1 Wall Management System

Category	Subcategory	Grade
Overall Grade		F
Physical Health		
	Overall Condition	F
	Risk-Based Condition	F
Financial Health		
	Catch Up	F
	Keep Up	F

1.1 Background

1.1.1 What Services Do These Assets Provide?

There are approximately 39 miles of walls throughout the City of Livermore. These include walls constructed of a variety of materials including wooden fences. They are normally located where residential areas abut major streets and direct access to the street is not permitted or desirable. The 39 miles of walls does not include walls along the I-580 freeway.

A wall can provide privacy and security for the residents and, in some cases, noise attenuation from traffic, while visually enhancing the roadway for the community. In the past, little or no setback from the sidewalk to the wall was provided and landscaping was often limited to trees spaced along the wall (such as along Holmes Street, Murietta Boulevard and Stanley Boulevard). Frequently, the walls were merely decorative in nature.

In more recent residential developments, backing lot treatments include landscaped areas and walls which are often taller and provide some noise attenuation for adjacent residential properties. These walls are typically paid for and installed by private developers at the time of subdivision and residential development.

1.1.2 Who is Responsible?

Ownership and maintenance responsibilities depend on the location of each wall. The City is responsible for the maintenance, rehabilitation, and replacement of walls that are located on City property or in the public right-of-way. Per Civil Code Section 841, walls that are located on or inside private property line are the responsibility of the adjacent property owner. Walls that zig zag between private property and City right-of-way are the joint responsibility of the City and the adjacent private property owner.

Some walls within the City are located in Landscape Maintenance or Community Facility Districts (LMD or CFD), which are specific areas in the City where assessments are collected from the property owners to fund landscape maintenance. The City has established LMDs and CFDs in specific areas throughout the City to help fund the maintenance of green areas, including landscape areas and some parks and plazas. The maintenance work can include, but may not be limited to improving aesthetics, dust control, drainage improvements, and erosion resistance, along with other benefits. Of the total 39 miles of wall, approximately 20.6 miles are located within

LMD/CFD areas. It has been determined that the replacement of wall segments within LMDs and CFDs will be covered by these funds, so only walls in the General Fund area are included in the analyses.

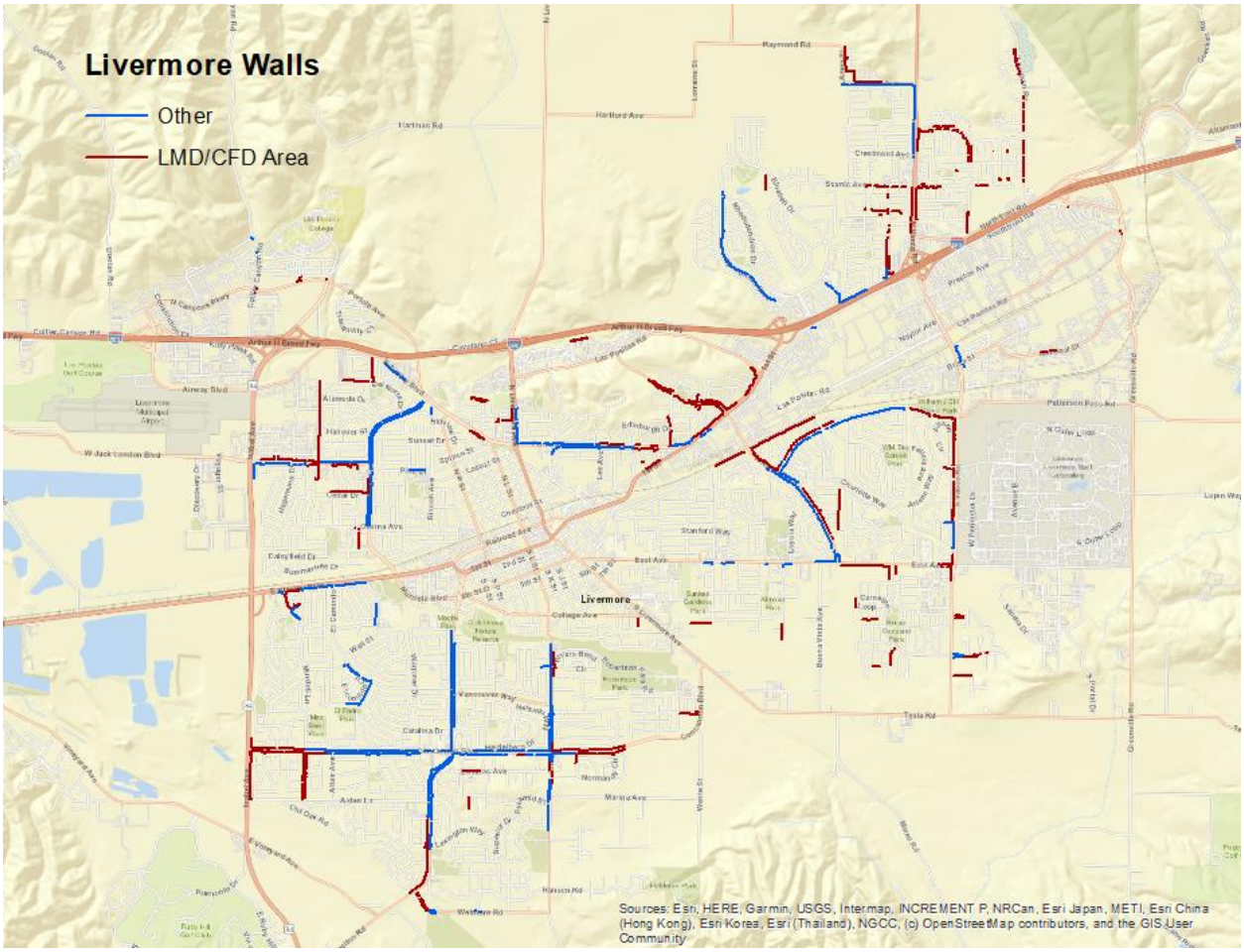

Figure 1-1 Livermore Walls Based on Location within or outside LMD/CFD Boundaries

After accounting for the walls on private property and within LMD/CFDs, the City is fully or partially responsible for approximately 9.3 miles of wall throughout the City.

For those walls that are the City's responsibility but are compromised due to an adjacent property owner's negligence (ex; damage due to an adjacent property owner's backfill), repairs are the responsibility of the private party.

1.2 Asset Register

1.2.1 Asset Definition

An asset in the Wall Management System is defined as something with value that is owned and managed by the City. For City staff use, an asset is defined at the level in which a maintenance work order will be generated. In the case of the walls, each segment from start to end was classified as one asset. In many cases, these segments were defined from street to street and/or by material.

1.2.2 *Asset Class*

Assets are grouped into classes for modeling and management purposes. An asset class generally refers to a group of assets that behave similarly (e.g., useful life, rehabilitation activities). Grouping the assets into these classes allows easier life-cycle behavior modeling. For the Wall Management System, the wall is the asset class.

1.2.3 *Asset Hierarchy*

The asset hierarchy allows for efficient organization of the wall asset data in the asset register. At the highest level, the wall assets are sorted by asset management system (i.e., Wall Management System). The next level in the hierarchy gives an indication of the owner of the wall. The next level of hierarchy gives an indication of the classification of the street (e.g., arterial, collector, residential) the wall runs along, as well as any other special considerations for the wall (e.g., high pedestrian area, city entry point).

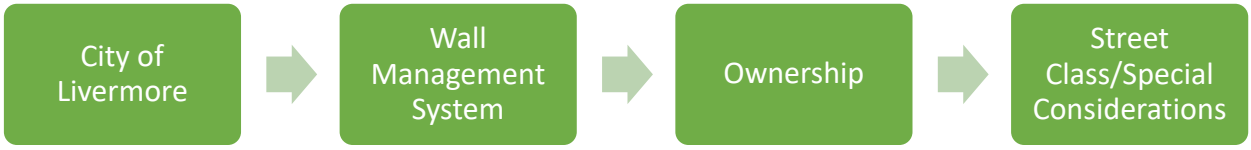

Figure 1-2 Wall Management System Hierarchy

1.2.4 *Asset Inventory*

The City is fully or partially responsible for approximately 9.3 miles of wall. During the asset inventory, different types of walls were observed. The City walls differ by type, material, shape, and height. The following figures show examples of the various wall types or construction materials.

