying preventive and stopgap maintenance for a section. Table 9 shows the cost by PCI ranges for rehabilitation activities for asphalt and PCC, which are defined by functional classification and are based on information summarized from City contracts, RS MEANS, and APTech's experience. PAVER will use the costs by PCI data in table 9 for each year of the simulation to estimate the costs of applying rehabilitation (major M&R) activities.

Table 8. Cost (per ft^2) by PCI range for preventive and stopgap maintenance.

PCI	Asphalt		PCC	
	Preventive	Stopgap	Preventive	Stopgap
0	$9.01	$1.91	$2.25	$10.57
10	$9.01	$0.90	$2.25	$5.01
20	$4.78	$0.22	$2.25	$2.22
30	$2.81	$0.07	$2.25	$0.87
40	$1.41	$0.02	$2.25	$0.55
50	$0.56	$0.00	$2.25	$0.32
60	$0.06	$0.00	$2.25	$0.13
70	$0.02	$0.00	$0.95	$0.06
80	$0.02	$0.00	$0.53	$0.02
90	$0.01	$0.00	$0.05	$0.00
100	$0.00	$0.00	$0.00	$0.00

Table 9. Cost (per ft^2) by PCI range for rehabilitation activities.

PCI	Arterial/Collector[1]		Local[1]	
	PCC	Asphalt	PCC	Asphalt
0	$27.83	$10.43	$19.48	$7.30
10	$27.83	$10.43	$19.48	$7.30
20	$27.83	$10.43	$19.48	$7.30
30	$27.83	$10.43	$19.48	$7.30
40	$27.83	$10.43	$19.48	$7.30
50	$9.55	$3.21	$7.25	$2.52
60	$5.08	$3.21	$4.92	$2.52
70	$0.30	$0.30	$0.30	$0.30
80	$0.30	$0.30	$0.30	$0.30
90	$0.00	$0.00	$0.00	$0.00
100	$0.00	$0.00	$0.00	$0.00

[1] Street classification as defined by City of Newcastle standards.

Prioritization Guidelines

Prioritization is a technique used to determine which M&R activities should be performed when there is insufficient funding to perform all necessary work. A prioritization scheme should be developed such that more important pavements receive their recommended work on schedule and less important pavements have their recommended work postponed as necessary.

Priorities should consider all factors relevant in determining the relative importance of various pavements. Typically, agency policy is a key factor in determining priorities. For example, some agencies may determine that certain roadways are more important than others because of traffic patterns or other priorities. The priorities used for the City network are based on the functional classification of the road and are as follows:

- High priority – Principal and minor urban arterial roads. Includes roads which serve as the main distributing arteries for traffic.
- Medium priority – Urban collector roads. Includes roads which supplement the arterial roads by providing access to, between, and within the various functional areas.
- Low priority – Urban local roads. Includes all roads not classified as arterial or collector roads.

When a constrained budget (insufficient budget to fund every need) analysis is performed, PAVER prioritizes projects in the following order:

- First Priority: Stopgap maintenance.
- Second Priority: Preventive maintenance.
- Third Priority: Major M&R above critical PCI with structural defects.
- Fourth Priority: Major M&R below critical PCI.

Preliminary Analysis

The preliminary analysis considered an unconstrained budget (scenario in which an unlimited yearly budget is available, allowing any candidate sections to receive a treatment), three target condition (PCI) scenarios, and one constrained budget scenario evaluated over a 6-year period. The unconstrained budget scenario identifies all the eligible projects within the PMS and funds them. This scenario, while not producing a system-wide PCI of 100, is seen as the maximum attainable network PCI given the available treatments and project triggers. The target condition scenarios are (1) budget needs to maintain the current (2021 PCI of 74) area-weighted average network condition, (2) budget needs to maintain the current (2021 PCI of 74) area-weighted average network condition with the use of surface treatments (global M&R), and (3) budget required to achieve a minimum area-weighted average network condition of 76 at the end of a 6-year period. The constrained budget scenario is the City's current budget level. These scenarios were compared with a no funding/do nothing scenario to realize the effect of each scenario. The starting date (year 1) for the analysis was selected to be April 1, 2022, and the ending date (year 6) was selected to be April 1, 2027. Figure 17 illustrates the change in PCI over the analysis period using the different scenarios. Figure 18 illustrates the total funding over the analysis period for the scenarios.

The City indicated that annual available funding changes based on the 2022-2027 Six-Year Transportation Improvement Program. To maintain consistency with the 2017 and 2019 reports, 65 percent of the total contract award amount was considered to be expended in the actual pavement items that are modeled in the PAVER system. The total contract amounts, including incidental items like traffic control, utility adjustment, sidewalk repairs, and striping, are reported in the funding scenarios and this report. Project design and contract administration costs are outside of the recommended funding amounts. Table 10 summarizes the funding from the 2022-2027 Six Year Transportation Improvement Program.

Table 10. 2022-2027 Six Year Transportation Improvement Program funding.

Year	Funding	
	Total	**65 Percent**
2022	$250,000	$162,500
2023	$160,000	$104,000
2024	$1,205,000	$783,250
2025	$160,000	$104,000
2026	$1,025,000	$666,250
2027	$160,000	$104,000

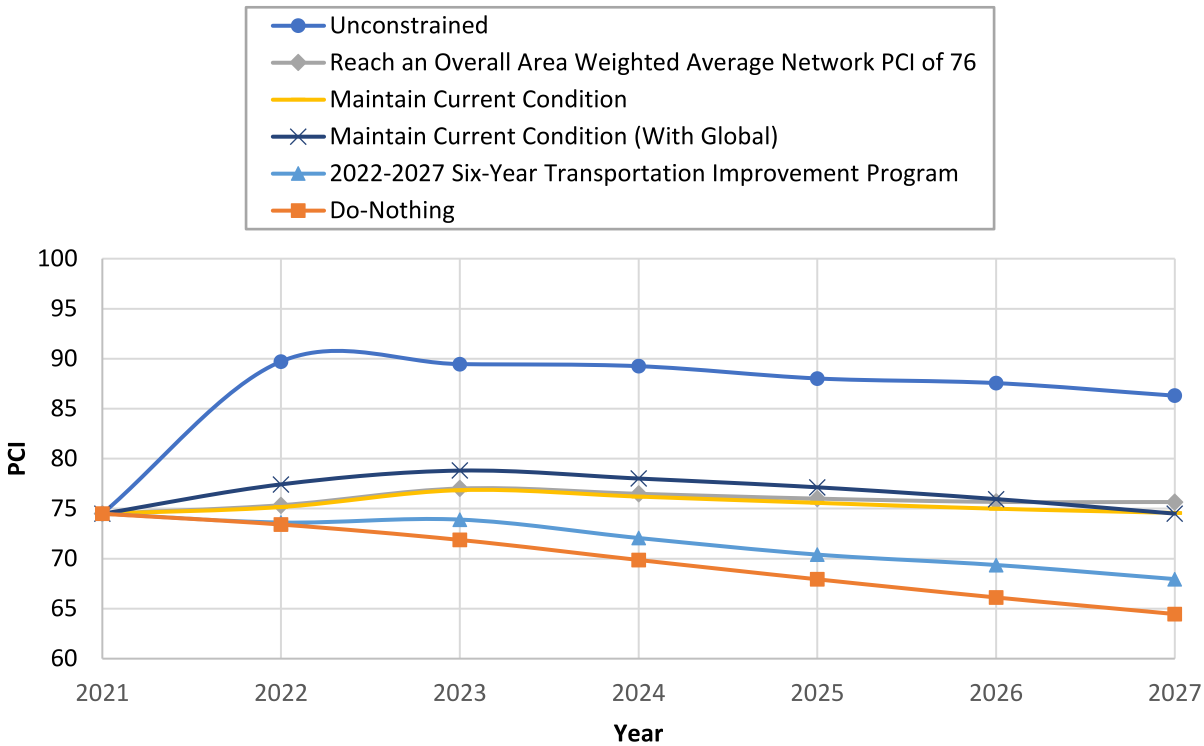


Figure 17. Change in condition for different budget scenarios.

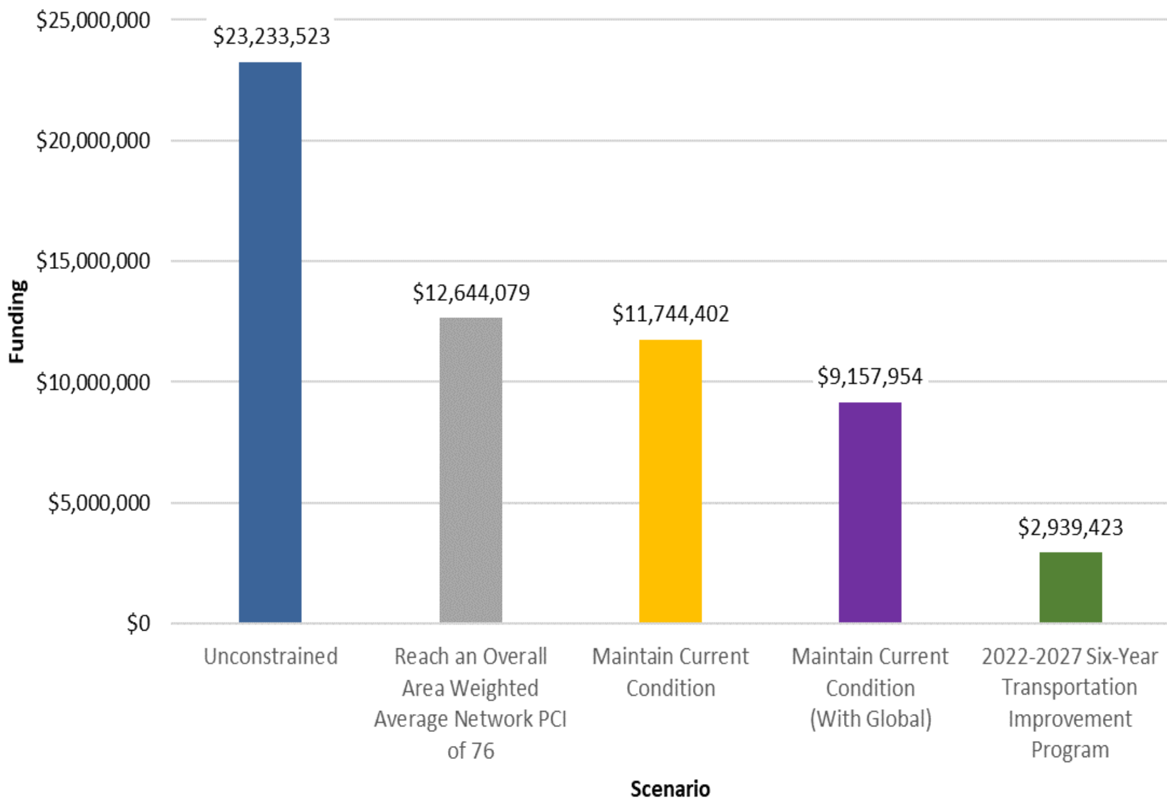


Figure 18. 6-year funding required for the budget scenarios.

The results of the preliminary analysis are summarized below:

- If no preventive maintenance or rehabilitation is done, the network PCI will drop by 10 points to 64 by 2027 (year 6).
- For the 2022-2027 Six-year Transportation Improvement Program funding level ($490k per year) the network PCI will drop by 6 points to 68 by 2027, and results in fair network condition.
- A total of $11.7M over a 6-year period ($1.96M per year) is necessary to maintain the current area-weighted average network condition (PCI equals 74).
- A total of $9.2M over a 6-year period ($1.52M per year) is necessary to maintain the current area-weighted average network condition (PCI equals 74) if surface treatments are included as part of the City's treatment strategy.
- A total of $12.6M over a 6-year period ($2.11M per year) is necessary to achieve the target area-weighted average network condition of 76 at the end of the analysis period.
- The unconstrained budget scenario shows a total of $23.2M over a 6-year period ($3.87M per year) will produce an area-weighted average network condition of 86 (good condition) at the end of the analysis period.
- It is noteworthy to mention that the costs shown in this report include non-pavement incidentals (e.g., pavement marking, signal loops, mobilization, traffic control). The costs for only pavement-related construction represent approximately 65 percent of the overall cost.

MAINTENANCE AND REHABILITATION PROGRAM

APTech has developed a 6-year recommended/optimal maintenance plan based on the current funding level (2022-2027 Six-Year Transportation Improvement Program). This recommended plan is different than the ones discussed in the "preliminary analysis" section because it has been tailored to maintain the City's network condition over the analysis period while addressing the goals and priorities of the City. The details of the plans are discussed in this section.

Impact of Do-Nothing Approach

If no funding were available for preventive maintenance and rehabilitation activities, the area-weighted average network PCI is projected to drop to 64 at the end of the analysis period. Appendix C shows the projected PCIs of each pavement section if no major rehabilitation work is performed in the next 6 years. The forecasted PCIs are determined using the prediction models developed for the City pavement network (discussed in the previous chapter).

Annual M&R Program Recommendation

The recommended M&R program was developed by taking into consideration the City's primary objective of preserving its roadway network with programmed and available funding.

The City is interested in introducing surface treatments as a form of preventive maintenance to their roads; hence scenarios including surface treatments and with no surface treatments were analyzed. Neighboring cities have introduced slurry seals and micro surfacing; therefore it was agreed to consider the use of these two treatments in the analysis. The purpose of a surface treatment is to apply a cost-effective technique to a section in order to slow deterioration and extend its service life. To achieve this, these treatments must be placed on the proper candidates. To ensure that surface treatments are recommended for proper candidates, a series of parameters were defined.

- Slurry seals are to be used for urban local roads and micro surfacing for arterials and collectors. These treatments will only be recommended for asphalt-surfaced roads.
- A 3-year period should pass before a surface treatment is considered for new pavements (overlays included).
- The time to reach the pre-treatment condition (treatment life) and the application interval is recommended to be 6 years.
- The range of PCIs for which the treatments will be applied will be from 94 (based on the performance models a minimum of 3 years are required to reach this condition) to 70. Anything below 70 would become a candidate for a major M&R.
- Unit cost for slurry seals is \$0.24 ft^2 and micro surfacing is \$0.32 ft^2 (estimated from APTech experience).

