HISTORIC STREETS ASSESSMENT REPORT

PREPARED FOR

CITY OF PHILADELPHIA

DEPARTMENT OF STREETS

PHILADELPHIA CONTRACT NO.: 1220084

G&A FILE NO. 2011-03087-11

December 9, 2014

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1401 JFK Boulevard, Suite 830

PHILADELHIA, PA 19102-1676

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Submitted

December 9, 2014

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Executive Summary

The City of Philadelphia faces an immense challenge as it seeks to preserve its existing capital assets. The City has an extensive assortment of assets to maintain, including its historic streets. In some cases, these historic streets have aged to the point of needing significant repairs and even full replacement. These historic streets "possess significance as rare surviving fragments of the history of street paving in the City of Philadelphia, and as landmarks forming a visual record of the way Philadelphia looked in the past." [1] Without adequate funds, this unique set of assets will continue to degrade and cause significant reductions in service levels and safety. Preservation of this asset is important from a historic and infrastructure perspective.

In the coming years, as these historic streets continue to age, increased planning for repair and replacement funding will be needed. As funding is sought to complete the recommended work, it is not only the benefits of the investment that should be considered. What are the negative impacts of underinvestment, of allowing the historic streets to continue in their current state for a year – or five more?

This report is intended to provide the City with immediate value by providing an adaptable spreadsheet tool classifying the existing conditions and anticipated costs to upgrade the historic streets infrastructure to a state-of-good-repair. For the purposes of this report, a state-of-good-repair is defined as the roadway being well-maintained, such that repairs are made before the condition deteriorates to the point of presenting a safety risk, and the roadway can be driven on at the defined speed limit and/or walked on with general comfort.

The data collected for the 551 historic blocks included four objective criteria to determine areas of failure: depressions, potholes, patching, and inconsistencies with the historic material from the 1999 Philadelphia Historic Streets Paving Thematic District Inventory. Field data was compiled in Microsoft Excel to create an adaptable and searchable database. In addition to the documented information, the database includes subjective scores from the DOS and Philadelphia Historical Commission.

Based on information provided by the DOS, they are responsible for 309 (64%) of the 551 historic blocks; a bulk of the responsibility for the balance of blocks is shared between the Pennsylvania Department of Transportation (PennDOT) and the Southeastern Pennsylvania Transit Authority (SEPTA). It was found that, including cutback area and assuming that DOS' blocks with over 50% required repairs would be completely restored, 80% of the DOS' blocks needed preventative repair (repair to less than 30% of the block area), 10% of the DOS' blocks needed partial repair (repair to 30 -50% of the block area), and 10% of the DOS' blocks needed total repair (repair to over 50% of the block area). The total engineer's opinion of probable cost to bring all 309 to a state-of-good-repair is $60 million; however, if Federal Aid to Municipalities (FAM) funds are made available, the City's direct cost could drop to $53.5 million. A review of the City's repair methods found that the City will be investing its funds wisely when it completes this work.

It is recommended that the City begin investing additional funds annually into this historic infrastructure to start making headway on the significant number of identified repairs and limit the increase of needed repairs. As with any of the City's capital assets, aging is a continuous process that drives the need for repairs to maintain performance. With this quantification and prioritization information, it is clear that significant investments must be made to address any of these priorities and begin returning the historic streets to a state-of-good repair.

Introduction

The intent of this report is to provide the City with objective results that can be used to prioritize historic streets repair investments. This report describes the results of a 2013 Historic Street Condition Study conducted to determine what is needed to achieve a state-of-good-repair for the historic streets. The objectives of the study were to assess the current conditions of the historic streets in the City of Philadelphia; calculate the cost of repairing the historic streets to a state-of-good-repair; develop an objective framework for prioritizing repairs to the historic streets; and identify best practice repair methods. For the purposes of this report, a state-of-good-repair is defined as the roadway being well-maintained, such that repairs are made before the condition deteriorates to the point of presenting a safety risk, and the roadway can be driven on at the defined speed limit and/or walked on with general comfort.

This report is organized to summarize the results of the study in several sections:

- **Section 1: Historic Streets Condition Assessment** presents the findings of fieldwork, primarily focused on documenting the current conditions of the historic blocks. A Microsoft Excel database was generated to store individual block information in searchable format that could be adapted for the engineer's opinion of probable cost.
- **Section 2: Engineer's Opinion of Probable Cost** describes the analytical approach for preparing the engineer's opinion of probable cost of the repair work and manner in which the spreadsheet tool was supplemented to support the repair recommendations. Several cost summaries are also presented in this section.
- **Section 3: Historic Streets Prioritization** provides repair prioritization recommendations based on the framework built in the previous sections. Top 10 Lists of recommended repairs are included based on several categories.
- **Section 4: Repair Recommendations** details recommended changes to existing practices in order to maintain a state-of-good-repair.
- **Section 5: Conclusion** summarizes the results of the report.
- **References**
- **Appendix A** provides a copy of the Historic Streets Inventory prepared by KMJ Consulting, Inc.
- **Appendix B** provides a copy of the 2013 Philadelphia Historic Streets Inventory and Engineer's Opinion of Probable Cost. An electronic copy was also transmitted under separate cover to the City of Philadelphia's Department of Streets.