Figure 1-3 Wall Material: Brick

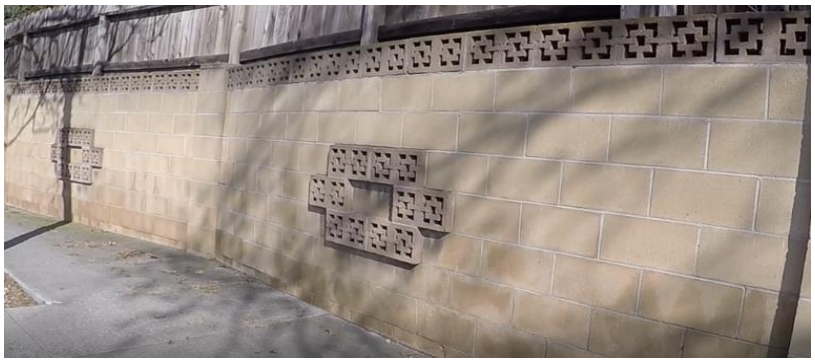

Figure 1-4 Wall Material: Concrete Block (Old Style)

Figure 1-5 Wall Material: Concrete Block (New Style)

Figure 1-6 Wall Material: Concrete Panel (Pre-Cast)

Figure 1-7 Wall Material: Slump Block

Figure 1-8 Wall Material: Stone

Figure 1-9 Wall Material: Wood

The following figure displays the locations of the walls for which the City is at least partially responsible represented by blue lines.

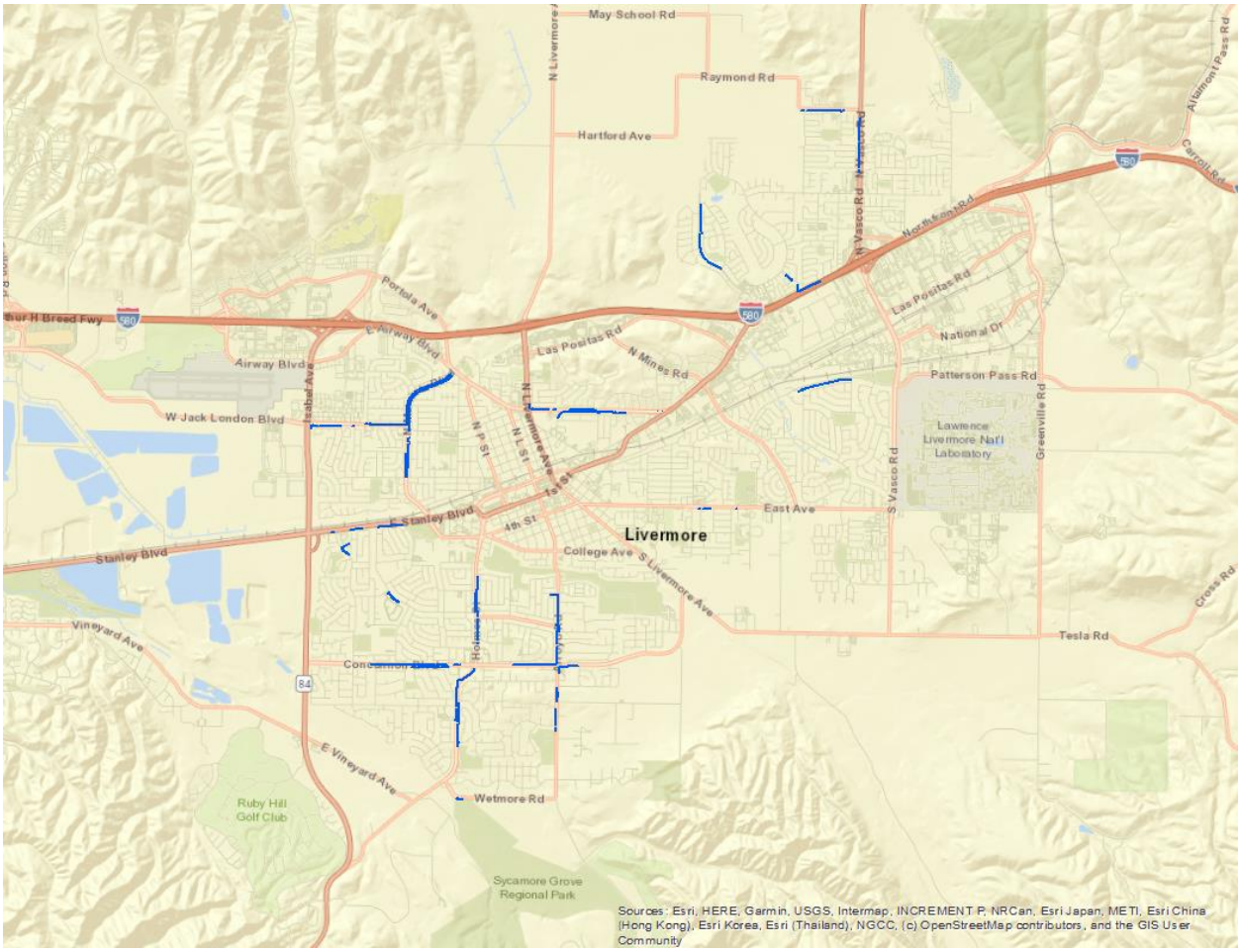

Figure 1-10 Wall Location Overview Map

In order to compile the asset register, data was collected by visiting each wall segment. Walls were evaluated with respect to rehabilitation and/or replacement needs. Numerous wall data attributes were collected during the inventory process, including the following:

- Location (street names, side of street, GPS)
- Length (estimated)
- Material (e.g., concrete, concrete block, wood)
- Type (e.g., zig-zag, straight, scalloped)
- Height
- Distance from the street curb
- Proximity to sidewalk
- General condition
- Wall surface (i.e., paint). If painted, general condition of the paint is noted.
- Picture/video of the wall
- Approximate height of the backfill

- Approximate year of installation
- Landscape Maintenance or Community Facility District (LMD or CFD) where applicable

The last attribute on the list, Landscape Maintenance or Community Facility District (LMD or CFD) was used to help determine the City's responsibility for funding the walls. As mentioned previously, the replacement of wall segments within LMDs and CFDs will be covered by those funds rather than the General Fund.

The following table summarizes the walls for which the City is fully or partially responsible by material.

Table 1-1 General Fund Wall Asset Inventory by Material Type

Material	Total Length	
	Feet	Miles
Brick	3,371	0.6
Concrete Block	25,466	4.8
Concrete Panel	4,372	0.8
Slump Block	12,947	2.5
Stone	271	0.1
Wood	2,644	0.5
Grand Total	49,071	9.3

1.2.5 Asset Replacement Cost

Each asset in the asset register was assigned an estimated replacement cost. Although the walls are made of various materials, the City has opted to replace them with a standard design. As such, the wall assets were assigned a replacement cost of $950 per linear foot of wall based on the City's historical records. This cost includes project costs (e.g., design, engineering, permit fees). The total replacement cost for the walls for which the City is at least partially responsible is approximately $46.6 million.

1.2.6 Installation and Consumption Profile

The installation profile gives an indication of the age of the assets. Installation year was determined based on historical data. Exact installation year from records for certain assets was incorporated whenever possible.

The figure below shows the installation profile for the Wall Management System. The graph shows the City's historical investments represented in 2020 dollars.

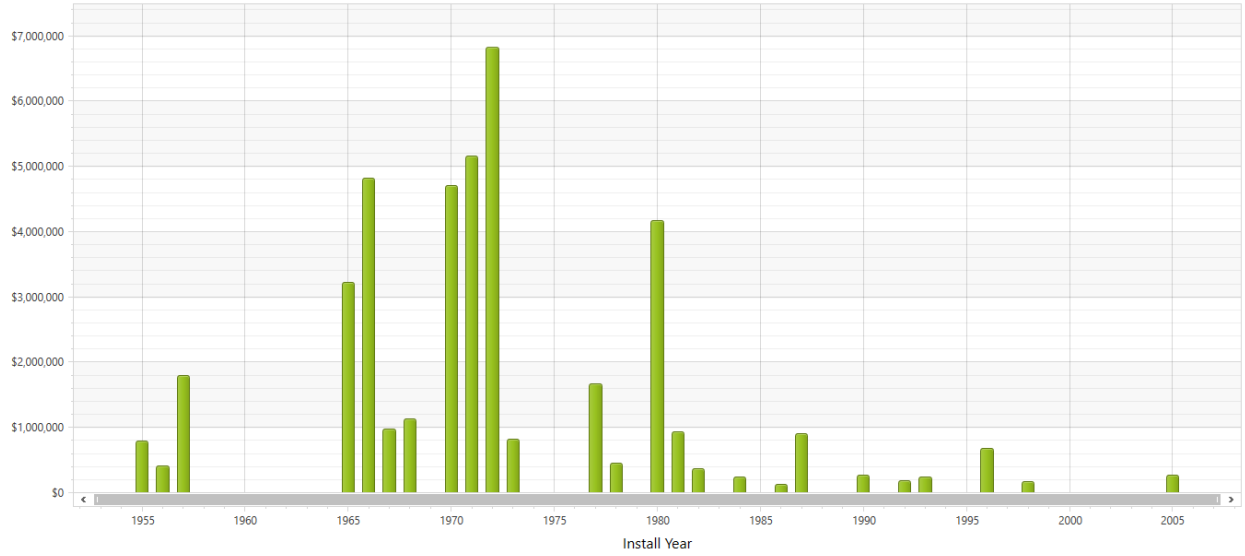

Figure 1-11 Installation Profile

More important than the installation data is the estimated current state or consumption of the assets. Consumption represents the percentage of an asset's expected life that it has used up or consumed. As illustrated in the following figure, most wall assets have consumed approximately 70% or less of their useful lives. Although 70% may seem high, these assets may be in relatively good condition with years of life left, as explained in the next section. Another reason for the high consumption peak in the 70% was that many assets received a condition score of 3 (Good or As Expected Based on Age). An exponential decay curve was utilized to represent the deterioration of the asset, which roughly translated a condition assessment score of 3 to be 70% consumed. Discussion on the condition assessment rating scale is presented in the following section.