Figure 19 shows the change in condition between the aforementioned scenarios along with the no-rehabilitation (do-nothing) scenario throughout the analysis period. Although minimal, mainly due to the overall condition of the network, the overall area-weighted average PCI is higher over the 6-year analysis period when utilizing surface treatments.

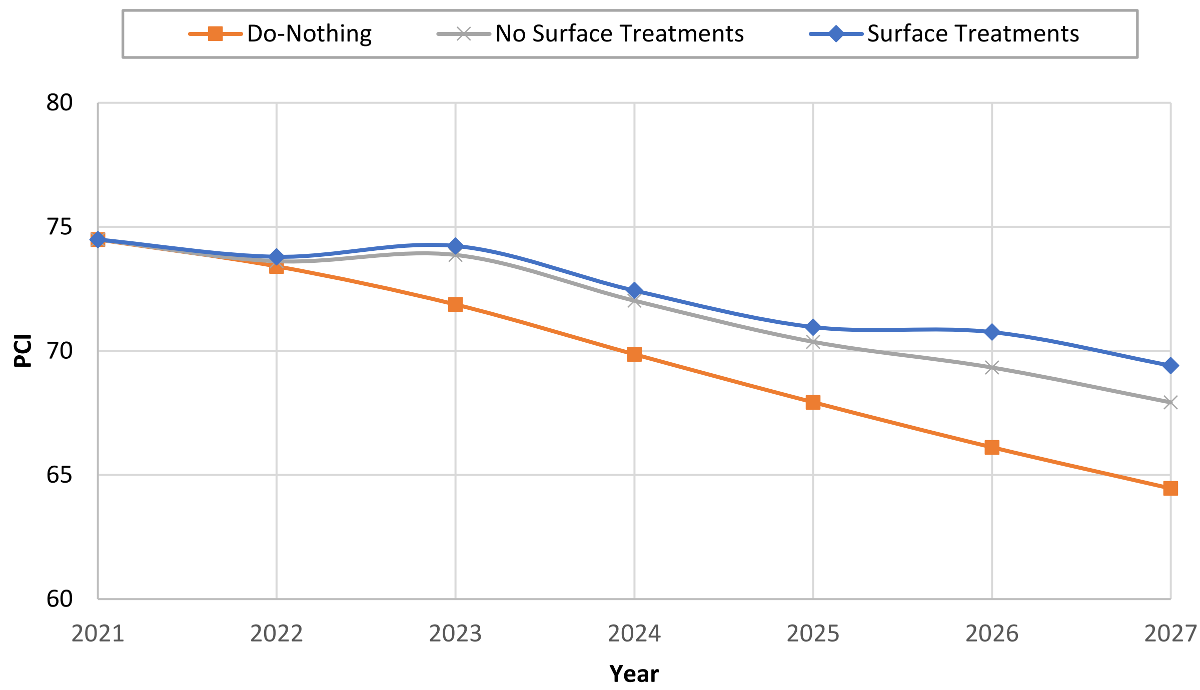


Figure 19. Change in condition for the considered scenarios

Figures 20 and 21 show the difference in budget allocation for both scenarios. Less funds are necessary in the localized and stopgap work types. This behavior is expected when properly selecting pavements that are candidates for surface treatments.

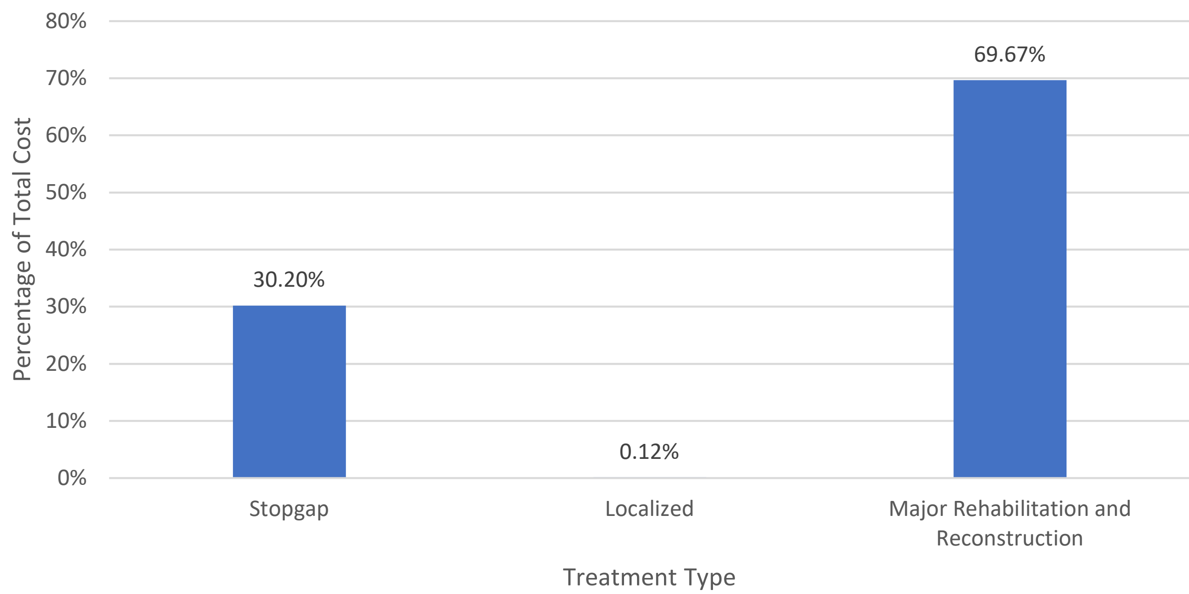


Figure 20. Funding distribution by work type (no surface treatments scenario).

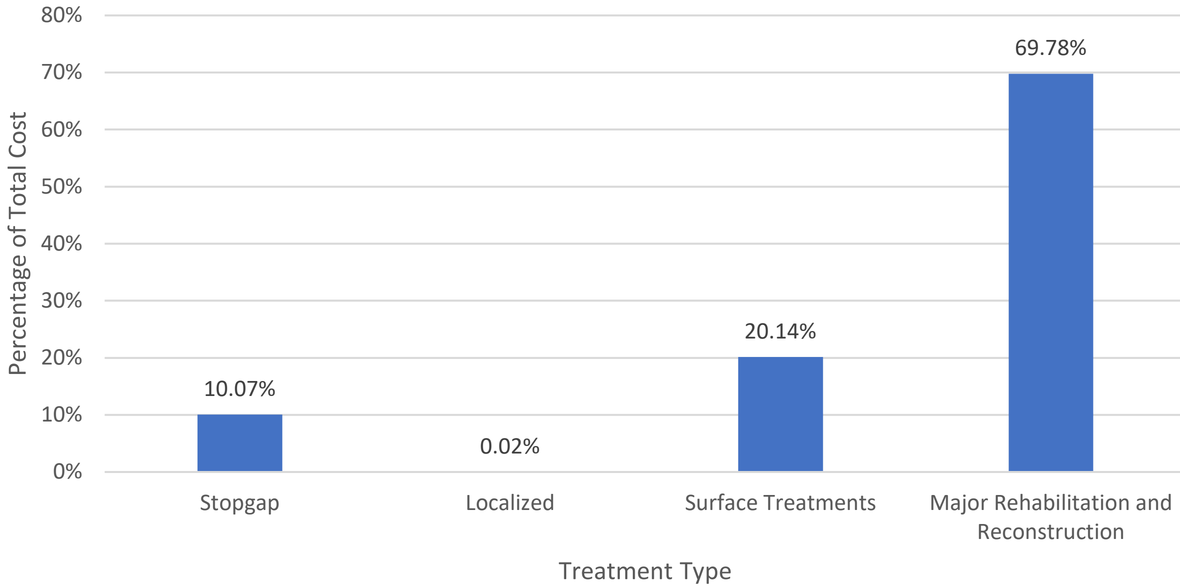


Figure 21. Funding distribution by work type (surface treatments scenario).

Table 11 summarizes the funding for the 6-year M&R plans developed based on annual funding levels of the 2022-2027 Six Year Transportation Improvement Program. For each plan, the preliminary recommendations produced through the PAVER analysis were closely evaluated and customized to maximize the pavement network condition. The analysis indicates that approximately $11.7 million without the use of surface treatments or $9.2 million including surface treatments is needed over the next 6 years, starting in 2022, to maintain the current condition. However, if the recommended work plan for the 2022-2027 Six Year Transportation Improvement Program budget is implemented (including surface treatments), the area-weighted network average PCI will only drop 5 points to a 69. A map for each of these M&R plans is provided in Appendix D.

Table 11. Allocated funds by rehabilitation activities (2022-2027 Six Year Transportation Improvement Program).

Year	Treatment Type				
	Stopgap	**Localized**	**Surface Treatments**	**Major Rehabilitation and Reconstruction**	**Total**
No Surface Treatments (See Appendix D1)					
2022	$73,017	$1,981	$0	$167,505	$242,503
2023	$47,899	$98	$0	$110,169	$158,166
2024	$0	$0	$0	$1,250,000	$1,250,000
2025	$47,943	$57	$0	$107,488	$155,488
2026	$307,029	$0	$0	$713,917	$1,020,945
2027	$47,993	$5	$0	$109,324	$157,321
Total	$523,880	$2,140	$0	$2,458,403	$2,984,423
Surface Treatments (See Appendix D2)					
2022	$24,820	$175	$49,722	$167,505	$242,222
2023	$15,984	$15	$31,529	$110,169	$157,698
2024	$0	$0	$0	$1,250,000	$1,250,000
2025	$15,980	$19	$31,940	$107,488	$155,428
2026	$102,344	$0	$204,684	$711,867	$1,018,896
2027	$15,999	$0	$31,151	$111,911	$159,061
Total	$175,128	$210	$349,026	$2,458,940	$2,983,304

City's Current M&R Approach

The City has considered an M&R program that funds localized maintenance such as patching and crack sealing during even years and larger rehabilitation such as mill and overlays and reconstruction on odd years. The plan is to devote a low percentage of their budget during even years and carry over the remaining funds to address larger projects during odd years gaining more competition and potentially lower project unit prices.

A 6-year M&R plan was modeled in PAVER for the 2022-2027 Six-Year Transportation Improvement Program budget. As optimized from previous scenarios, approximately a third of the yearly budget in odd years is assigned to localized maintenance, two thirds assigned to surface treatments, and the entire budget used in even years for rehabilitation and reconstruction projects. Figure 22 shows the results of this analysis.

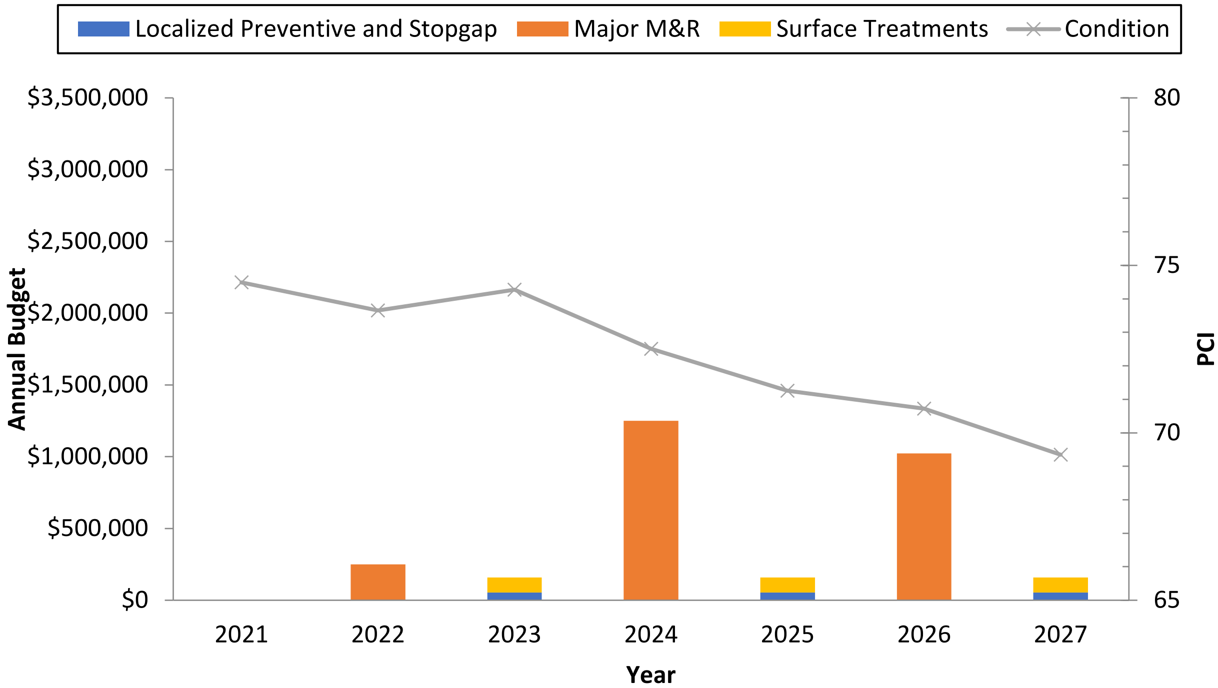


Figure 22. Funding distribution and change in condition.

The analysis indicates that, over the next 6 years, maintaining the City's current approach will have a similar outcome of the recommended M&R program using PAVER's budget optimization. The overall area-weighted average network condition will have a 5-point drop to a PCI of 69. It is noteworthy to mention that PAVER does not consider economies of scale. Contractors are more likely to lower the unit costs for larger projects, allowing for other projects to be targeted during the odd years. A map of this M&R plan is provided in Appendix D3.

An alternative funding scenario was evaluated to determine the project types that would be required to achieve a network average PCI of 76. This scenario would achieve the target established by a previous City council. The evaluation considered rehabilitation, stopgap, and preventive maintenance project types. Rehabilitation projects are the majority of those required in this scenario to achieve the goal as shown in figure 23.

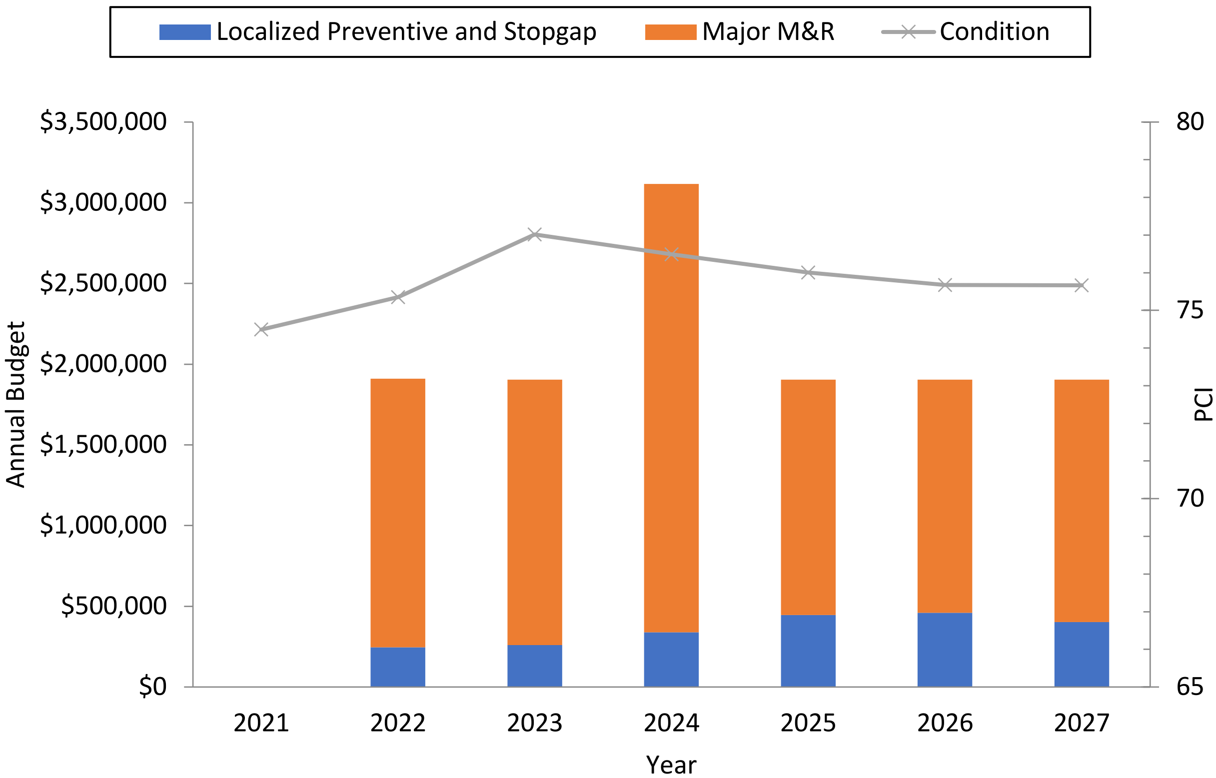


Figure 23. Funding distribution and change in condition to reach a PCI of 76.

SUMMARY AND RECOMMENDATIONS

The City of Newcastle hired APTech to survey their arterial and collector roads network, update their pavement management system, and develop a maintenance and rehabilitation plan. This update included conducting a needs assessment, determining the impact of pavement life due to treatment application, providing recommendations for distribution of the annual pavement maintenance budget, and helping prioritize pavement M&R needs for future years.

In August 2021, APTech inspected the City's maintained arterial and collector roads network which is comprised of approximately 10 centerline-miles of roadway pavement. The 2021 area-weighted PCI calculated for the City of Newcastle is 74, based on 520 pavement sections (77 sections were inspected, the conditions of the remaining 443 are projected based on their 2019 condition and their corresponding performance models). It is noteworthy to mention that during the 2021 survey, a decline in the condition compared to the 2019 survey was observed. Due to heavier traffic loads on arterial and collector roads, a number of sections have begun to show structural distresses that adversely affect the PCI. The following summarizes the findings from analyzing the PCI data and M&R planning scenarios:

- If no funding is provided for pavement maintenance and rehabilitation, the pavement network is expected to deteriorate from a 2021 area-weighted PCI of 74 to a PCI of 64 by 2027.
- Based on the results of the PAVER constrained funding analysis and 2022-2027 Six-Year Transportation Improvement Program budget, a recommended/optimal rehabilitation plan was developed. If the recommended/optimal rehabilitation and maintenance plan (including surface treatments) is followed, the PCI is projected to decline to 69 in 2027.
- Addressing needs identified on the pavement maintenance and preservation plan is expected to reduce the rate of deterioration on the selected pavement sections identified and delay the need for major rehabilitation activities.
- The process employed during the 2021 distress survey is in accordance with ASTM D6433 standards, which allows it to be replicated in the future. It is recommended to continue to perform automated or manual systemwide PCI surveys in 2 to 4-year intervals. Considering the overall condition of the pavement network, it is recommended that a similar PCI inspection of all City-owned routes occur in 2023 and that work history information in the PAVER database be updated upon completion of a project.
- Based on the cost effectiveness and increased levels of service that can result, it is recommended that the City include surface treatments such as slurry seal and micro surface in their future M&R plans. Other agencies in the area have seen success in their use after gaining familiarity with their application.

APPENDIX A – 2021 ARTERIAL AND COLLECTOR ROADS PCI AND EXTRAPOLATED DISTRESSES

Branch ID	Section ID	Surface Type	Area	PCI	Distress Description	Unit	Extrapolated Distress Quantity			
							Low Severity	Medium Severity	High Severity	No Severity
116THAVESE	000013-040	AAC	7,190	45	ALLIGATOR CRACKING	ft²		246		
116THAVESE	000013-040	AAC	7,190	45	ALLIGATOR CRACKING	ft²	345			
116THAVESE	000013-040	AAC	7,190	45	L&T CRACKING	ft	66			
116THAVESE	000013-040	AAC	7,190	45	PATCH/UTILITY CUT	ft²		10		
116THAVESE	000013-040	AAC	7,190	45	PATCH/UTILITY CUT	ft²	1,024			
116THAVESE	000013-040	AAC	7,190	45	RAVELING	ft²		49		
116THAVESE	000013-040	AAC	7,190	45	WEATHERING	ft²		3,034		
116THAVESE	000013-040	AAC	7,190	45	WEATHERING	ft²	3,083			
116THAVESE	000013-050	AAC	3,093	55	ALLIGATOR CRACKING	ft²		18		
116THAVESE	000013-050	AAC	3,093	55	ALLIGATOR CRACKING	ft²	144			
116THAVESE	000013-050	AAC	3,093	55	L&T CRACKING	ft	54			
116THAVESE	000013-050	AAC	3,093	55	PATCH/UTILITY CUT	ft²	594			
116THAVESE	000013-050	AAC	3,093	55	RAVELING	ft²		9		
116THAVESE	000013-050	AAC	3,093	55	WEATHERING	ft²	1,245			
116THAVESE	000013-050	AAC	3,093	55	WEATHERING	ft²		1,245		
116THAVESE	000013-060	AAC	6,028	43	ALLIGATOR CRACKING	ft²		307		
116THAVESE	000013-060	AAC	6,028	43	ALLIGATOR CRACKING	ft²	338			
116THAVESE	000013-060	AAC	6,028	43	L&T CRACKING	ft	46			
116THAVESE	000013-060	AAC	6,028	43	PATCH/UTILITY CUT	ft²	875			
116THAVESE	000013-060	AAC	6,028	43	RAVELING	ft²		61		
116THAVESE	000013-060	AAC	6,028	43	WEATHERING	ft²		2,515		
116THAVESE	000013-060	AAC	6,028	43	WEATHERING	ft²	2,577			
116THAVESE	000013-070	AAC	11,086	37	ALLIGATOR CRACKING	ft²	527			
116THAVESE	000013-070	AAC	11,086	37	ALLIGATOR CRACKING	ft²		2,107		
116THAVESE	000013-070	AAC	11,086	37	L&T CRACKING	ft	158			
116THAVESE	000013-070	AAC	11,086	37	RAVELING	ft²		105		
116THAVESE	000013-070	AAC	11,086	37	WEATHERING	ft²		5,464		
116THAVESE	000013-070	AAC	11,086	37	WEATHERING	ft²	5,543			
116THAVESE	000013-080	AC	8,591	37	ALLIGATOR CRACKING	ft²		185		

Branch ID	Section ID	Surface Type	Area	PCI	Distress Description	Unit	Extrapolated Distress Quantity			
							Low Severity	Medium Severity	High Severity	No Severity
116THAVESE	000013-080	AC	8,591	37	ALLIGATOR CRACKING	ft²	831			
116THAVESE	000013-080	AC	8,591	37	L&T CRACKING	ft		462		
116THAVESE	000013-080	AC	8,591	37	PATCH/UTILITY CUT	ft²	1,293			
116THAVESE	000013-080	AC	8,591	37	RAVELING	ft²		55		
116THAVESE	000013-080	AC	8,591	37	WEATHERING	ft²		7,242		
116THAVESE	000013-090	AC	7,148	75	L&T CRACKING	ft	16			
116THAVESE	000013-090	AC	7,148	75	PATCH/UTILITY CUT	ft²	1,414			
116THAVESE	000013-090	AC	7,148	75	WEATHERING	ft²	5,734			
116THAVESE	000013-100	AC	14,609	82	ALLIGATOR CRACKING	ft²	493			
116THAVESE	000013-100	AC	14,609	82	L&T CRACKING	ft	33			
116THAVESE	000013-100	AC	14,609	82	WEATHERING	ft²	14,609			
116THAVESE	000013-110	AC	15,532	37	ALLIGATOR CRACKING	ft²		1,183		
116THAVESE	000013-110	AC	15,532	37	ALLIGATOR CRACKING	ft²	2,958			
116THAVESE	000013-110	AC	15,532	37	L&T CRACKING	ft		158		
116THAVESE	000013-110	AC	15,532	37	WEATHERING	ft²		15,532		
116THAVESE	000013-120	AC	10,694	38	ALLIGATOR CRACKING	ft²	1,494			
116THAVESE	000013-120	AC	10,694	38	ALLIGATOR CRACKING	ft²		1,718		
116THAVESE	000013-120	AC	10,694	38	WEATHERING	ft²		10,694		
132NDPLSE	000045-040	AC	2,132	95	L&T CRACKING	ft	5			
132NDPLSE	000045-040	AC	2,132	95	WEATHERING	ft²	2,132			
68THSTSE	000078-010	AC	6,579	95	WEATHERING	ft²	6,579			
76THSTSE	000095-010	AAC	7,039	58	ALLIGATOR CRACKING	ft²	140			
76THSTSE	000095-010	AAC	7,039	58	ALLIGATOR CRACKING	ft²		211		
76THSTSE	000095-010	AAC	7,039	58	L&T CRACKING	ft		53		
76THSTSE	000095-010	AAC	7,039	58	L&T CRACKING	ft	176			
76THSTSE	000095-010	AAC	7,039	58	RUTTING	ft²	35			
76THSTSE	000095-010	AAC	7,039	58	WEATHERING	ft²	7,039			
76THSTSE	000095-020	AAC	3,090	59	ALLIGATOR CRACKING	ft²		40		
76THSTSE	000095-020	AAC	3,090	59	ALLIGATOR CRACKING	ft²	119			

Branch ID	Section ID	Surface Type	Area	PCI	Distress Description	Unit	Extrapolated Distress Quantity			
							Low Severity	Medium Severity	High Severity	No Severity
76THSTSE	000095-020	AAC	3,090	59	L&T CRACKING	ft	297			
76THSTSE	000095-020	AAC	3,090	59	WEATHERING	ft^2	3,090			
76THSTSE	000095-030	AAC	7,827	77	ALLIGATOR CRACKING	ft^2		30		
76THSTSE	000095-030	AAC	7,827	77	ALLIGATOR CRACKING	ft^2	108			
76THSTSE	000095-030	AAC	7,827	77	L&T CRACKING	ft	394			
76THSTSE	000095-030	AAC	7,827	77	PATCH/UTILITY CUT	ft^2	25			
76THSTSE	000095-030	AAC	7,827	77	WEATHERING	ft^2	7,827			
76THSTSE	000095-040	AAC	3,205	85	ALLIGATOR CRACKING	ft^2	30			
76THSTSE	000095-040	AAC	3,205	85	L&T CRACKING	ft	80			
76THSTSE	000095-040	AAC	3,205	85	WEATHERING	ft^2	3,205			
76THSTSE	000095-050	AAC	3,919	64	ALLIGATOR CRACKING	ft^2		40		
76THSTSE	000095-050	AAC	3,919	64	ALLIGATOR CRACKING	ft^2	180			
76THSTSE	000095-050	AAC	3,919	64	L&T CRACKING	ft	100			
76THSTSE	000095-050	AAC	3,919	64	WEATHERING	ft^2	3,919			
76THSTSE	000095-060	AAC	3,170	62	ALLIGATOR CRACKING	ft^2	305			
76THSTSE	000095-060	AAC	3,170	62	BLEEDING	ft^2	26			
76THSTSE	000095-060	AAC	3,170	62	L&T CRACKING	ft		41		
76THSTSE	000095-060	AAC	3,170	62	PATCH/UTILITY CUT	ft^2	81			
76THSTSE	000095-060	AAC	3,170	62	WEATHERING	ft^2		3,170		
76THSTSE	000095-070	AAC	10,217	41	ALLIGATOR CRACKING	ft^2		190		
76THSTSE	000095-070	AAC	10,217	41	ALLIGATOR CRACKING	ft^2	1,422			
76THSTSE	000095-070	AAC	10,217	41	L&T CRACKING	ft	142			
76THSTSE	000095-070	AAC	10,217	41	PATCH/UTILITY CUT	ft^2	95			
76THSTSE	000095-070	AAC	10,217	41	RUTTING	ft^2	522			
76THSTSE	000095-070	AAC	10,217	41	WEATHERING	ft^2		10,217		
COALCREEK	000143-010	AC	27,474	76	ALLIGATOR CRACKING	ft^2	582			
COALCREEK	000143-010	AC	27,474	76	L&T CRACKING	ft	194			
COALCREEK	000143-010	AC	27,474	76	WEATHERING	ft^2		27,474		
COALCREEK	000143-020	AAC	37,144	70	ALLIGATOR CRACKING	ft^2	1,793			