The following figure shows the consumption profile represented in 2020 dollars. Approximately $3.9 million worth of assets are estimated to be fully consumed. The replacement or rehabilitation of these assets should take place in the near future.

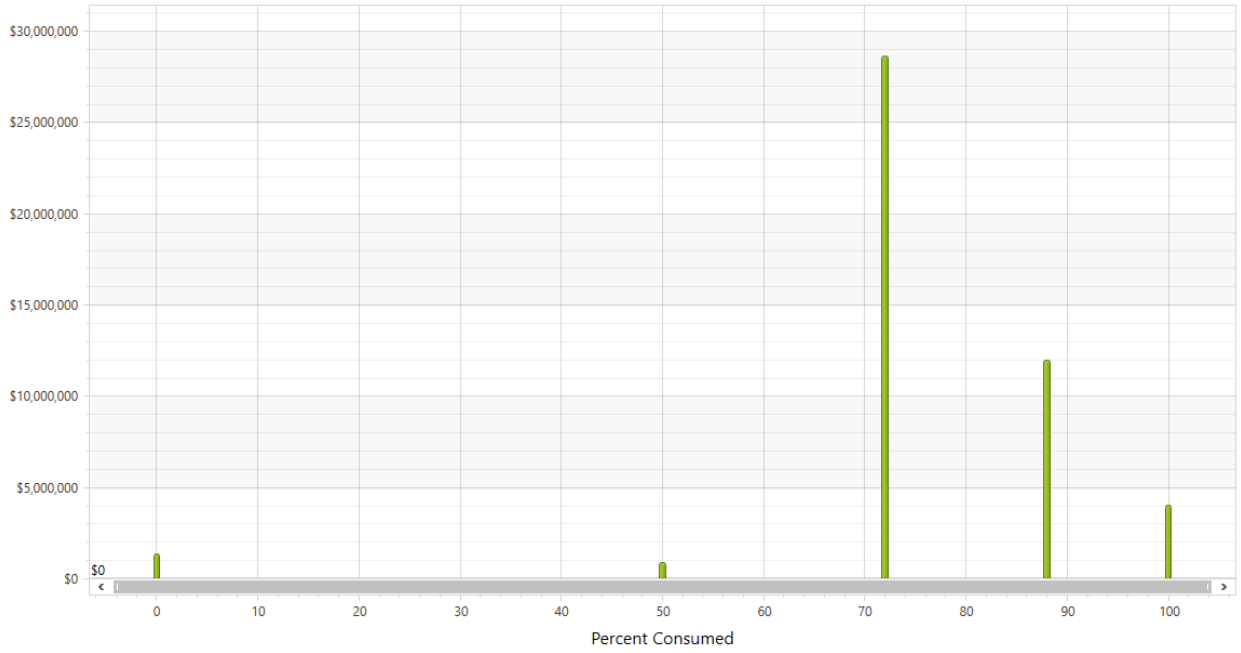

Figure 1-12 Consumption Profile

1.2.7 Condition Assessment

Condition is one of the best indicators for estimation of immediate and/or future rehabilitation and replacement work. During the asset inventory field visits, each wall was assessed for damage points along the wall. These damage points ranged from minor damage (e.g., graffiti, minor cracking) to major faults (e.g., wall leaning several degrees, major vertical/structural cracks, failed panels). A total of 841 wall fault locations (e.g., crack, bulging, leaning) were identified throughout the City. These locations are represented by the red dots on the map in the following figure.

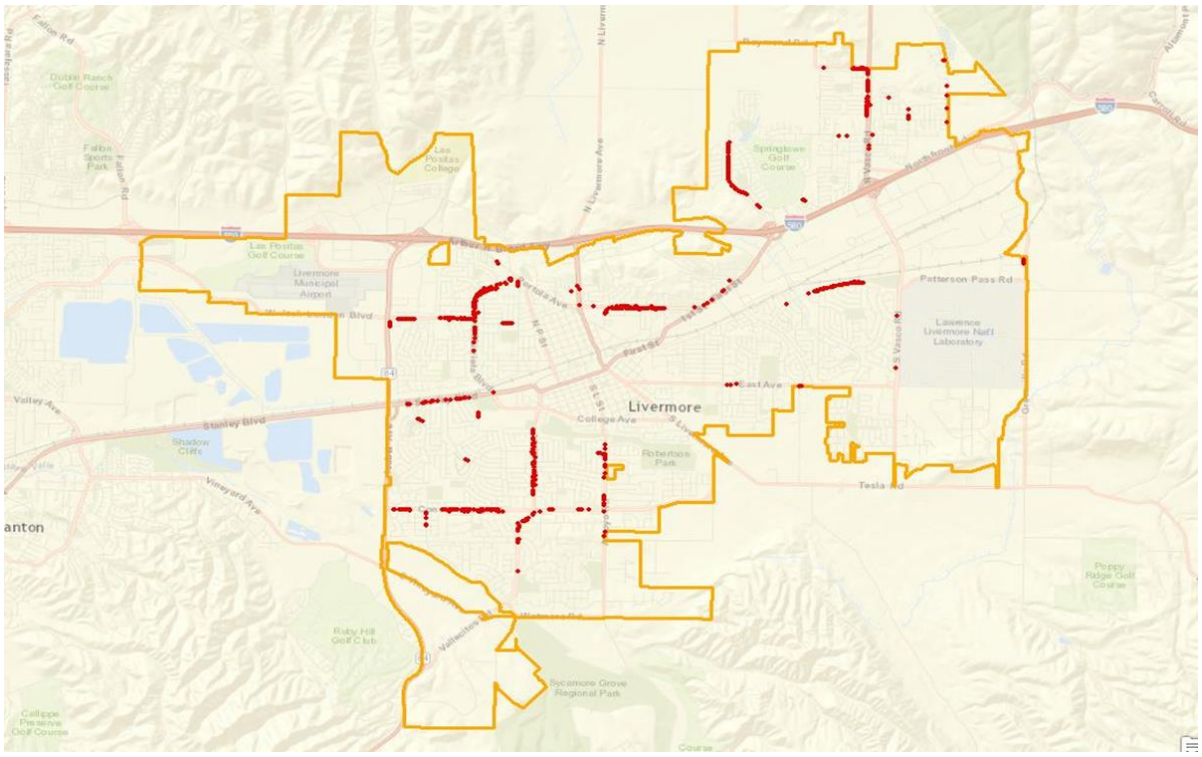

Figure 1-13 Wall Fault Locations

Once the fault locations were recorded, each wall was assessed for condition based on amount and severity of the faults observed. The condition was assessed based on the following scale. Condition information for each asset is available in the City's IRIS database. This information would be too lengthy to include in this report.

Table 1-2 Wall Condition Scale

Scale	Description
1	New or nearly new
2	Very good
3	Good
4	Poor or recommended replacement within near-term
5	Failed or nearing failure, needs immediate attention

The following pictures illustrate condition 4 walls. The wall pictured on the left is bulging and leaning likely due to backfill pressure and a tree pushing against the wall, while the wall on the right is raised off of the ground by the tree root. Although still standing, these walls will need to be addressed in the near future.

Figure 1-14 Condition 4 Wall Example

The walls in the images below show examples of condition 5 walls, or walls that are now failing or have failed. A large portion of the wall pictured on the left has completely collapsed and many areas of the wall on the right have large structural cracks, the wall is bulging, and raised off the ground by the tree.

Figure 1-15 Wall Condition 5 Example

Many of the walls and are in good condition with condition scores of 1, 2, or 3. As shown in Table 1-3, approximately 3.2 miles of wall is in poor condition (i.e., condition score of 4 or 5). The cost to replace condition 4 and 5 walls is approximately $15.9 million.

Table 1-3 Condition 4 Walls

Condition	Total Est. Length (LF)	Total Est. Length (mi)	Percent of Total Wall Length
Condition 4	12,558	2.4	25.6%
Condition 5	4,182	0.8	8.5%

Figure 1-16 highlights walls that are in poor condition and will therefore need attention in the near future.