Branch ID	Section ID	Surface Type	Area	PCI	Distress Description	Unit	Extrapolated Distress Quantity			
							Low Severity	Medium Severity	High Severity	No Severity
COALCREEK	000143-020	AAC	37,144	70	L&T CRACKING	ft	558			
COALCREEK	000143-020	AAC	37,144	70	WEATHERING	ft²		37,144		
COALCREEK	000143-030	AAC	82,600	72	ALLIGATOR CRACKING	ft²	3,701			
COALCREEK	000143-030	AAC	82,600	72	L&T CRACKING	ft	168			
COALCREEK	000143-030	AAC	82,600	72	WEATHERING	ft²		82,600		
COALCREEK	000143-040	AAC	70,447	73	ALLIGATOR CRACKING	ft²	2,794			
COALCREEK	000143-040	AAC	70,447	73	L&T CRACKING	ft	268			
COALCREEK	000143-040	AAC	70,447	73	WEATHERING	ft²		70,447		
COALCREEK	000143-050	AAC	28,656	74	ALLIGATOR CRACKING	ft²		28		
COALCREEK	000143-050	AAC	28,656	74	ALLIGATOR CRACKING	ft²	788			
COALCREEK	000143-050	AAC	28,656	74	L&T CRACKING	ft	165			
COALCREEK	000143-050	AAC	28,656	74	WEATHERING	ft²		28,656		
COALCREEK	000143-060	AAC	68,176	71	ALLIGATOR CRACKING	ft²		138		
COALCREEK	000143-060	AAC	68,176	71	ALLIGATOR CRACKING	ft²	2,839			
COALCREEK	000143-060	AAC	68,176	71	L&T CRACKING	ft	277			
COALCREEK	000143-060	AAC	68,176	71	WEATHERING	ft²		68,176		
COALCREEK	000143-070	AAC	68,829	65	ALLIGATOR CRACKING	ft²		302		
COALCREEK	000143-070	AAC	68,829	65	ALLIGATOR CRACKING	ft²	4,443			
COALCREEK	000143-070	AAC	68,829	65	L&T CRACKING	ft	345			
COALCREEK	000143-070	AAC	68,829	65	WEATHERING	ft²		68,829		
COALCREEK	000143-080	AAC	68,055	63	ALLIGATOR CRACKING	ft²		1,347		
COALCREEK	000143-080	AAC	68,055	63	ALLIGATOR CRACKING	ft²	4,056			
COALCREEK	000143-080	AAC	68,055	63	L&T CRACKING	ft	322			
COALCREEK	000143-080	AAC	68,055	63	WEATHERING	ft²		68,055		
COALCREEK	000143-090	AAC	45,103	46	ALLIGATOR CRACKING	ft²		1,622		
COALCREEK	000143-090	AAC	45,103	46	ALLIGATOR CRACKING	ft²	5,492			
COALCREEK	000143-090	AAC	45,103	46	L&T CRACKING	ft	558			
COALCREEK	000143-090	AAC	45,103	46	WEATHERING	ft²		45,103		
COALCREEK	000143-100	AC	10,154	72	ALLIGATOR CRACKING	ft²	370			

Branch ID	Section ID	Surface Type	Area	PCI	Distress Description	Unit	Extrapolated Distress Quantity			
							Low Severity	Medium Severity	High Severity	No Severity
COALCREEK	000143-100	AC	10,154	72	L&T CRACKING	ft	159			
COALCREEK	000143-100	AC	10,154	72	WEATHERING	ft²		10,154		
LKWSHGTNBD	000145-010	AC	49,292	42	ALLIGATOR CRACKING	ft²		974		
LKWSHGTNBD	000145-010	AC	49,292	42	ALLIGATOR CRACKING	ft²	5,916			
LKWSHGTNBD	000145-010	AC	49,292	42	BLOCK CRACKING	ft²		1,549		
LKWSHGTNBD	000145-010	AC	49,292	42	BLOCK CRACKING	ft²	31,088			
LKWSHGTNBD	000145-010	AC	49,292	42	PATCH/UTILITY CUT	ft²	494			
LKWSHGTNBD	000145-010	AC	49,292	42	WEATHERING	ft²		48,798		
LKWSHGTNBD	000145-020	AC	23,420	40	ALLIGATOR CRACKING	ft²		171		
LKWSHGTNBD	000145-020	AC	23,420	40	ALLIGATOR CRACKING	ft²	3,412			
LKWSHGTNBD	000145-020	AC	23,420	40	BLOCK CRACKING	ft²	18,736			
LKWSHGTNBD	000145-020	AC	23,420	40	PATCH/UTILITY CUT	ft²	23			
LKWSHGTNBD	000145-020	AC	23,420	40	SWELL	ft²			34	
LKWSHGTNBD	000145-020	AC	23,420	40	SWELL	ft²		57		
LKWSHGTNBD	000145-020	AC	23,420	40	WEATHERING	ft²		23,397		
MAYCREEKPK	000147-120	AC	27,839	85	ALLIGATOR CRACKING	ft²	63			
MAYCREEKPK	000147-120	AC	27,839	85	L&T CRACKING	ft	190			
MAYCREEKPK	000147-120	AC	27,839	85	PATCH/UTILITY CUT	ft²	310			
MAYCREEKPK	000147-120	AC	27,839	85	RAVELING	ft²			63	
MAYCREEKPK	000147-120	AC	27,839	85	WEATHERING	ft²		13,530		
MAYCREEKPK	000147-120	AC	27,839	85	WEATHERING	ft²	13,935			
MAYCREEKPK	000147-130	AC	45,395	75	ALLIGATOR CRACKING	ft²	726			
MAYCREEKPK	000147-130	AC	45,395	75	L&T CRACKING	ft	2,361			
MAYCREEKPK	000147-130	AC	45,395	75	WEATHERING	ft²	11,349			
MAYCREEKPK	000147-130	AC	45,395	75	WEATHERING	ft²		34,046		
MAYCREEKPK	000147-140	AAC	3,100	72	ALLIGATOR CRACKING	ft²	50			
MAYCREEKPK	000147-140	AAC	3,100	72	L&T CRACKING	ft	210			
MAYCREEKPK	000147-140	AAC	3,100	72	PATCH/UTILITY CUT	ft²	30			
MAYCREEKPK	000147-140	AAC	3,100	72	WEATHERING	ft²	620			

Branch ID	Section ID	Surface Type	Area	PCI	Distress Description	Unit	Extrapolated Distress Quantity			
							Low Severity	Medium Severity	High Severity	No Severity
MAYCREEKPK	000147-140	AAC	3,100	72	WEATHERING	ft²		2,480		
MAYCREEKPK	000147-150	AAC	8,630	70	ALLIGATOR CRACKING	ft²	447			
MAYCREEKPK	000147-150	AAC	8,630	70	L&T CRACKING	ft	26			
MAYCREEKPK	000147-150	AAC	8,630	70	WEATHERING	ft²		8,630		
NWCSTLCMWY	000153-010	AC	16,090	95	WEATHERING	ft²	16,090			
NWCSTLCMWY	000153-020	PCC	2,757	100	JOINT SPALLING	slabs	1			
NWCSTLCMWY	000153-030	AC	10,620	92	PATCH/UTILITY CUT	ft²	256			
NWCSTLCMWY	000153-030	AC	10,620	92	WEATHERING	ft²	10,364			
NWCSTLCMWY	000153-040	AC	43,701	95	WEATHERING	ft²	43,701			
NWCSTLGFCB	000149-010	AAC	53,133	91	ALLIGATOR CRACKING	ft²	234			
NWCSTLGFCB	000149-010	AAC	53,133	91	WEATHERING	ft²	53,133			
NWCSTLGFCB	000149-020	AAC	19,746	61	ALLIGATOR CRACKING	ft²		151		
NWCSTLGFCB	000149-020	AAC	19,746	61	ALLIGATOR CRACKING	ft²	1,549			
NWCSTLGFCB	000149-020	AAC	19,746	61	L&T CRACKING	ft	756			
NWCSTLGFCB	000149-020	AAC	19,746	61	WEATHERING	ft²		5,924		
NWCSTLGFCB	000149-020	AAC	19,746	61	WEATHERING	ft²	13,822			
NWCSTLGFCB	000149-030	AAC	32,731	66	ALLIGATOR CRACKING	ft²		317		
NWCSTLGFCB	000149-030	AAC	32,731	66	ALLIGATOR CRACKING	ft²	2,244			
NWCSTLGFCB	000149-030	AAC	32,731	66	L&T CRACKING	ft	686			
NWCSTLGFCB	000149-030	AAC	32,731	66	PATCH/UTILITY CUT	ft²	84			
NWCSTLGFCB	000149-030	AAC	32,731	66	WEATHERING	ft²		12,470		
NWCSTLGFCB	000149-030	AAC	32,731	66	WEATHERING	ft²	20,229			
NWCSTLGFCB	000149-040	AAC	108,201	92	L&T CRACKING	ft	140			
NWCSTLGFCB	000149-040	AAC	108,201	92	PATCH/UTILITY CUT	ft²	740			
NWCSTLGFCB	000149-040	AAC	108,201	92	WEATHERING	ft²		10,846		
NWCSTLGFCB	000149-040	AAC	108,201	92	WEATHERING	ft²	96,615			
NWCSTLGFCB	000149-050	AAC	66,714	95	L&T CRACKING	ft	36			
NWCSTLGFCB	000149-050	AAC	66,714	95	WEATHERING	ft²	66,714			
NWCSTLGFCB	000149-060	AAC	14,215	94	L&T CRACKING	ft	61			

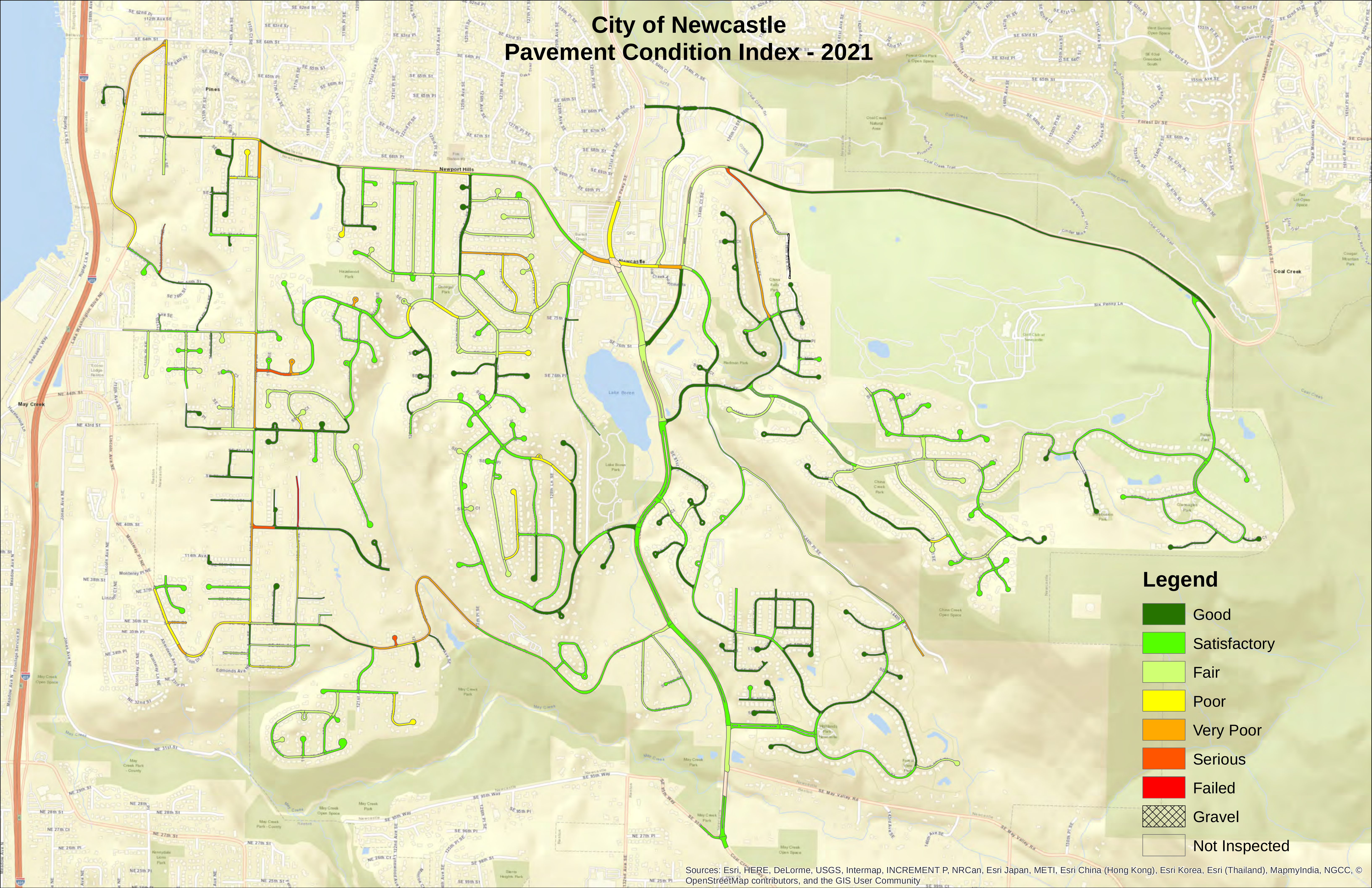
Branch ID	Section ID	Surface Type	Area	PCI	Distress Description	Unit	Extrapolated Distress Quantity			
							Low Severity	Medium Severity	High Severity	No Severity
NWCSTLGFCB	000149-060	AAC	14,215	94	WEATHERING	ft²	14,215			
NWCSTLWAY	000150-010	AC	11,003	100	NO DISTRESS					
NWCSTLWAY	000150-020	AC	4,122	56	ALLIGATOR CRACKING	ft²		30		
NWCSTLWAY	000150-020	AC	4,122	56	ALLIGATOR CRACKING	ft²	280			
NWCSTLWAY	000150-020	AC	4,122	56	L&T CRACKING	ft	30			
NWCSTLWAY	000150-020	AC	4,122	56	PATCH/UTILITY CUT	ft²	440			
NWCSTLWAY	000150-020	AC	4,122	56	WEATHERING	ft²		3,682		
NWCSTLWAY	000150-030	AC	6,028	55	ALLIGATOR CRACKING	ft²		50		
NWCSTLWAY	000150-030	AC	6,028	55	ALLIGATOR CRACKING	ft²	656			
NWCSTLWAY	000150-030	AC	6,028	55	L&T CRACKING	ft	101			
NWCSTLWAY	000150-030	AC	6,028	55	WEATHERING	ft²		6,028		
NWCSTLWAY	000150-040	AC	9,278	44	ALLIGATOR CRACKING	ft²		582		
NWCSTLWAY	000150-040	AC	9,278	44	ALLIGATOR CRACKING	ft²	1,107			
NWCSTLWAY	000150-040	AC	9,278	44	WEATHERING	ft²		9,278		
NWCSTLWAY	000150-050	AC	21,547	87	L&T CRACKING	ft	1,128			
NWCSTLWAY	000150-050	AC	21,547	87	WEATHERING	ft²	21,547			
NWCSTLWAY	000150-060	AC	5,863	86	ALLIGATOR CRACKING	ft²	35			
NWCSTLWAY	000150-060	AC	5,863	86	L&T CRACKING	ft	222			
NWCSTLWAY	000150-060	AC	5,863	86	WEATHERING	ft²	5,863			
NWCSTLWAY	000150-070	AC	7,269	68	ALLIGATOR CRACKING	ft²	302			
NWCSTLWAY	000150-070	AC	7,269	68	L&T CRACKING	ft	436			
NWCSTLWAY	000150-070	AC	7,269	68	WEATHERING	ft²		7,269		
NWCSTLWAY	000150-080	AC	9,760	81	ALLIGATOR CRACKING	ft²	21			
NWCSTLWAY	000150-080	AC	9,760	81	L&T CRACKING	ft	86			
NWCSTLWAY	000150-080	AC	9,760	81	WEATHERING	ft²		9,760		
NWCSTLWAY	000150-090	AC	5,313	58	ALLIGATOR CRACKING	ft²		38		
NWCSTLWAY	000150-090	AC	5,313	58	ALLIGATOR CRACKING	ft²	567			
NWCSTLWAY	000150-090	AC	5,313	58	WEATHERING	ft²		5,313		
NWCSTLWAY	000150-100	AC	6,515	54	ALLIGATOR CRACKING	ft²		175		

Branch ID	Section ID	Surface Type	Area	PCI	Distress Description	Unit	Extrapolated Distress Quantity			
							Low Severity	Medium Severity	High Severity	No Severity
NWCSTLWAY	000150-100	AC	6,515	54	ALLIGATOR CRACKING	ft²	248			
NWCSTLWAY	000150-100	AC	6,515	54	L&T CRACKING	ft	466			
NWCSTLWAY	000150-100	AC	6,515	54	WEATHERING	ft²		6,515		
NWCSTLWAY	000150-110	AC	11,399	41	ALLIGATOR CRACKING	ft²		968		
NWCSTLWAY	000150-110	AC	11,399	41	ALLIGATOR CRACKING	ft²	1,211			
NWCSTLWAY	000150-110	AC	11,399	41	L&T CRACKING	ft	726			
NWCSTLWAY	000150-110	AC	11,399	41	WEATHERING	ft²		11,399		
NWCSTLWAY	000150-120	AC	16,917	82	ALLIGATOR CRACKING	ft²	134			
NWCSTLWAY	000150-120	AC	16,917	82	WEATHERING	ft²		16,917		
NWCSTLWAY	000150-130	AAC	39,700	79	ALLIGATOR CRACKING	ft²		40		
NWCSTLWAY	000150-130	AAC	39,700	79	ALLIGATOR CRACKING	ft²	883			
NWCSTLWAY	000150-130	AAC	39,700	79	L&T CRACKING	ft	1,191			
NWCSTLWAY	000150-130	AAC	39,700	79	WEATHERING	ft²		2,265		
NWCSTLWAY	000150-130	AAC	39,700	79	WEATHERING	ft²	37,435			
NWCSTLWAY	000150-140	AAC	19,982	39	ALLIGATOR CRACKING	ft²	1,620			
NWCSTLWAY	000150-140	AAC	19,982	39	ALLIGATOR CRACKING	ft²		1,696		
NWCSTLWAY	000150-140	AAC	19,982	39	L&T CRACKING	ft	648			
NWCSTLWAY	000150-140	AAC	19,982	39	PATCH/UTILITY CUT	ft²	2,440			
NWCSTLWAY	000150-140	AAC	19,982	39	WEATHERING	ft²		17,924		
NWCSTLWAY	000150-150	AAC	23,966	49	ALLIGATOR CRACKING	ft²		1,206		
NWCSTLWAY	000150-150	AAC	23,966	49	ALLIGATOR CRACKING	ft²	1,608			
NWCSTLWAY	000150-150	AAC	23,966	49	DEPRESSION	ft²		43		
NWCSTLWAY	000150-150	AAC	23,966	49	L&T CRACKING	ft	482			
NWCSTLWAY	000150-150	AAC	23,966	49	PATCH/UTILITY CUT	ft²	2,412			
NWCSTLWAY	000150-150	AAC	23,966	49	WEATHERING	ft²		21,554		
NWCSTLWAY	000150-160	AAC	14,761	33	ALLIGATOR CRACKING	ft²	2,263			
NWCSTLWAY	000150-160	AAC	14,761	33	ALLIGATOR CRACKING	ft²		3,238		
NWCSTLWAY	000150-160	AAC	14,761	33	PATCH/UTILITY CUT	ft²	683			
NWCSTLWAY	000150-160	AAC	14,761	33	RUTTING	ft²		209		

Branch ID	Section ID	Surface Type	Area	PCI	Distress Description	Unit	Extrapolated Distress Quantity			
							Low Severity	Medium Severity	High Severity	No Severity
NWCSTLWAY	000150-160	AAC	14,761	33	WEATHERING	ft²		14,078		

APPENDIX B – PCI MAP

City of Newcastle
Pavement Condition Index - 2021



Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

APPENDIX C– CURRENT AND FORECASTED PCI

The following table provides PCI values for each section defined in the City's road network. The PCI values for 2021 are based on either conditions measured during the most recent pavement inspection or predicted from the PCI assigned in 2019. The reported PCIs for 2022 to 2027 are predicted PCI values assuming no major M&R except the 2024 Overlay plan is carried out within this time period. The PCI values for all years reported in this table are shaded according to the following PCI scale:

0-10	FAILED
11-25	SERIOUS
26-40	VERY POOR
41-55	POOR
56-70	FAIR
71-85	SATISFACTORY
86-100	GOOD

Branch ID	Section ID	Surface	Functional Classification	Inspected	Projected						
				2021	2021	2022	2023	2024	2025	2026	2027
111THPLSE	000003-010	AC	E		63	63	61	59	58	56	54
111THPLSE	000003-020	AC	E		84	83	82	81	80	79	79
112THAVESE	000004-010	PCC	E		70	70	66	62	59	55	51
112THAVESE	000004-020	AC	E		24	24	22	20	19	17	15
112THAVESE	000004-030	AC	E		55	55	53	51	50	48	46
112THAVESE	000004-040	AC	B	58		58	57	100	100	98	96
112THAVESE	000004-050	AC	B	44		43	39	100	100	98	96
112THAVESE	000004-060	AC	B	48		47	43	100	100	98	96
113THAVESE	000005-010	AC	E		81	81	80	79	79	79	78
113THAVESE	000005-020	AC	E		81	81	80	79	79	78	78
113THAVESE	000005-030	AC	E		90	89	87	85	84	82	81
113THAVESE	000005-040	AC	E		90	89	87	85	84	82	81
113THAVESE	000005-050	AC	E		78	78	78	78	78	78	78
113THAVESE	000005-060	AC	E		69	68	67	65	63	61	59
113THAVESE	000005-070	AC	E		57	57	55	53	52	50	48
114THAVESE	000007-010	AC	E		89	88	86	85	83	82	81
114THAVESE	000007-020	AC	E		95	95	93	91	89	87	85
114THAVESE	000007-030	AC	E		88	87	86	84	82	81	80
114THAVESE	000007-040	AC	E		86	86	84	83	81	80	79
114THCTSE	000008-010	AC	E		60	60	58	56	55	53	51
114THPLSE	000009-010	AC	E		85	85	83	82	81	80	79
115THAVESE	000010-010	AC	E		59	59	57	55	54	52	50
115THAVESE	000010-020	AC	E		46	46	44	42	41	39	37
115THCTSE	000011-010	AC	E		86	86	84	83	81	80	79
115THCTSE	000011-020	AC	E		88	87	86	84	82	81	80
115THCTSE	000011-030	AC	E		88	87	86	84	82	81	80
115THCTSE	000011-040	AC	E		88	87	86	84	82	81	80
115THPLSE	000012-010	AC	E		89	88	86	85	83	82	81
115THPLSE	000012-020	AC	E		53	53	51	49	48	46	44
116THAVESE	000013-010	AC	E		84	83	82	81	80	79	79
116THAVESE	000013-020	AC	E		84	83	82	81	80	79	79
116THAVESE	000013-030	AC	E		90	89	87	85	84	82	81
116THAVESE	000013-040	AAC	B	45		44	39	32	24	16	9
116THAVESE	000013-050	AAC	B	55		55	54	53	52	50	48
116THAVESE	000013-060	AAC	B	43		41	36	29	20	13	6
116THAVESE	000013-070	AAC	B	37		35	27	19	12	5	0
116THAVESE	000013-080	AC	B	37		35	27	19	12	5	0
116THAVESE	000013-090	AC	B	75		74	71	68	65	63	61
116THAVESE	000013-100	AC	B	82		81	77	74	70	67	65
116THAVESE	000013-110	AC	B	37		35	27	19	12	5	0
116THAVESE	000013-120	AC	B	38		36	29	20	13	6	0
116THAVESE	000013-130	AC	B	57		57	56	100	100	98	96
116THAVESE	000013-140	AC	B	60		60	59	100	100	98	96
116THAVESE	000013-150	AC	B	40		38	32	100	100	98	96
116THCTSE	000014-010	AAC	E		71	71	69	67	65	63	61
117THAVESE	000015-010	AC	E		73	73	71	69	67	65	63
117THAVESE	000015-020	AC	E		78	78	78	78	78	78	78
117THAVESE	000015-030	AC	E		94	94	91	89	87	85	84
117THAVESE	000015-040	AC	E		88	87	86	84	82	81	80
117THCTSE	000016-010	AAC	E		35	35	33	31	30	28	26
117THPLSE	000017-010	AC	E		91	90	88	86	85	83	82
117THPLSE	000017-020	AC	E		81	81	80	79	79	79	78
118THAVESE	000018-010	AC	E		81	81	80	79	79	79	78
118THAVESE	000018-020	AC	E		84	84	83	81	80	80	79
118THAVESE	000018-030	AC	E		56	56	54	52	51	49	47
118THAVESE	000018-040	AC	E		50	50	48	46	45	43	41
118THAVESE	000018-050	AC	E		0	0	0	0	0	0	0
118THAVESE	000018-060	AC	E		53	53	51	49	48	46	44
118THAVESE	000018-070	AC	E		64	64	62	60	59	57	55

Branch ID	Section ID	Surface	Functional Classification	Inspected	Projected						
				2021	2021	2022	2023	2024	2025	2026	2027
118THAVESE	000018-080	AAC	E		81	81	80	79	79	79	78
118THAVESE	000018-090	AAC	E		81	81	80	79	79	79	78
118THCTSE	000019-010	AC	E		68	68	66	64	62	60	58
118THCTSE	000019-020	AC	E		81	81	80	79	79	79	78
118THPLSE	000020-010	AC	E		76	76	75	73	70	68	67
119THAVESE	000021-010	AC	E		69	68	67	65	63	61	59
119THAVESE	000021-020	AC	E		69	68	67	65	63	61	59
119THCTSE	000022-010	AC	E		95	95	93	91	88	87	85
119THCTSE	000022-020	AC	E		39	39	37	35	34	32	30
119THPLSE	000023-010	AC	E		78	78	78	78	78	78	78
119THPLSE	000023-020	AC	E		52	52	50	48	47	45	43
119THPLSE	000023-030	AAC	E		95	95	93	91	88	87	85
120THAVESE	000024-010	AC	E		79	79	79	78	78	78	78
120THAVESE	000024-020	AC	E		56	56	54	52	51	49	47
120THPLSE	000025-010	AC	E		67	67	65	63	61	59	58
120THPLSE	000025-020	AC	E		94	94	91	89	87	85	84
120THPLSE	000025-030	AC	E		81	81	80	79	79	79	78
120THPLSE	000025-040	AAC	E		81	81	80	79	79	79	78
120THPLSE	000025-050	AAC	E		81	81	80	79	79	79	78
121STAVESE	000026-020	AC	E		81	81	80	79	79	79	78
121STAVESE	000026-030	AC	E		80	80	79	79	78	78	78
121STAVESE	000026-040	AAC	E		81	81	80	79	79	79	78
121STAVESE	000026-050	AC	E		85	85	83	82	81	80	79
121STAVESE	000026-060	AC	E		73	73	71	69	67	65	63
121STAVESE	000026-070	AC	E		80	80	79	79	78	78	78
121STPLSE	000027-010	AC	E		90	89	87	85	84	82	81
121STPLSE	000027-020	AC	E		68	68	66	64	62	60	58
121STPLSE	000027-030	AC	E		73	73	71	69	67	65	63
121STPLSE	000027-040	AC	E		70	69	68	66	64	62	60
122NDAVESE	000028-010	AC	E		81	81	80	79	79	79	78
122NDAVESE	000028-020	AC	E		73	73	71	69	67	65	63
122NDAVESE	000028-030	AC	E		66	66	64	62	61	59	57
122NDCTSE	000029-010	AC	E		22	22	20	18	17	15	13
122NDPLSE	000030-010	AC	E		53	53	51	49	48	46	44
122NDPLSE	000030-020	AAC	E		88	87	86	84	82	81	80
122NDPLSE	000030-030	AAC	E		88	87	86	84	82	81	80
122NDPLSE	000030-040	AAC	E		90	89	87	85	84	82	81
122NDPLSE	000030-050	AC	E		46	46	44	42	41	39	37
123RDAVESE	000031-010	AC	E		85	85	83	82	81	80	79
123RDAVESE	000031-020	AC	E		73	73	71	69	67	65	63
123RDAVESE	000031-030	AC	E		76	76	75	73	70	68	67
124THAVESE	000032-010	AC	E		86	86	84	83	81	80	79
125THAVESE	000033-010	AAC	E		100	99	97	95	93	91	89
125THAVESE	000033-020	AAC	E		100	99	97	95	93	91	89
125THAVESE	000033-030	AAC	E		100	99	97	95	93	91	89
125THAVESE	000033-040	AAC	E		100	99	97	95	93	91	89
125THAVESE	000033-050	AAC	E		100	99	97	95	93	91	89
125THAVESE	000033-060	AAC	E		100	99	97	95	93	91	89
125THAVESE	000033-070	AAC	E		100	99	97	95	93	91	89
125THAVESE	000033-080	AAC	E		100	99	97	95	93	91	89
125THCTSE	000034-010	AC	E		80	80	79	79	78	78	78
125THPLSE	000035-020	AC	E		65	65	63	61	60	58	56
125THPLSE	000035-030	AC	E		60	60	58	56	55	53	51
125THPLSE	000035-040	AC	E		50	50	48	46	45	43	41
125THPLSE	000035-050	AC	E		57	57	55	53	52	50	48
126THAVESE	000036-010	AC	E		81	81	80	79	79	78	78
126THAVESE	000036-020	AC	E		80	80	79	79	78	78	78
126THAVESE	000036-030	AC	E		80	80	79	79	78	78	78
126THAVESE	000036-040	AC	E		95	95	93	91	88	87	85
126THAVESE	000036-050	AC	E		95	95	93	91	88	87	85