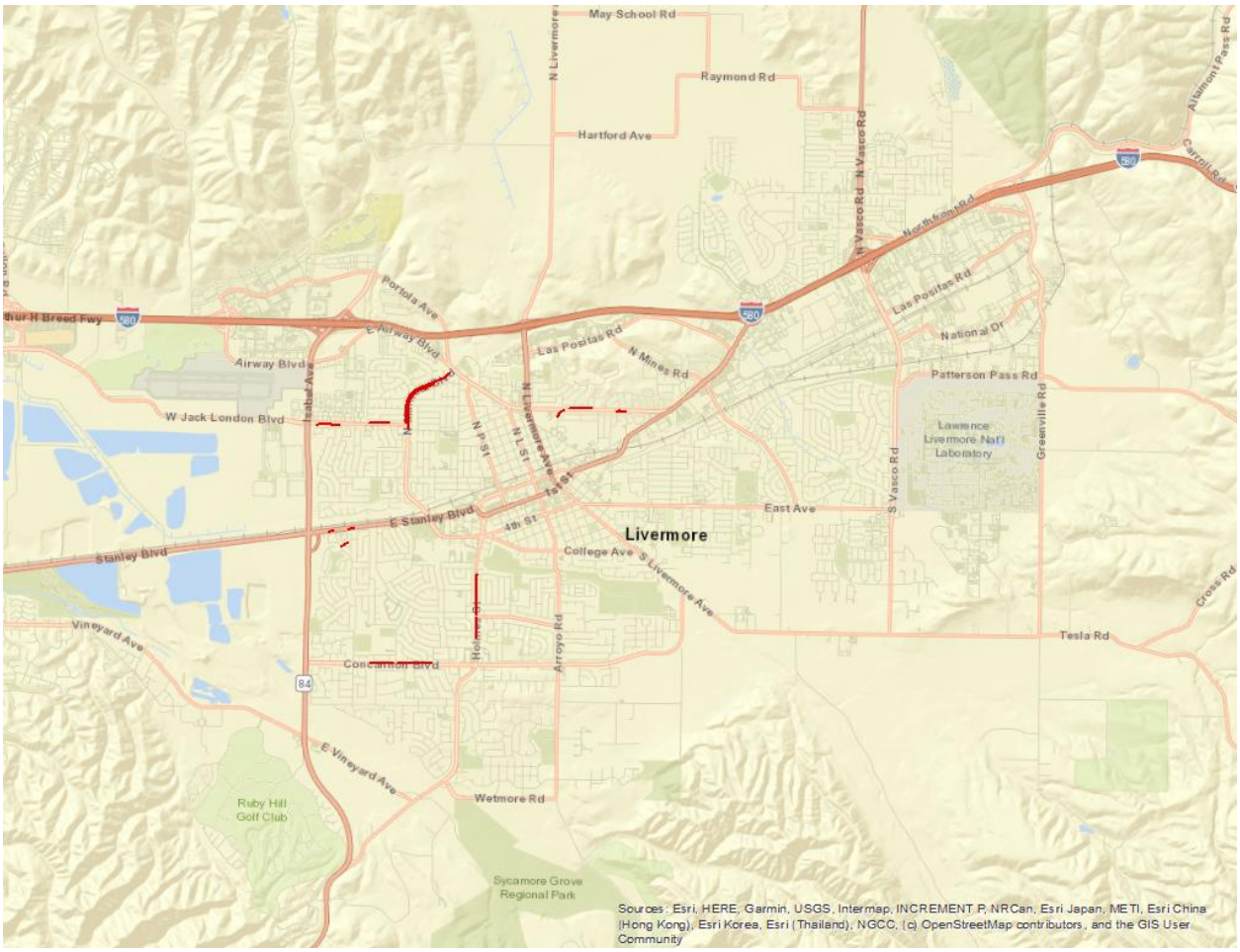

Figure 1-16 Walls in Conditions 4 or 5

While some of the walls in poor condition require full replacement, some wall conditions can be improved with some repair work.

The following images are of the wall along Portola Avenue, on the north side of the road from Yorkshire Drive to Royal Road. This wall shown is in good enough condition to require only repair work rather than needing full replacement. The damage shown here was caused by trees on the resident's side of the wall but can be repaired by mortar/grouting.

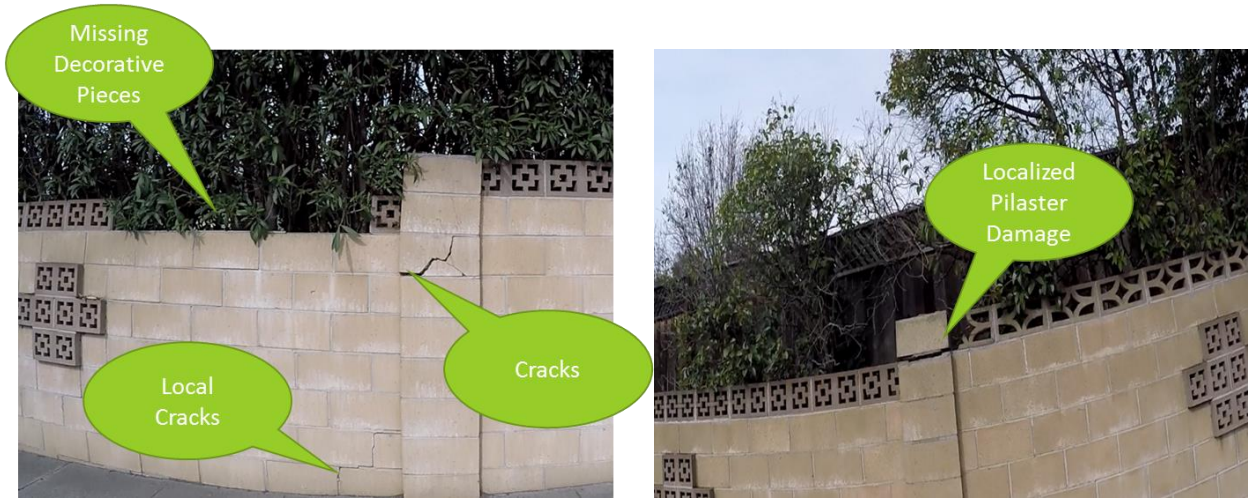

Figure 1-17 Wall Repair Example

Figure 1-18 shows the wall along E Jack London Boulevard, on the north side of the road from Murrieta Boulevard to Troy Street. The walls that are bulging or leaning in several areas. In the case of these walls, with the extent of the wall damage present, multiple panels of wall would be in need of full replacement.

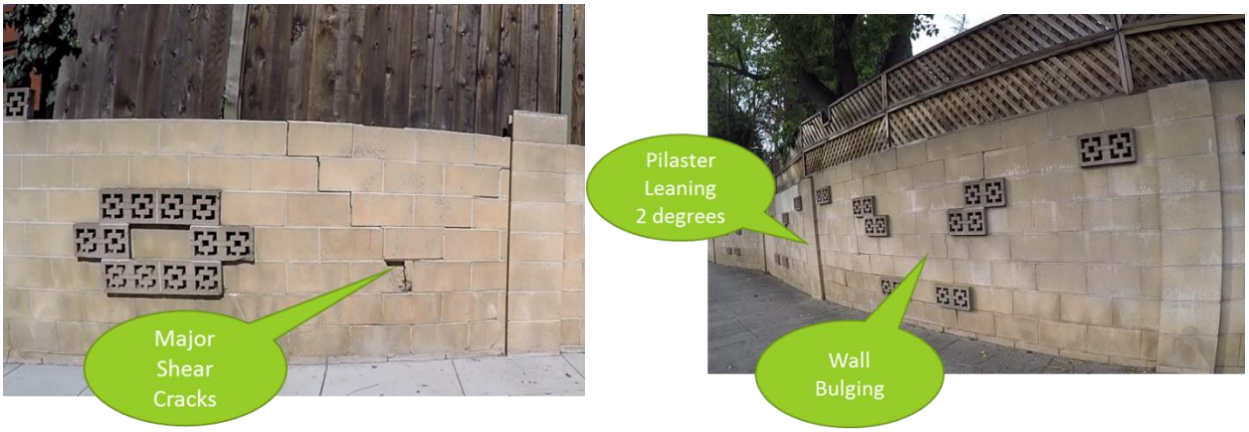

Figure 1-18 Wall Replacement Example

Based on the number of issues along the poor and failed walls, it will be important for the City to monitor the condition 3 walls as these walls may deteriorate faster than anticipated. Approximately 5.7 miles of walls received a condition score of 3, which is approximately 61% of the total wall length.

1.3 Risk Analysis

1.3.1 Probability of Failure

For most of the assets, Probability of Failure (PoF) was determined by the condition score assigned during visual inspection. In cases where the assets were not visible or where visual assessment was not a good representation of the asset's condition, PoF was calculated based on age by comparing the installation year and estimated useful life based on the City's historical usage, manufacturer's estimation, and/or other reputable resources (e.g., research results, ENR, Whitestone, neighboring cities). PoF information for each asset is available in the City's IRIS database.

This information would be too lengthy to include in this report.

Failure of a given wall is based on its mortality (condition) and level of service. A wall failing from the mortality failure mode is a wall in poor condition that is no longer structurally sound. A wall failing from level of service is a wall that is failing to deliver its original purpose (e.g., aesthetics, sound attenuation).