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				2021	2021	2022	2023	2024	2025	2026	2027
126THAVESE	000036-060	AC	E		62	62	60	58	57	55	53
126THPLSE	000037-010	AC	E		78	78	78	78	78	78	78
126THPLSE	000037-020	AC	E		76	76	75	73	70	68	67
126THPLSE	000037-030	AC	E		79	79	79	78	78	78	78
126THPLSE	000037-040	AC	E		79	79	79	78	78	78	78
126THPLSE	000037-050	AC	E		62	62	60	58	57	55	53
127THAVESE	000038-010	AC	E		59	59	57	55	54	52	50
127THAVESE	000038-020	AC	E		61	61	59	57	56	54	52
127THAVESE	000038-030	AC	E		80	80	79	79	78	78	78
127THAVESE	000038-040	AC	E		79	79	78	78	78	78	78
127THAVESE	000038-050	AC	E		80	80	79	79	78	78	78
127THAVESE	000038-060	AC	E		79	79	79	78	78	78	78
127THAVESE	000038-070	AC	E		47	47	45	43	42	40	38
127THAVESE	000038-080	AC	E		65	65	63	61	60	58	56
127THPLSE	000039-010	AC	E		52	52	50	48	47	45	43
127THPLSE	000039-020	AC	E		46	46	44	42	41	39	37
127THPLSE	000039-030	AC	E		47	47	45	43	42	40	38
127THPLSE	000039-040	AC	E		52	52	50	48	47	45	43
127THPLSE	000039-050	AC	E		40	40	38	36	35	33	31
127THPLSE	000039-060	AC	E		59	59	57	55	54	52	50
127THPLSE	000039-070	AC	E		63	63	61	59	58	56	54
128THAVESE	000040-010	AAC	E		100	99	97	95	93	91	89
128THAVESE	000040-020	AAC	E		81	81	80	79	79	78	78
128THAVESE	000040-030	AC	E		71	71	69	67	65	63	61
129THAVESE	000042-010	AC	E		80	79	79	79	78	78	78
129THAVESE	000042-020	AC	E		81	81	80	79	79	79	78
129THAVESE	000042-030	AC	E		81	81	80	79	79	79	78
129THAVESE	000042-040	AAC	E		79	79	79	78	78	78	78
129THAVESE	000042-050	AC	E		79	79	79	78	78	78	78
129THAVESE	000042-060	AAC	E		95	95	93	91	88	87	85
129THAVESE	000042-070	AC	E		61	61	59	57	56	54	52
129THAVESE	000042-080	AAC	E		76	76	75	73	70	68	67
129THCTSE	000043-010	AAC	E		91	90	88	86	85	83	82
129THPLSE	000044-010	AC	E		81	81	80	79	79	79	78
129THPLSE	000044-020	AAC	E		90	89	87	85	84	82	81
129THPLSE	000044-030	AAC	E		95	95	93	91	89	87	85
129THPLSE	000044-040	AAC	E		90	89	87	85	84	82	81
130THPLSE	000152-010	AC	E		91	90	88	86	85	83	82
132NDPLSE	000045-010	AC	E		63	63	61	59	58	56	54
132NDPLSE	000045-020	AC	E		70	69	68	66	64	62	60
132NDPLSE	000045-030	AC	E		95	95	93	91	88	86	85
132NDPLSE	000045-040	AC	E	95		94	92	90	88	86	84
133RDAVESE	000046-010	AC	E		80	80	79	79	78	78	78
133RDAVESE	000046-020	AC	E		69	68	67	65	63	61	59
134THAVESE	000047-010	AAC	E		90	89	87	85	84	82	81
134THAVESE	000047-020	AC	E		73	73	71	69	67	65	63
134THAVESE	000047-030	AC	E		70	69	68	66	64	62	60
134THAVESE	000047-040	AAC	E		90	89	87	85	84	82	81
135THAVESE	000049-010	AAC	E		100	99	97	95	93	91	89
135THAVESE	000049-020	AC	E		81	81	80	79	79	79	78
135THAVESE	000049-030	AC	E		76	76	75	73	70	68	67
135THAVESE	000049-040	AC	E		61	61	59	57	56	54	52
135THAVESE	000049-050	AC	E		86	86	84	83	81	80	79
135THPLSE	000050-010	AC	E		69	68	67	65	63	61	59
135THPLSE	000050-020	AAC	E		100	99	97	95	93	91	89
135THPLSE	000050-030	AAC	E		89	88	86	85	83	82	81
135THPLSE	000050-040	AAC	E		90	89	87	85	84	82	81
136THAVESE	000051-010	AC	E		95	95	93	91	88	87	85
136THAVESE	000051-020	AC	E		84	84	83	81	80	80	79
136THAVESE	000051-030	AC	E		83	83	81	80	80	79	79

Branch ID	Section ID	Surface	Functional Classification	Inspected	Projected						
				2021	2021	2022	2023	2024	2025	2026	2027
136THAVESE	000051-040	AC	E		80	80	79	79	78	78	78
136THAVESE	000051-050	AAC	E		100	99	97	95	93	91	89
136THAVESE	000051-060	AAC	E		100	99	97	95	93	91	89
136THAVESE	000051-070	AAC	E		100	99	97	95	93	91	89
136THAVESE	000051-080	AC	E		27	27	25	23	22	20	18
136THAVESE	000051-090	AC	E		14	14	12	10	9	7	5
137THAVESE	000052-010	AC	E		88	87	86	84	82	81	80
137THAVESE	000052-020	AC	E		86	86	84	83	81	80	79
137THAVESE	000052-030	AC	E		81	81	80	79	79	78	78
137THAVESE	000052-040	AC	E		90	89	87	85	84	82	81
137THPLSE	000053-010	AC	E		81	81	80	79	79	78	78
137THPLSE	000053-020	AC	E		84	84	83	81	80	80	79
138THAVESE	000054-010	AC	E		68	68	66	64	62	60	58
138THAVESE	000054-020	AC	E		86	86	84	83	81	80	79
138THAVESE	000054-030	AC	E		80	79	79	79	78	78	78
138THAVESE	000054-040	AC	E		88	87	86	84	82	81	80
138THAVESE	000054-050	AC	E		86	86	84	83	81	80	79
138THAVESE	000054-060	AC	E		69	68	67	65	63	61	59
138THAVESE	000054-070	AC	E		79	79	79	78	78	78	78
138THAVESE	000054-080	AC	E		89	88	86	85	83	82	81
138THAVESE	000054-090	AC	E		88	87	86	84	82	81	80
138THCTSE	000055-010	AC	E		88	87	86	84	82	81	80
138THPLSE	000056-010	AC	E		88	87	86	84	82	81	80
138THPLSE	000056-020	AC	E		90	89	87	85	84	82	81
139THAVESE	000057-010	AC	E		90	89	87	85	84	82	81
139THAVESE	000057-020	AC	E		84	83	82	81	80	79	79
139THAVESE	000057-030	AC	E		88	87	86	84	82	81	80
139THAVESE	000057-040	AC	E		95	95	93	91	89	87	85
140THAVESE	000058-010	AC	E		80	80	79	79	78	78	78
140THAVESE	000058-020	AC	E		80	80	79	79	78	78	78
140THAVESE	000058-030	AC	E		90	89	87	85	84	82	81
140THAVESE	000058-040	AC	E		88	87	86	84	82	81	80
140THAVESE	000058-050	AC	E		88	87	86	84	82	81	80
141STAVESE	000059-010	PCC	E		62	61	58	54	51	47	43
142NDWAYSE	000060-010	AC	E		80	80	79	79	78	78	78
142NDWAYSE	000060-020	AC	E		69	68	67	65	63	61	59
143RDAVESE	000061-010	AC	E		90	89	87	85	84	82	81
143RDAVESE	000061-020	AC	E		79	79	79	78	78	78	78
143RDAVESE	000061-030	AC	E		81	81	80	79	79	79	78
143RDAVESE	000061-040	AC	E		78	78	78	78	78	78	78
143RDCTSE	000062-010	PCC	E		68	67	64	60	56	53	49
144THAVESE	000063-010	AC	E		80	79	79	79	78	78	78
144THAVESE	000063-020	AC	E		86	86	84	83	81	80	79
144THAVESE	000063-030	AC	E		80	80	79	79	78	78	78
144THAVESE	000063-040	AC	E		63	63	61	59	58	56	54
144THPLSE	000064-020	AC	E		29	29	27	25	24	22	20
144THPLSE	000064-030	AC	E		58	58	56	54	53	51	49
144THPLSE	000064-040	AC	E		70	69	68	66	64	62	60
145THAVESE	000065-010	AC	E		68	68	66	64	62	60	58
145THCTSE	000066-010	AC	E		80	79	79	79	78	78	78
146THPLSE	000067-010	AC	E		81	81	80	79	79	79	78
146THPLSE	000067-020	AC	E		80	80	79	79	78	78	78
146THPLSE	000067-030	AC	E		81	81	80	79	79	79	78
147THAVESE	000068-010	AC	E		79	79	79	78	78	78	78
147THAVESE	000068-020	AC	E		73	73	71	69	67	65	63
147THAVESE	000068-030	AC	E		78	78	78	78	78	78	78
148THAVESE	000069-010	AC	E		64	64	62	60	59	57	55
149THPLSE	000070-010	AC	E		88	87	86	84	82	81	80
149THPLSE	000070-020	AC	E		80	80	79	79	78	78	78
150THPLSE	000071-010	AC	E		90	89	87	85	84	82	81

Branch ID	Section ID	Surface	Functional Classification	Inspected	Projected						
				2021	2021	2022	2023	2024	2025	2026	2027
154THAVESE	000072-010	AC	E		81	81	80	79	79	79	78
154THAVESE	000072-020	AC	E		81	81	80	79	79	79	78
155THAVESE	000073-010	AC	E		81	81	80	79	79	79	78
155THAVESE	000073-020	AC	E		81	81	80	79	79	78	78
155THAVESE	000073-030	AC	E		80	80	79	79	78	78	78
155THAVESE	000073-040	AC	E		79	79	78	78	78	78	78
66THCTSE	000076-010	AC	E		88	87	86	84	82	81	80
66THSTSE	000077-010	AC	E		90	89	87	85	84	82	81
68THSTSE	000078-010	AC	B	95		94	91	87	84	80	77
69THPLSE	000079-010	AC	E		90	89	87	85	84	82	81
70THSTSE	000080-010	AC	E		48	48	46	44	43	41	39
70THSTSE	000080-020	AC	E		59	59	57	55	54	52	50
70THSTSE	000080-030	AC	E		76	76	75	73	70	68	67
70THSTSE	000080-040	AC	E		76	76	75	73	70	68	67
70THSTSE	000080-050	AC	E		61	61	59	57	56	54	52
70THSTSE	000080-060	AC	E		65	65	63	61	60	58	56
70THSTSE	000080-070	AC	E		56	56	54	52	51	49	47
71STCTSE	000081-010	AAC	E		90	89	87	85	84	82	81
71STPLSE	000082-020	AC	E		90	89	87	85	84	82	81
71STPLSE	000082-030	AAC	E		93	92	90	88	86	85	83
71STPLSE	000082-040	AC	E		89	88	86	85	83	82	81
71STSTSE	000083-010	AC	E		66	66	64	62	61	59	57
71STSTSE	000083-020	AC	E		65	65	63	61	60	58	56
71STSTSE	000083-030	AC	E		67	67	65	63	61	59	58
72NDSTSE	000084-010	AC	E		84	84	83	81	80	80	79
72NDSTSE	000084-020	AC	E		80	80	79	79	78	78	78
72NDSTSE	000084-030	AC	E		62	62	60	58	57	55	53
73RDCTSE	000085-010	AC	E		65	65	63	61	60	58	56
73RDPLSE	000086-010	AC	E		78	78	78	78	78	78	78
73RDPLSE	000086-020	AC	E		67	67	65	63	61	59	58
73RDPLSE	000086-030	AC	E		55	55	53	51	50	48	46
73RDPLSE	000086-040	AC	E		83	83	81	80	80	79	79
73RDPLSE	000086-050	AC	E		67	67	65	63	61	59	58
73RDPLSE	000086-060	AC	E		57	57	55	53	52	50	48
73RDPLSE	000086-070	AC	E		78	78	78	78	78	78	78
73RDPLSE	000086-080	AC	E		79	79	79	78	78	78	78
73RDPLSE	000086-090	AC	E		58	58	56	54	53	51	49
73RDPLSE	000086-100	AAC	E		70	69	68	66	64	62	60
73RDSTSE	000087-010	AC	E		73	73	71	69	67	65	63
73RDSTSE	000087-020	AC	E		84	83	82	81	80	79	79
73RDSTSE	000087-030	AC	E		26	26	24	22	21	19	17
73RDSTSE	000087-040	AC	E		33	33	31	29	28	26	24
73RDSTSE	000087-050	AC	E		69	68	67	65	63	61	59
74THCTSE	000088-010	AC	E		57	57	55	53	52	50	48
74THPLSE	000089-010	AC	E		78	78	78	78	78	78	78
74THSTSE	000090-010	AC	E		95	95	93	91	89	87	85
74THSTSE	000090-020	AC	E		58	58	56	54	53	51	49
74THSTSE	000090-030	AC	E		54	54	52	50	49	47	45
74THSTSE	000090-040	AC	E		65	65	63	61	60	58	56
74THSTSE	000090-050	AC	E		58	58	56	54	53	51	49
75THPLSE	000091-010	AAC	E		81	81	80	79	79	79	78
75THPLSE	000091-020	AC	E		81	81	80	79	79	79	78
75THPLSE	000091-030	AC	E		81	81	80	79	79	79	78
75THPLSE	000091-040	AC	E		81	81	80	79	79	79	78
75THPLSE	000091-050	AC	E		81	81	80	79	79	78	78
75THPLSE	000091-060	AC	E		65	65	63	61	60	58	56
75THPLSE	000091-070	AC	E		49	49	47	45	44	42	40
75THSTSE	000092-010	AC	E		69	68	67	65	63	61	59
75THSTSE	000092-020	AC	E		79	79	78	78	78	78	78
75THSTSE	000092-030	AC	E		83	83	81	80	80	79	79