Like any asset, a wall will eventually fail to serve its purpose or function. Many walls or portions of walls in the City have begun to or are failing. Upon investigating the causes of failure, many factors were correlated. The following table provides a list of possible reasons as to why the wall was failing or failed.

Table 1-4 Causes of Wall Failure

Cause of Failure	Description
Age/Condition	As with any asset, materials deteriorate with age and can no longer function as designed.
Physical Damage	A wall may endure physical damage from various sources. Whether it is someone driving through the wall or drilling a hole in the wall, physical damage will weaken the structural integrity and affect the wall's useful life.
Trees	Trees can cause damage to and put continuous stress on walls. As trees grow, their roots can lift the wall up off the ground, branches can push a wall out, and/or trees may lean on a wall. In all cases, trees can inflict significant damage on the wall.
Backfill	As property owners landscape their yard they often add soil to the back of a wall, which creates pressure that the walls were not designed for.
Drainage	Improper drainage in yards, especially in areas that have been backfilled, causes many wall issues. Soil retains any water that has not been drained, creating hydraulic pressure that stresses the wall.
Earthquakes	Walls were designed to be stationary. Any movement will create great stress and result in cracks in a wall.

For level of service, walls serve three main functions: aesthetics and safety. Walls were built to create some visual uniformity for anyone who drives through the City. They were also built to provide privacy and security for adjacent residences. A wall that is failing from the level of service mode is no longer aesthetically pleasing to look at (e.g. falling apart, cracks, bulges) and/or does not provide its intended function in a safe manner (i.e., leaning wall).

1.3.2 Consequence of Failure

The following table presents the Consequence of Failure (CoF) rating methodology developed for the Wall Management System. Safety and visibility are the factors of highest concern for walls in regard to the consequence of failure of an asset.

Table 1-5 Wall Consequence of Failure

Location	Consequence of Failure
Gateways/High Pedestrian Areas/Retaining Walls	5
Arterial	4
Collector	3
Residential	2
Other Road Class	1

Walls along City gateways, in high pedestrian areas, and retaining walls are considered to be the highest criticality. Walls along City entry points are considered critical due to their high visibility. These walls help to provide the initial impression for the City. A visitor who enters the City and sees clean, aesthetically-pleasing walls will gain the impression that the City is well-maintained, while a visitor who enters the City and sees broken walls that are falling apart can develop a negative view of the City. Walls along high pedestrian traffic areas (e.g., downtown, school, parks) are also considered critical due to their visibility as well as safety concerns. Similarly, retaining walls have a large effect on safety and were included in the high criticality category. If the retaining wall fails, it may cause the failure of the soil and possible structures held by the wall.

Level of service (e.g., aesthetics) of the wall was the main factor in determining the remainder of the criticality rankings. Walls along arterial streets were given a CoF of 4, walls along collector streets were given a CoF of 3, walls along residential streets were given a CoF of 2, and walls along the remaining road classes (i.e., access road, rural route) were given a CoF of 1. This order was determined based on the amount of traffic expected on each road class; higher traffic on arterials corresponds to higher visibility and higher noise. There were very few City-owned walls along the residential streets.

The map below shows the CoF assigned to the walls.

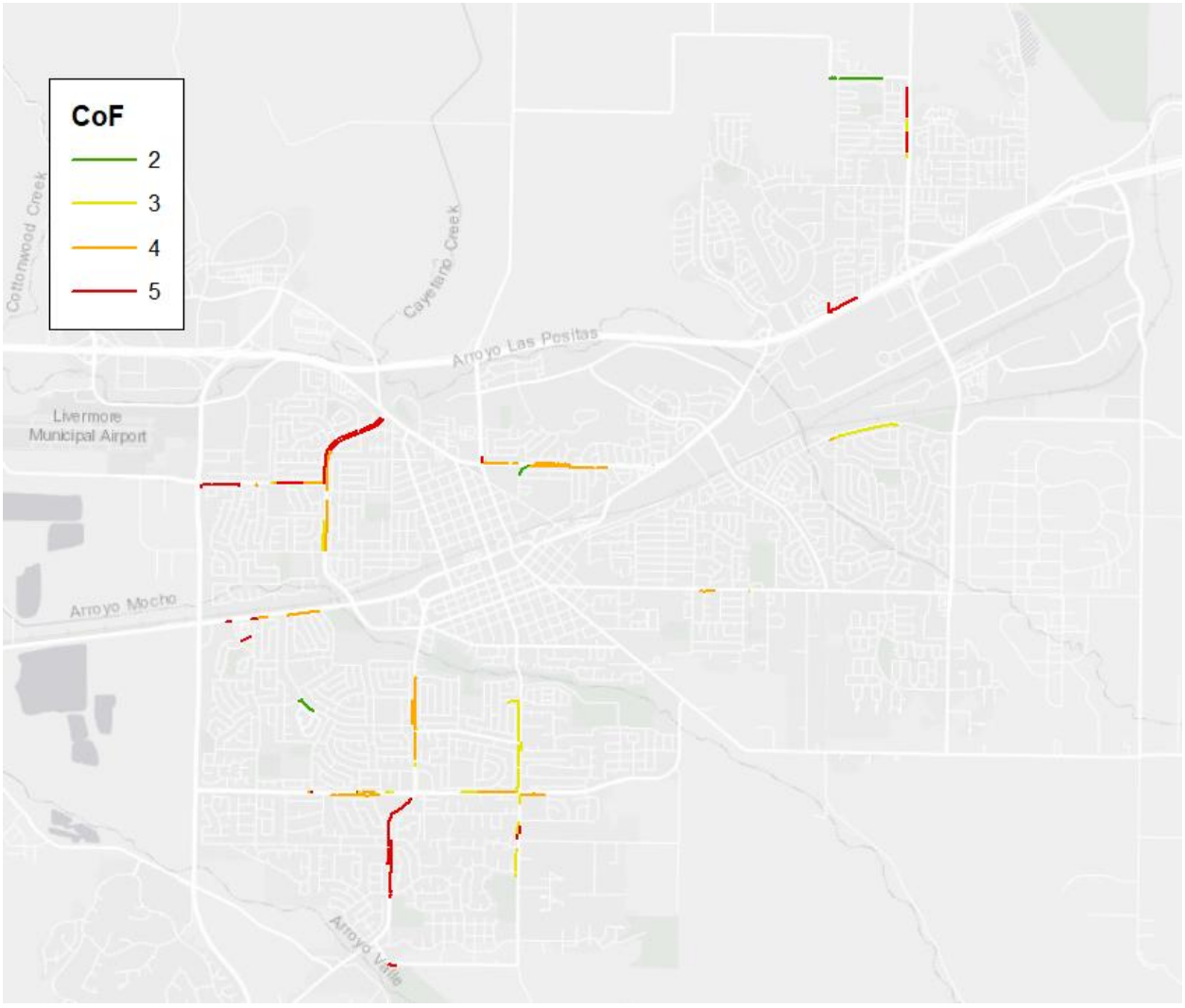

Figure 1-19 Wall CoF Map

1.3.3 Risk Analysis Results

Figure 1-20 shows the resulting overall risk profile for the Wall Management System. This profile incorporates both the PoF and CoF scores to prioritize the walls. The assets in the red zone of the risk matrix are the highest risk assets that have both a high probability and high consequence of failure. Walls with a risk score of 4 and above were considered high risk. The summation of replacement cost for all high-risk walls (red zone) equated to approximately $9.7 million. These high-risk assets consist of walls in poor condition along high pedestrian areas, city entry points, and arterials.