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				2021	2021	2022	2023	2024	2025	2026	2027
75THSTSE	000092-040	AC	E		80	80	79	79	78	78	78
75THSTSE	000092-050	AC	E		90	89	87	85	84	82	81
75THSTSE	000092-060	AC	E		90	89	87	85	84	82	81
76THCTSE	000093-020	AC	E		95	95	93	91	88	87	85
76THCTSE	000093-030	AC	E		81	81	80	79	79	79	78
76THCTSE	000093-040	AC	E		95	95	93	91	88	87	85
76THCTSE	000093-050	PCC	E		99	99	98	97	96	95	94
76THPLSE	000093-010	AC	E		73	73	71	69	67	65	63
76THPLSE	000093-020	AC	E		73	73	71	69	67	65	63
76THPLSE	000094-010	AAC	E		90	89	87	85	84	82	81
76THSTSE	000095-010	AAC	B	58		58	57	56	56	55	55
76THSTSE	000095-020	AAC	B	59		59	57	57	56	55	55
76THSTSE	000095-030	AAC	B	77		76	72	69	66	64	62
76THSTSE	000095-040	AAC	B	85		84	80	77	73	70	67
76THSTSE	000095-050	AAC	B	64		63	61	60	58	57	56
76THSTSE	000095-060	AAC	B	62		61	60	58	57	56	56
76THSTSE	000095-070	AAC	B	41		39	33	25	17	10	3
76THSTSE	000095-080	PCC	E		73	72	69	65	61	58	54
76THSTSE	000095-090	AAC	E		81	81	80	79	79	78	78
77THCTSE	000096-010	AC	E		81	81	80	79	79	79	78
77THCTSE	000096-020	AAC	E		92	91	89	87	85	84	82
77THCTSE	000096-030	AC	E		80	80	79	79	78	78	78
77THCTSE	000096-040	AC	E		80	80	79	79	78	78	78
77THCTSE	000096-050	AC	E		95	95	93	91	88	87	85
77THPLSE	000097-010	AC	E		81	81	80	79	79	79	78
77THPLSE	000097-020	AC	E		65	65	63	61	60	58	56
77THPLSE	000097-030	AAC	E		24	24	22	20	19	17	15
77THPLSE	000097-040	AAC	E		21	21	19	17	16	14	12
77THPLSE	000097-050	AAC	E		33	33	31	29	28	26	24
77THPLSE	000097-060	AAC	E		90	89	87	85	84	82	81
77THPLSE	000097-070	AC	E		79	79	79	78	78	78	78
77THPLSE	000097-080	PCC	E		86	85	82	77	73	70	66
77THSTSE	000098-010	AC	E		81	81	80	79	79	78	78
78THCTNE	000099-010	AC	E		71	71	69	67	65	63	61
78THPLSE	000100-010	AC	E		60	60	58	56	55	53	51
78THPLSE	000100-020	AC	E		81	81	80	79	79	79	78
78THPLSE	000100-030	AC	E		90	89	87	85	84	82	81
78THPLSE	000100-040	AC	E		90	89	87	85	84	82	81
78THPLSE	000100-050	PCC	E		92	92	92	92	92	92	92
78THSTSE	000101-010	AC	E		66	66	64	62	61	59	57
78THWAYSE	000102-010	AC	E		81	81	80	79	79	78	78
78THWAYSE	000102-020	AC	E		81	81	80	79	79	79	78
78THWAYSE	000102-030	AC	E		81	81	80	79	79	78	78
78THWAYSE	000102-040	AC	E		80	79	79	79	78	78	78
79THCTSE	000103-010	AC	E		66	66	64	62	61	59	57
79THCTSE	000103-020	AC	E		79	79	79	78	78	78	78
79THDRSE	000104-010	AAC	E		79	79	78	78	78	78	78
79THDRSE	000104-020	AAC	E		80	79	79	79	78	78	78
79THDRSE	000104-030	AAC	E		73	73	71	69	67	65	63
79THDRSE	000104-040	AC	E		64	64	62	60	59	57	55
79THDRSE	000104-050	AC	E		61	61	59	57	56	54	52
79THDRSE	000104-060	AC	E		58	58	56	54	53	51	49
79THDRSE	000104-070	AC	E		66	66	64	62	61	59	57
79THPLSE	000105-010	AC	E		86	86	84	83	81	80	79
79THPLSE	000105-020	AC	E		81	81	80	79	79	79	78
79THPLSE	000105-030	AC	E		81	81	80	79	79	79	78
79THSTSE	000106-010	AC	E		68	68	66	64	62	60	58
79THSTSE	000106-020	AAC	E		95	95	93	91	89	87	85
80THCTSE	000107-010	AC	E		76	76	75	73	70	68	67
80THPLSE	000108-010	AC	E		81	81	80	79	79	79	78

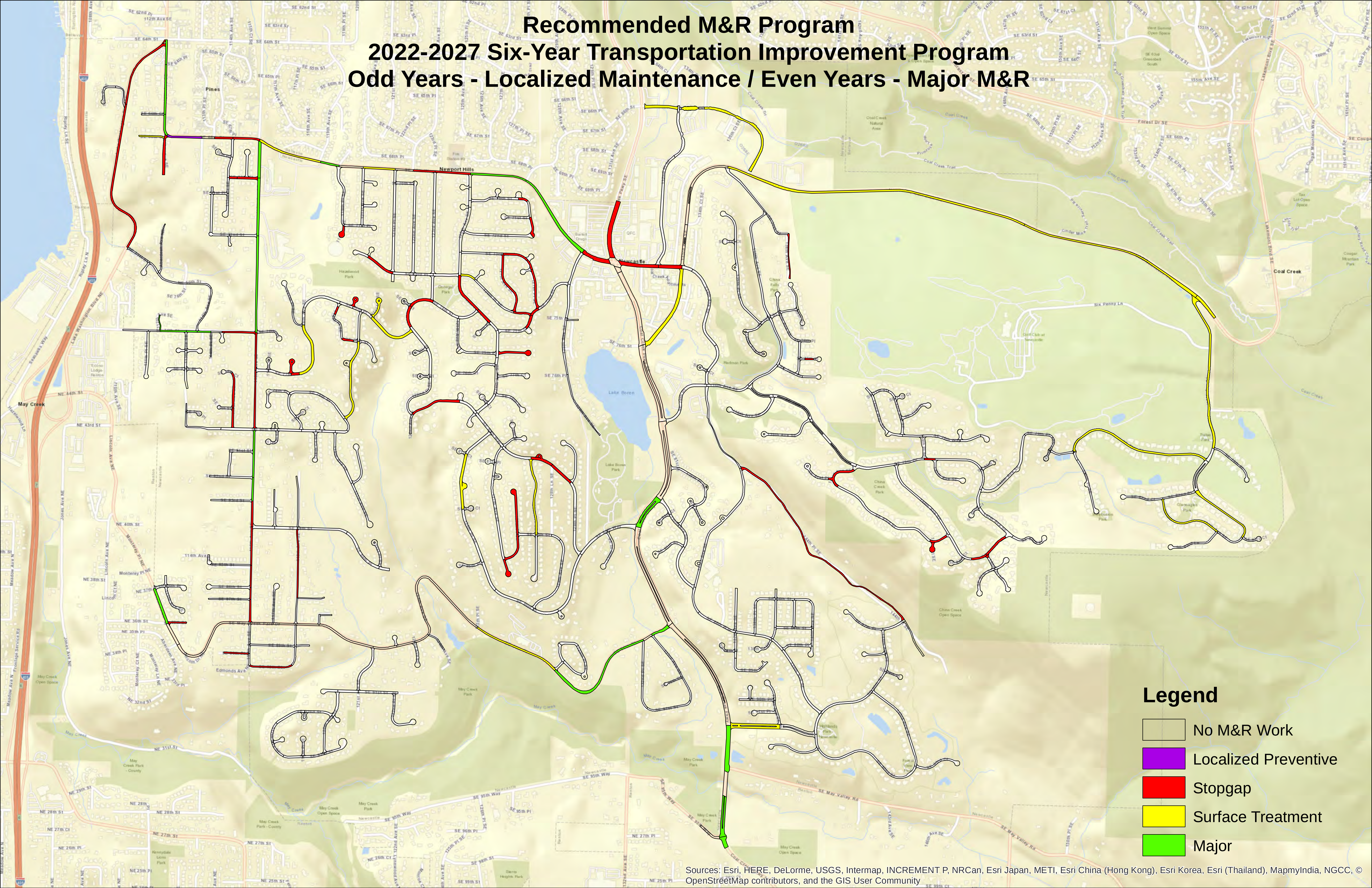
Branch ID	Section ID	Surface	Functional Classification	Inspected	Projected						
				2021	2021	2022	2023	2024	2025	2026	2027
80THSTSE	000109-010	AC	E		88	87	86	84	82	81	80
80THSTSE	000109-020	AC	E		61	61	59	57	56	54	52
80THSTSE	000109-030	AC	E		95	95	93	91	88	86	85
80THSTSE	000109-040	AC	E		95	95	93	91	88	86	85
80THSTSE	000109-050	AC	E		95	95	93	91	88	86	85
80THSTSE	000109-060	AC	E		94	94	91	89	87	85	84
80THSTSE	000109-070	AC	E		94	94	91	89	87	85	84
80THSTSE	000109-080	AC	E		95	95	93	91	88	86	85
80THSTSE	000109-090	AC	E		95	95	93	91	88	86	85
80THSTSE	000109-100	AC	E		80	79	79	79	78	78	78
80THWAYSE	000110-010	AC	E		57	57	55	53	52	50	48
80THWAYSE	000110-020	AC	E		81	81	80	79	79	79	78
80THWAYSE	000110-030	AC	E		73	73	71	69	67	65	63
80THWAYSE	000110-040	AC	E		76	76	75	73	70	68	67
80THWAYSE	000110-050	AC	E		80	80	79	79	78	78	78
80THWAYSE	000110-060	AAC	E		47	47	45	43	42	40	38
80THWAYSE	000110-070	AAC	E		50	50	48	46	45	43	41
81STCTSE	000111-010	AC	E		63	63	61	59	58	56	54
81STPLSE	000112-010	AC	E		80	79	79	79	78	78	78
81STPLSE	000112-020	AC	E		88	87	86	84	82	81	80
81STPLSE	000112-030	AC	E		93	92	90	88	86	85	83
82NDCTSE	000113-010	AC	E		80	80	79	79	78	78	78
82NDPLSE	000114-010	AC	E		81	81	80	79	79	79	78
82NDSTSE	000115-010	AC	E		95	95	93	91	88	86	85
82NDSTSE	000115-020	AC	E		81	81	80	79	79	79	78
82NDSTSE	000115-030	AC	E		80	80	79	79	78	78	78
83RDCTSE	000116-010	AC	E		56	56	54	52	51	49	47
83RDCTSE	000116-020	AC	E		86	86	84	83	81	80	79
83RDLNSE	000117-010	AC	E		88	87	86	84	82	81	80
83RDPLSE	000118-010	PCC	E		92	92	92	92	92	92	92
83RDSTSE	000119-010	AC	E		90	89	87	85	84	82	81
83RDSTSE	000119-020	AAC	E		100	99	97	95	93	91	89
83RDSTSE	000119-030	AAC	E		100	99	97	95	93	91	89
83RDSTSE	000119-040	AC	E		95	95	93	91	88	86	85
83RDSTSE	000119-050	PCC	E		53	52	49	45	42	38	34
84THCTSE	000120-010	AAC	E		100	99	97	95	93	91	89
84THCTSE	000120-020	AC	E		80	80	79	79	78	78	78
84THPLSE	000121-010	AC	E		87	87	85	83	82	81	80
84THPLSE	000121-020	AC	E		86	86	84	83	81	80	79
84THSTSE	000122-010	AC	E		19	19	17	15	14	12	10
84THSTSE	000122-020	AC	E		90	89	87	85	84	82	81
84THSTSE	000122-030	AC	E		89	88	86	85	83	82	81
84THSTSE	000122-040	AC	E		78	78	78	78	78	78	78
84THSTSE	000122-050	AAC	E		81	81	80	79	79	79	78
84THSTSE	000122-060	AAC	E		81	81	80	79	79	79	78
84THSTSE	000122-070	PCC	E		66	65	62	58	55	51	47
84THSTSE	000122-080	PCC	E		58	57	54	50	47	43	39
84THWAYSE	000123-010	AC	E		81	81	80	79	79	79	78
84THWAYSE	000123-020	AAC	E		100	99	97	95	93	91	89
85THPLSE	000124-010	AC	E		71	71	69	67	65	63	61
85THSTSE	000125-010	AC	E		90	89	87	85	84	82	81
85THSTSE	000125-020	AAC	E		100	99	97	95	93	91	89
85THSTSE	000125-030	AC	E		81	81	80	79	79	78	78
85THSTSE	000125-040	AC	E		81	81	80	79	79	79	78
86THPLSE	000126-010	AC	E		79	79	79	78	78	78	78
86THPLSE	000126-020	AC	E		80	80	79	79	78	78	78
86THPLSE	000126-030	AC	E		76	76	75	73	70	68	67
86THPLSE	000126-040	AAC	E		90	89	87	85	84	82	81
86THSTSE	000127-010	AC	E		78	78	78	78	78	78	78
86THSTSE	000127-020	AC	E		88	87	86	84	82	81	80

Branch ID	Section ID	Surface	Functional Classification	Inspected	Projected						
				2021	2021	2022	2023	2024	2025	2026	2027
86THSTSE	000127-030	AC	E		88	87	86	84	82	81	80
86THSTSE	000127-040	AC	E		88	87	86	84	82	81	80
87THCTSE	000128-010	AC	E		84	84	83	81	80	80	79
87THPLSE	000129-010	AC	E		90	89	87	85	84	82	81
87THSTSE	000130-010	AC	E		81	81	80	79	79	79	78
87THSTSE	000130-020	AAC	E		95	95	93	91	88	86	85
87THSTSE	000130-030	AC	E		88	87	86	84	82	81	80
87THSTSE	000130-040	AC	E		88	87	86	84	82	81	80
87THSTSE	000130-050	AC	E		78	78	78	78	78	78	78
88THPLSE	000131-010	AC	E		81	81	80	79	79	79	78
88THPLSE	000131-020	AC	E		90	89	87	85	84	82	81
88THPLSE	000131-030	AC	E		88	87	86	84	82	81	80
88THSTSE	000132-010	AC	E		32	32	30	28	27	25	23
88THWAYSE	000133-010	AC	E		88	87	86	84	82	81	80
88THWAYSE	000133-020	AC	E		64	64	62	60	59	57	55
88THWAYSE	000133-030	AC	E		76	76	75	73	70	68	67
89THPLSE	000134-010	AC	E		55	55	53	51	50	48	46
89THPLSE	000134-020	AC	E		86	86	84	83	81	80	79
89THPLSE	000134-030	AC	E		86	86	84	83	81	80	79
89THSTSE	000135-010	AC	E		62	62	60	58	57	55	53
89THSTSE	000135-020	AC	E		79	79	78	78	78	78	78
89THSTSE	000135-030	AC	E		90	89	87	85	84	82	81
90THPLSE	000136-010	AC	E		90	89	87	85	84	82	81
90THPLSE	000136-020	AC	E		90	89	87	85	84	82	81
90THSTSE	000137-010	AC	E		46	46	44	42	41	39	37
90THSTSE	000137-020	AC	E		81	81	80	79	79	79	78
90THSTSE	000137-030	AC	E		87	87	85	83	82	81	80
90THSTSE	000137-040	AC	E		80	80	79	79	78	78	78
91STPLSE	000151-010	AC	E		95	95	93	91	88	86	85
91STSTSE	000138-010	AC	E		79	79	79	78	78	78	78
91STSTSE	000138-020	AC	E		79	79	79	78	78	78	78
91STSTSE	000138-030	AC	E		84	84	83	81	80	80	79
91STSTSE	000138-050	AC	E		76	76	75	73	70	68	67
91STSTSE	000138-060	AC	E		79	79	79	78	78	78	78
91STSTSE	000138-070	AC	E		84	83	82	81	80	79	79
92NDPLSE	000139-010	AC	E		67	67	65	63	61	59	58
92NDSTSE	000140-010	AC	E		65	65	63	61	60	58	56
92NDSTSE	000140-020	AC	E		60	60	58	56	55	53	51
92NDSTSE	000140-030	AC	E		80	79	79	79	78	78	78
92NDSTSE	000140-040	AC	E		90	89	87	85	84	82	81
92NDSTSE	000140-050	AC	E		84	84	83	81	80	80	79
93RDSTSE	000141-010	AC	E		56	56	54	52	51	49	47
93RDSTSE	000141-020	AC	E		60	60	58	56	55	53	51
93RDSTSE	000141-030	AC	E		80	80	79	79	78	78	78
93RDSTSE	000141-040	AC	E		70	69	68	66	64	62	60
95THWAYSE	000142-040	AC	E		81	81	80	79	79	79	78
COALCREEK	000143-010	AC	A	76		75	71	68	66	63	61
COALCREEK	000143-020	AAC	A	70		69	66	64	62	60	58
COALCREEK	000143-030	AAC	A	72		71	68	65	63	61	59
COALCREEK	000143-040	AAC	A	73		72	69	66	64	61	60
COALCREEK	000143-050	AAC	A	74		73	70	67	64	62	60
COALCREEK	000143-060	AAC	A	71		70	67	64	62	60	59
COALCREEK	000143-070	AAC	A	65		64	62	60	59	58	57
COALCREEK	000143-080	AAC	A	63		62	60	59	58	57	56
COALCREEK	000143-090	AAC	A	46		45	40	34	27	18	11
COALCREEK	000143-100	AC	A	72		71	68	65	63	61	59
LKWSHGTNBD	000145-010	AC	B	42		40	34	27	19	12	5
LKWSHGTNBD	000145-020	AC	B	40		38	32	23	16	9	2
MAYCREEKPK	000147-010	AC	B	43		41	36	100	100	98	96
MAYCREEKPK	000147-020	AC	B	34		32	24	100	100	98	96

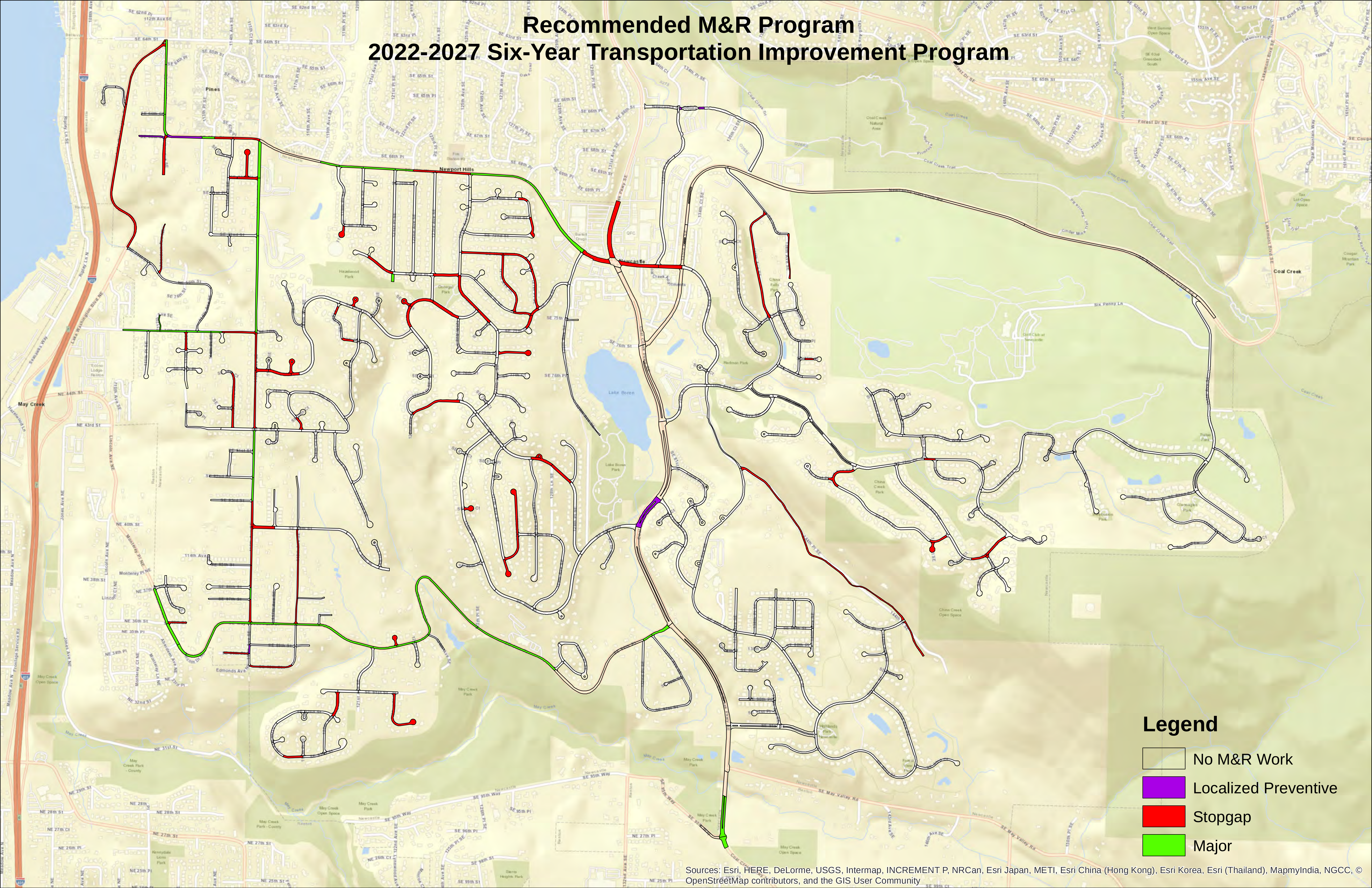
Branch ID	Section ID	Surface	Functional Classification	Inspected	Projected						
				2021	2021	2022	2023	2024	2025	2026	2027
MAYCREEKPK	000147-030	AC	B	44		43	38	100	100	98	96
MAYCREEKPK	000147-040	AC	B	68		67	64	100	100	98	96
MAYCREEKPK	000147-050	AC	B	88		87	83	100	100	98	96
MAYCREEKPK	000147-060	AC	B	72		71	68	100	100	98	96
MAYCREEKPK	000147-070	AC	B	86		85	81	100	100	98	96
MAYCREEKPK	000147-080	AC	B	39		37	31	100	100	98	96
MAYCREEKPK	000147-090	AC	B	48		47	43	100	100	98	96
MAYCREEKPK	000147-100	AC	B	38		36	31	100	100	98	96
MAYCREEKPK	000147-110	AC	B	26		23	13	100	100	98	96
MAYCREEKPK	000147-120	AC	B	85		84	80	77	73	70	67
MAYCREEKPK	000147-130	AC	B	75		74	71	68	65	63	61
MAYCREEKPK	000147-140	AAC	B	72		71	68	65	63	61	59
MAYCREEKPK	000147-150	AAC	B	70		69	66	64	62	60	58
MONTEREYPL	000148-010	AC	B	53		53	52	100	100	98	96
NWCSTLCMWY	000153-010	AC	B	95		94	91	87	84	80	77
NWCSTLCMWY	000153-020	PCC	B	100		100	100	99	98	97	96
NWCSTLCMWY	000153-030	AC	B	92		91	87	84	80	77	73
NWCSTLCMWY	000153-040	AC	B	95		94	91	87	84	80	77
NWCSTLGFCB	000149-010	AAC	A	91		90	86	83	79	75	72
NWCSTLGFCB	000149-020	AAC	A	61		60	59	58	57	56	56
NWCSTLGFCB	000149-030	AAC	A	66		65	63	61	59	58	57
NWCSTLGFCB	000149-040	AAC	A	92		91	87	84	80	77	73
NWCSTLGFCB	000149-050	AAC	A	95		94	91	87	84	80	77
NWCSTLGFCB	000149-060	AAC	A	94		93	90	86	83	79	75
NWCSTLWAY	000150-010	AC	B	100		100	99	97	94	91	88
NWCSTLWAY	000150-020	AC	B	56		56	55	55	54	54	52
NWCSTLWAY	000150-030	AC	B	55		55	54	53	52	50	48
NWCSTLWAY	000150-040	AC	B	44		43	37	30	22	15	8
NWCSTLWAY	000150-050	AC	B	87		86	82	78	75	72	69
NWCSTLWAY	000150-060	AC	B	86		85	81	77	74	71	68
NWCSTLWAY	000150-070	AC	B	68		67	64	62	60	59	58
NWCSTLWAY	000150-080	AC	B	81		80	76	73	70	67	64
NWCSTLWAY	000150-090	AC	B	58		58	57	56	56	55	55
NWCSTLWAY	000150-100	AC	B	54		54	53	51	49	46	41
NWCSTLWAY	000150-110	AC	B	41		39	33	25	17	10	3
NWCSTLWAY	000150-120	AC	B	82		81	77	74	70	67	65
NWCSTLWAY	000150-130	AAC	B	79		78	74	71	68	65	63
NWCSTLWAY	000150-140	AAC	B	39		37	30	22	14	7	0
NWCSTLWAY	000150-150	AAC	A	49		48	45	40	34	26	18
NWCSTLWAY	000150-160	AAC	A	33		30	22	15	8	1	0

APPENDIX D – RECOMMENDED M&R PLAN MAPS

Recommended M&R Program
2022-2027 Six-Year Transportation Improvement Program
Odd Years - Localized Maintenance / Even Years - Major M&R



Recommended M&R Program
2022-2027 Six-Year Transportation Improvement Program



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Recommended M&R Program
2022-2027 Six-Year Transportation Improvement Program
Including Surface Treatments