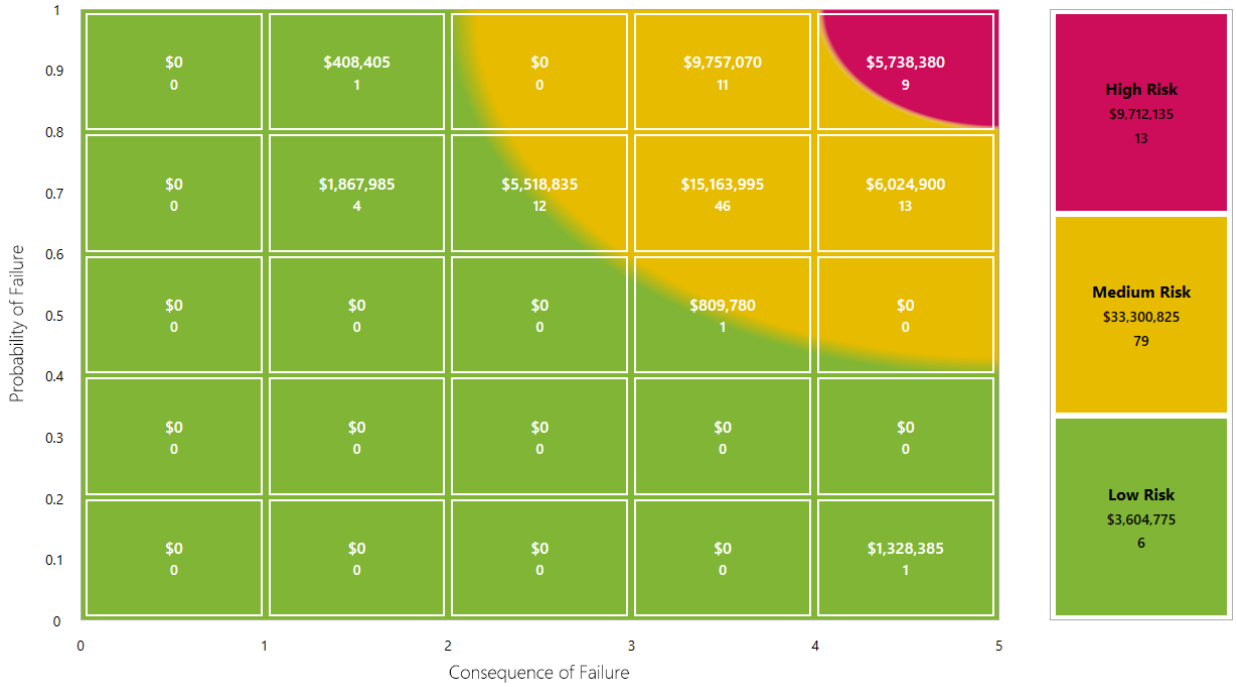

Figure 1-20 Wall Management System Risk Matrix

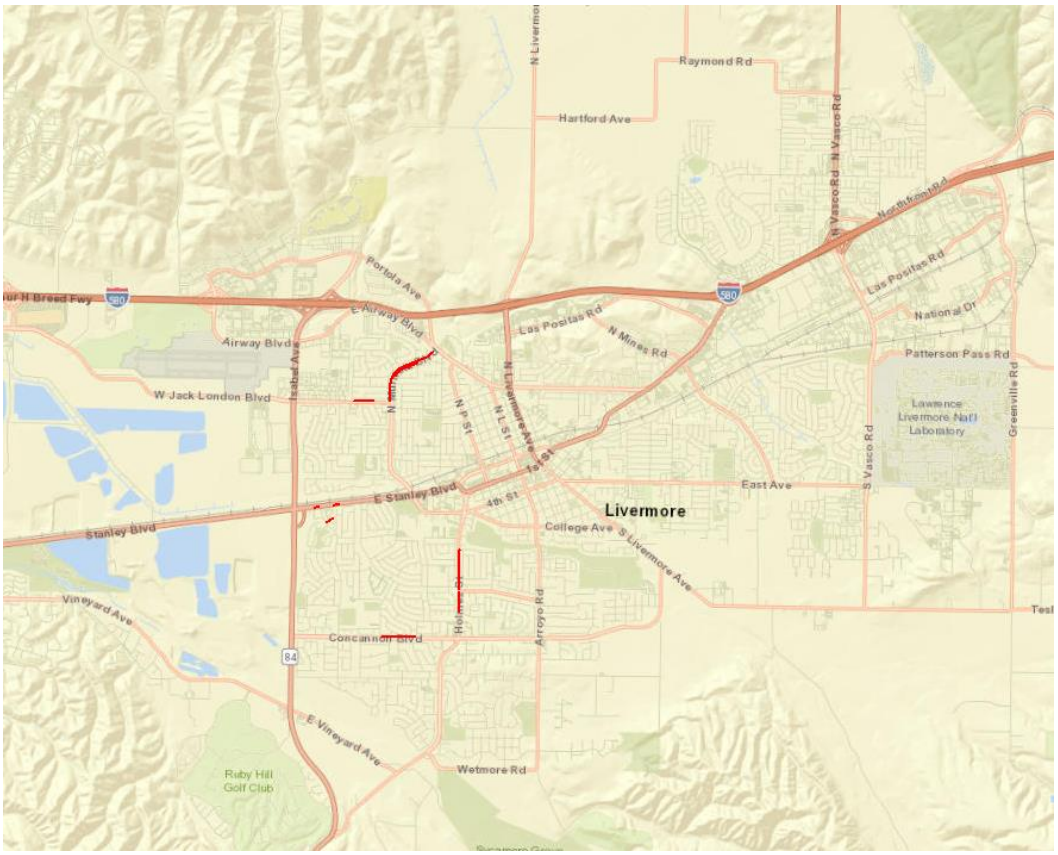

Figure 1-21 High Risk Walls Map

As mentioned previously, it will be important for the City to monitor the condition 3 walls as the condition of these walls may deteriorate faster than anticipated and could end up in the immediate needs in the near future. Approximately 5.7 miles of walls received a condition score of 3, which is approximately 61% of the total wall length for which the City is at least partially responsible.

1.4 Future Needs

1.4.1 Life Cycle Cost Logic

Life cycle cost logic, also known as management strategies, were developed for the wall assets. Each asset class was assigned a management strategy that includes the rehabilitation and replacement activities to best characterize the life cycle investment needs for the asset. The following table lists the management strategies for the walls by material type.

Table 1-6 Life Cycle Cost Logic

Wall Type	Useful Life (Years)	Rehab Frequency (Years)	Rehab Cost
Brick	70	15	Allocate 5% to address localized damages (e.g., paint, spot repair, graffiti removal)
Concrete Block	70	15	Allocate 5% to address localized damages (e.g., paint, spot repair, graffiti removal)
Concrete Panel	80	15	Allocate 5% to address localized damages (e.g., paint, spot repair, graffiti removal)
Slump Block	70	15	Allocate 5% to address localized damages (e.g., paint, spot repair, graffiti removal)
Stone	80	15	Allocate 5% to address localized damages (e.g., paint, spot repair, graffiti removal)
Veneer Stone	80	15	Allocate 5% to address localized damages (e.g., paint, spot repair, graffiti removal)
Wood	20	10	Allocate 5% to address localized damages (e.g., paint, spot repair, graffiti removal)

1.4.2 Long Range Replacement and Rehabilitation Profile

The following figures present the 30-year replacement and rehabilitation needs for which the City is responsible. The figure below presents the 30-year replacement and rehabilitation needs for the Wall Management System. Utilizing a deterministic model (i.e., assets fail at the end of their estimated useful lives), the average annual investment needed for the assets is approximately $1.6 million.

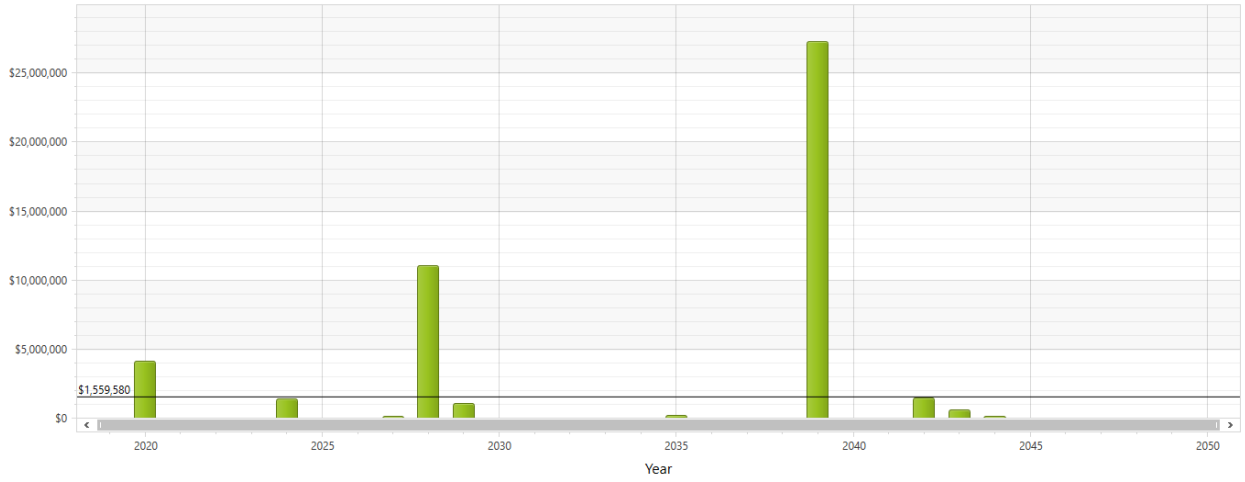

Figure 1-22 30-Year Wall Replacement and Rehabilitation Profile (Deterministic Model)

The 30-year life cycle cost analysis was repeated utilizing a probabilistic model. In this scenario, asset failures were smoothed to show that assets may fail sooner or later than their expected useful lives; as such, this scenario may present a more realistic estimate of the future asset failures and funding needs. The probabilistic analysis incorporates the concept of randomness in that early or late asset failures are distributed randomly using the assigned standard deviation (i.e., 20%). The probabilistic model predicts the City's annual replacement and rehabilitation needs at approximately $1.1 million.

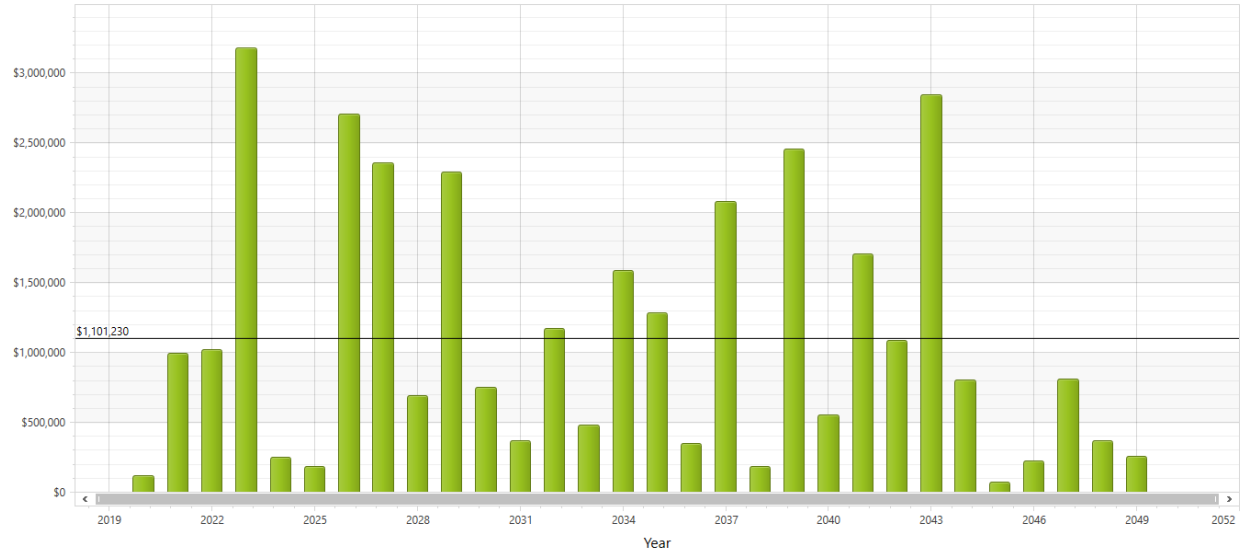

Figure 1-23 30-Year Wall Replacement and Rehabilitation Profile (Probabilistic Model)

Both analyses above represent results in 2020 dollars. Expecting the cost of construction will increase with time, a second model run was performed using a 3% annual inflation factor. With 3% inflation over the 30-year planning horizon, the projected annual investment need for the deterministic model increases from $1.6 million per year to $2.4 million per year. Similarly, for the probabilistic model, the annual investment need increased from $1.1 million per year to $1.7 million per year. The results of these analyses are presented the following figures.

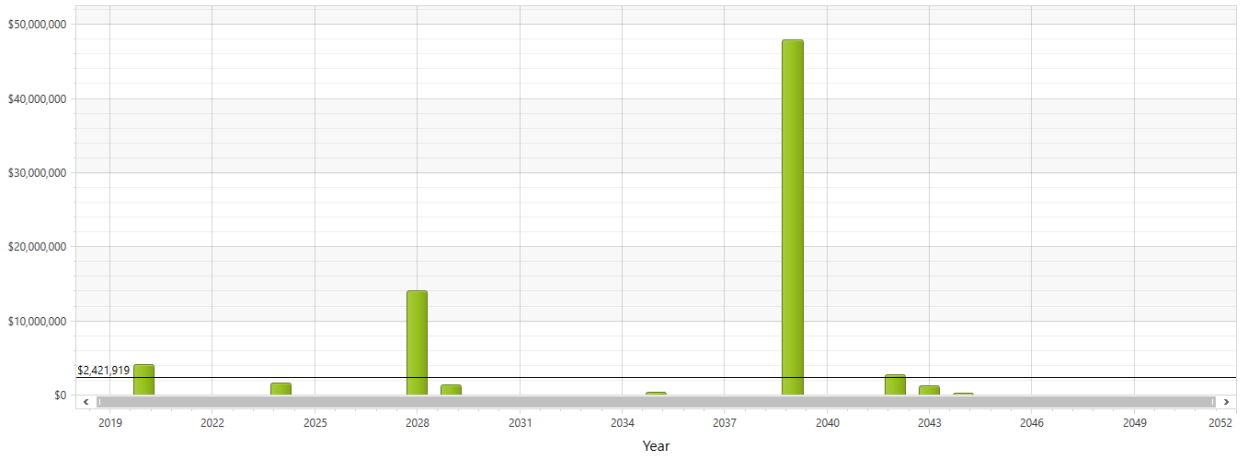

Figure 1-24 30-Year Wall Replacement and Rehabilitation Profile (Deterministic Model, 3% Inflation)

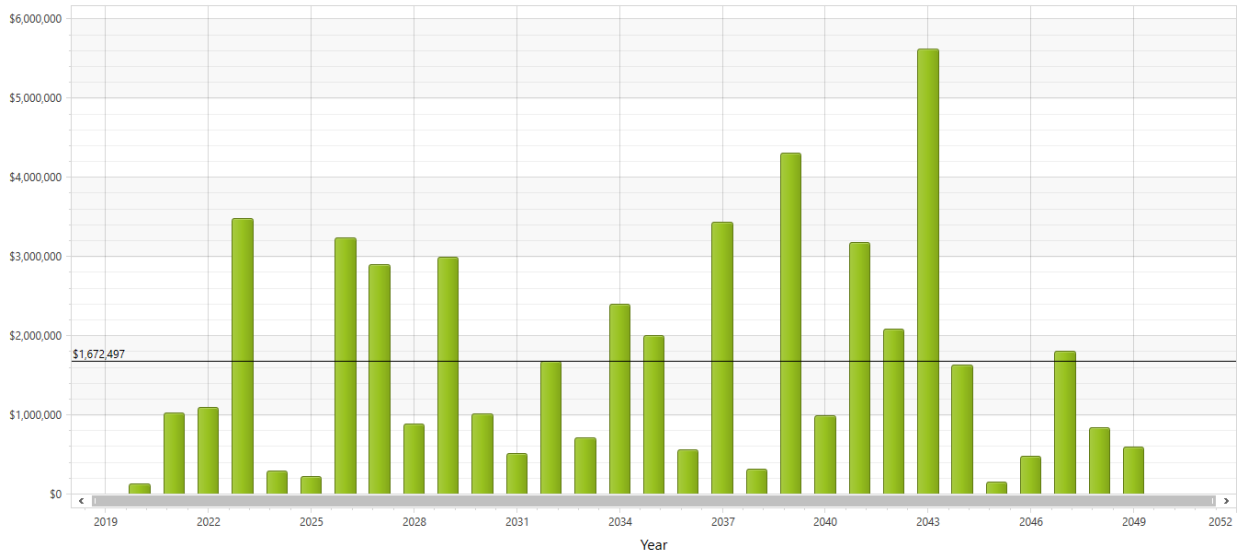

Figure 1-25 30-Year Wall Replacement and Rehabilitation Profile (Probabilistic Model, 3% Inflation)

The following table summarizes the 30-year replacement and rehabilitation needs.

Table 1-7 Wall Management System 30-Year Summary

Analysis Type	R&R Average
Deterministic	$1.6 million/yr
Probabilistic	$1.1 million/yr
Deterministic with 3% Inflation	$2.4 million/yr
Probabilistic with 3% Inflation	$1.7 million/yr

For asset management planning, both deterministic and probabilistic models are helpful. The deterministic model

will identify when the end of expected useful life of an asset will be reached. This allows the City to proactively inspect and plan the replacement or rehabilitation activities before failure. The probabilistic model provides a smoothed representation of the deterministic model. In order to reduce peaks, the analysis will assume that some assets fail earlier than expected life and some assets will exceed the expected life. The probabilistic model can represent a more realistic view of the asset failures. However, the randomness of the probabilistic model will prevent the City from proactively identifying assets before failure. Therefore, deterministic model is recommended for management.

1.4.3 Catch Up and Keep Up

When discussing replacement and rehabilitation, Catch Up describes all replacement and rehabilitation needs (e.g., assets fully consumed with condition score of 4 or 5) in the current year. Keep Up describes all replacement and rehabilitation needs for all of the assets in the remainder of a given planning horizon after the City has addressed the Catch Up needs. In the Catch Up and Keep Up analysis, the deterministic 30-year replacement and rehabilitation analysis is re-examined by bringing the high-risk assets (Catch Up needs) to the beginning of the planning horizon. The remaining replacement and rehabilitation needs are represented by the Keep Up. The following table displays the total Catch Up replacement and rehabilitation costs in 2020 and the Keep Up for a 30-year planning horizon in 2020 dollars with 30% for project delivery costs.

Table 1-8 Catch Up and Keep Up Values

Category	Cost
Catch Up	$9.7 million total
Keep Up	$1.3 million average per year

Overall, the Catch Up and Keep Up analysis provides a view of the future needs if the City were to focus solely on high-risk assets before addressing the other Keep Up needs. If the City were to fund the Catch Up ($9.7 million) in the immediate future, the Keep Up represents the annual average for the remaining rehabilitation and replacement needs in the 30-year planning horizon. As such, the Keep Up annual average should only be used as the future funding need estimate if the City has the budget to address all Catch Up needs in the immediate future. Otherwise, the replacement and rehabilitation analyses in Section 1.4.3 should be used as the basis for future planning.

1.5 Level of Service

1.5.1 Preferred Level of Service

The preferred level of service would be for the City to follow the maintenance, rehabilitation, and replacement cycles as outlined in the life cycle cost logic section of this report (i.e., full service, replace and rehabilitate all assets on schedule regardless of priority). However, due to the City's limited budget the City may prioritize assets to rehabilitate or replace.

The estimated annual budget over a 30-year horizon (Figure 1-22) for the preferred level of service was approximately $1.6 million or $2.4 million with 3% inflation.

1.5.2 Minimum Level of Service

Under the minimum level of service, the high-risk walls (i.e., CoF 4 and 5) would be the only walls that would be

rehabilitated and replaced. The following figure shows the rehabilitation and replacement profile over a 30-year horizon for the minimum level of service (high risk only). This would include the replacement and rehabilitation for the high consequence of failure General Fund walls. The annual average need for the minimum level of service is approximately $1.0 million per year or $1.7 million with 3% inflation.

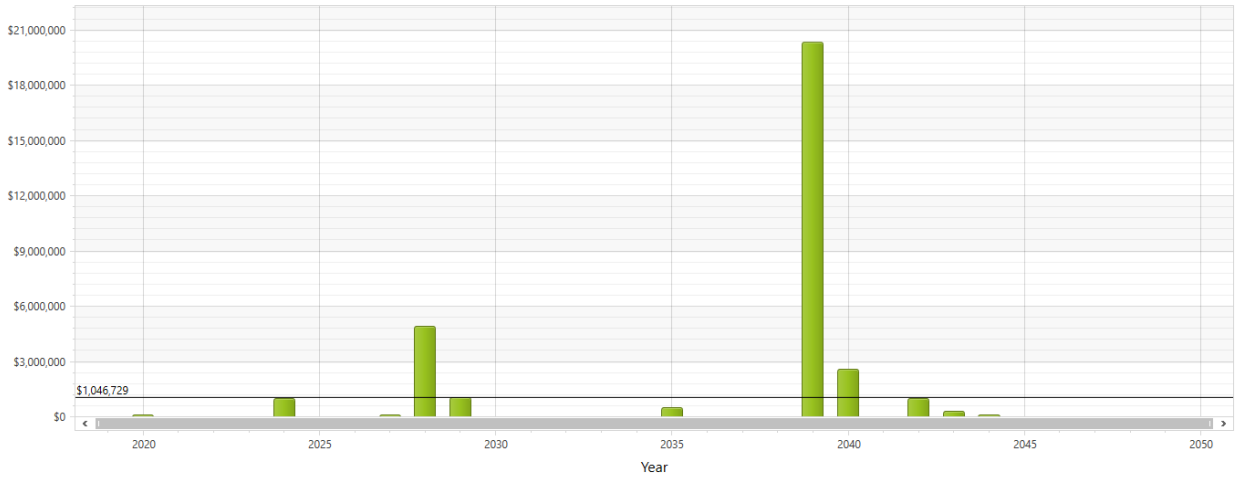

Figure 1-26 Minimum Level of Service Replacement and Rehabilitation Profile

While funding only the high-risk assets would allow the City to prioritize the high-CoF walls, approximately 1.6 miles of walls would not receive funding for replacement and rehabilitation activities under this minimum level of service.

1.6 Management System Score

1.6.1 Physical Health

The physical health of the Wall Management System was determined based on the ratio of poor condition assets and the high risk, red zone assets (as identified in Section 1.3) to the overall replacement cost of the system assets. These scores were used to assess the overall grade of the management system. For these scores, the lower the percentage of poor condition (Overall Condition) and high risk (Risk-Based Condition) scores, the better.

Table 1-9 Physical Health Values and Scores

Category	Score	Grade
Overall Condition	37%	F
Risk-Based Condition	24%	F

As shown in the table, the walls received condition and risk-based scores of F. This shows that a relatively high percentage of the walls for which the City is fully or partially responsible are in poor condition, and that a large portion of those are also high risk.

1.6.2 Financial Health

The financial health of the Wall Management System was judged based on the ratio of the catch up and keep up values to the 2020 annual rehabilitation and replacement budget of approximately $175,000. The scores for each

category are presented below. These scores were used to assess the overall grade of the management system.

Table 1-10 Financial Health Scores

Category	Score	Grade
Catch Up Score	2%	F
Keep Up Score	13%	F

With scores of F for both the catch up and keep up, the Wall Management System is shown to be seriously underfunded for the current and future needs. The poor financial health scores mean that the system will not have the funding it needs to keep the assets in decent condition in the future.

1.7 Policy

Replacement of the City's failing walls requires significant capital investment. For the long-term, sustainable management of the walls, the City will need to spend additional funds. However, under the current limited budget, the competition is tough among the other assets (e.g., pavement, buildings, parks) requiring General Fund dollars. The following potential options could be considered:

Increase Funding – The City may want to create a citywide infrastructure district and any costs incurred due to a wall would be paid for by this district. The City could also consider increasing property owners' parcel tax and pay for walls with the new portion of parcel tax.

Relocate Walls – When walls in the public right-of-way need to be replaced they could be relocated onto the adjacent property line. This requires property owner cooperation and could be done using an incentive process (ex: City funds the relocation and construction activities, the property owner funds future maintenance, repairs, and replacement). This should be done for an entire block to create positive aesthetics. Under this policy, approximately 1.7 miles of wall would be relocated and would be the responsibility of the property owner.

Develop Design Guidelines – The City should develop Design Guidelines for wall replacement activities along gateways, arterials, and collector streets. These guidelines should identify the style, material type, location, and height to ensure future replacement activities follow a consistent aesthetic look along each roadway.

Limit Construction of New Walls – The City could limit construction of future new walls to only those where the adjacent property owner bears full responsibility for all maintenance and replacement activities.

Provide Access for Walls on Property Line – For those walls that are currently on or inside a private property line, the City should provide access via the adjacent roadway or sidewalk for the private property owner to repair or replace the wall.

1.8 Confidence Level

Confidence level factor weights are based on the City's specific goals for this phase of the asset management program development. Factors that were focused on during this phase of the asset management program development, such as asset inventory and condition assessment, were given higher weight. One of the City's particular goals was also to encourage buy-in on the part of its staff and stakeholders, so the Community Asset

Management Program (CAMP) committee review was added to the general asset management program as a factor. On the other hand, factors that will be improved in future phases of the program development were given lower weight.

Table 1-11 Walls Confidence Level

Confidence Level Factor	Confidence Level Rating Score	Weighting Factor	Weighted Confidence Level Rating Score
Asset Inventory	85%	20%	17%
Data Quality	80%	15%	12%
Condition Assessment	80%	20%	16%
Asset Valuation	80%	10%	8%
Life-cycle Cost Logic	70%	10%	7%
Risk	85%	10%	9%
Staff Review	60%	5%	3%
CAMP Committee Review	100%	10%	10%
Total Score			82%

Asset Inventory (Unweighted Score - 85%)

On-site inventory collection and verification took place for each wall. Further use of the asset management system will determine whether all asset classes are represented in the asset register. Further investigation of ownership and responsibility may also affect the asset inventory in the future.

Data Quality (Unweighted Score - 80%)

On-site inventory collection and verification took place for each wall. Further verification with staff will take place in the future.

Condition Assessment (Unweighted Score - 80%)

On-site inventory condition assessment took place for each wall. Further verification with staff will take place in the future.

Asset Valuation (Unweighted Score - 80%)

Replacement costs were estimated for each asset based on City records. As assets are replaced in the future, the costs will be updated in the wall management system.

Life-cycle Cost Logic (Unweighted Score - 70%)

Life-cycle cost logic was assigned to the assets. Initial investigations into LMD/CFD funding for maintenance work was considered in the development of the management strategies; additional investigation into the LMD/CFD funding is recommended in the future.

Risk (Unweighted Score - 85%)

A robust CoF methodology was developed that incorporates the criticality of the location.

Staff Review (Unweighted Score - 60%)

Staff was involved in the development of the Wall Management System. Continued review of the inventory and condition assessment should happen regularly.

CAMP Committee Review (Unweighted Score - 100%)

The CAMP committee reviewed, analyzed, and provided input on the results throughout the asset management plan process.

1.9 Next Steps

Asset Inventory

This phase of the asset management project invested considerable effort in locating the walls for which the City is responsible. Any future changes to the asset inventory (e.g., newly constructed walls, City responsibility has been determined for an existing wall) should be reflected in the asset database.

Condition Assessment

During the condition assessment process, each wall segment was assigned a condition score based on the number and severity of faults and issues along the segment. As noted in this report, a significant number of the wall assets were determined to be condition 4 or 5. However, some walls may have degraded since the initial condition assessment. These walls should be monitored and their condition scores should be updated if necessary.