Section 1: Historic Streets Condition Assessment

In order to identify which blocks were classified as historic, the City of Philadelphia's Department of Streets (DOS) provided a paper copy of their 1999 Philadelphia Historic Streets Paving Thematic District Inventory. The 1999 Inventory identified 328 historic blocks and included information on the roadway material, historic/previous roadway material, and integrity of each block. The majority of blocks were granite/Belgian block material (68%) or red brick (25%). Other materials included yellow brick, orange brick, Belgian blue block, cobblestone, bluestone, and wood. Integrity was categorized as high, medium, or low. The blocks were fairly even split between being identified as high (45%) or medium integrity (49%); only 6% of roads were classified as low integrity in the 1999 Inventory. After review of the 1999 Inventory, Gilmore & Associates, Inc. contracted services from KMJ Consulting, Inc. to complete the 2013 field assessment of historic street conditions.

Gilmore & Associates, Inc., KMJ Consulting, Inc., and the DOS initiated the project with a discussion of the overall approach and agreed upon using field measurable objective criteria to empirically define the integrity of each block. To provide validity to the criteria, the pavement distresses most applicable to historic material roadways included in *ASTM D6433-11: Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys* were selected: depressions, patching, and potholes. Accounting for the unique historic aspects of these blocks, a fourth criterion was added to address inconsistencies with historic material from the 1999 Inventory.

1.1 Fieldwork

The fieldwork was conducted between August 14, 2013 and October 18, 2013. It was found that some "blocks" included in the 1999 Inventory actually included several blocks; a total of 551 individual blocks were identified during the 2013 fieldwork. For consistent reference to the 1999 Inventory block numbering convention, "blocks" that were divided into individual blocks were identified with a decimal, i.e. block 2 from the 1999 Inventory became blocks 2.01 and 2.02 in the 2013 Inventory. Blocks that were found during the fieldwork that were constructed with historic material but not included in the 1999 Inventory were numbered 300.01, 300.02, etc. based on alphabetic order.

The fieldwork focused on documenting the existing conditions and measuring the distressed areas associated with the four criteria. When multiple distresses were identified on a block, the fieldworker determined which criteria had the greatest negative impact to the roadway integrity and included the measurement in that category only. In this way, the criteria did not overlap and the maximum area needing repair for each block would be 100%. Providing consistency among several fieldworkers was controlled by the use of an established Field Work Checklist and procedures for photographing order.

All collected data was compiled in Microsoft Excel, generating an adaptable and searchable database. The database not only included the measured criteria, but all data gathered on the Field Work Checklist such as adjacent land use, City Planning District, presence of sidewalk, and previous paving/repair history.

For more detailed information on the fieldwork and a sample copy of the Field Work Checklist, refer to Appendix A: Historic Streets Inventory - Prepared by KMJ Consulting, Inc.

1.2 Assessment of Field Data

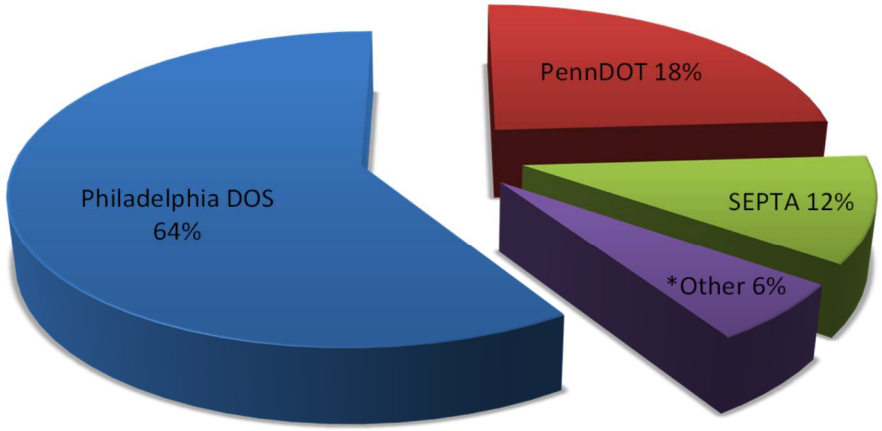
Per discussions with the DOS and the Philadelphia Historical Commission staff, 67 of the 551 blocks identified during the fieldwork were excluded from this report and recommended for exclusion from the updated Historic Street Inventory. Exclusion of a block is due to one of several reasons, such as the roadway having been paved over with concrete/asphalt (58 blocks) or a recommendation by the Philadelphia Historical Commission staff that the block had lost historic integrity. To maintain record of information gathered on the excluded blocks, a separate tab has been established in the 2013 Philadelphia Historic Streets Inventory and Engineer's Opinion of Probable Cost Microsoft Excel file.

In summary, 484 blocks are included in the current Inventory and Engineer's Opinion of Probable Cost tab. The DOS has indicated that its responsibility of maintaining these historic blocks is shared with various other entities, such as:

- Pennsylvania Department of Transportation (PennDOT)
- Southeastern Pennsylvania Transportation Authority (SEPTA)
- Delaware River Port Authority (DRPA)
- National Park Service (NPS)
- Philadelphia Housing Authority (PHA)
- Fairmount Park
- Private owners

Of the 484 blocks in the current Inventory, the DOS indicated they are responsible for 309 blocks (64%); PennDOT is responsible for 90 blocks (18%); SEPTA is responsible for 57 blocks (12%); and the remaining entities mentioned are responsible for a total of 28 blocks (6%). Figure 1.1 provides a visual representation of this distribution. A majority of the remaining discussion in this report will focus only on the 309 blocks that are the responsibility of the DOS though the 2013 Philadelphia Historic Streets Inventory and Engineer's Opinion of Probable Cost included as Appendix B provides information on all blocks.

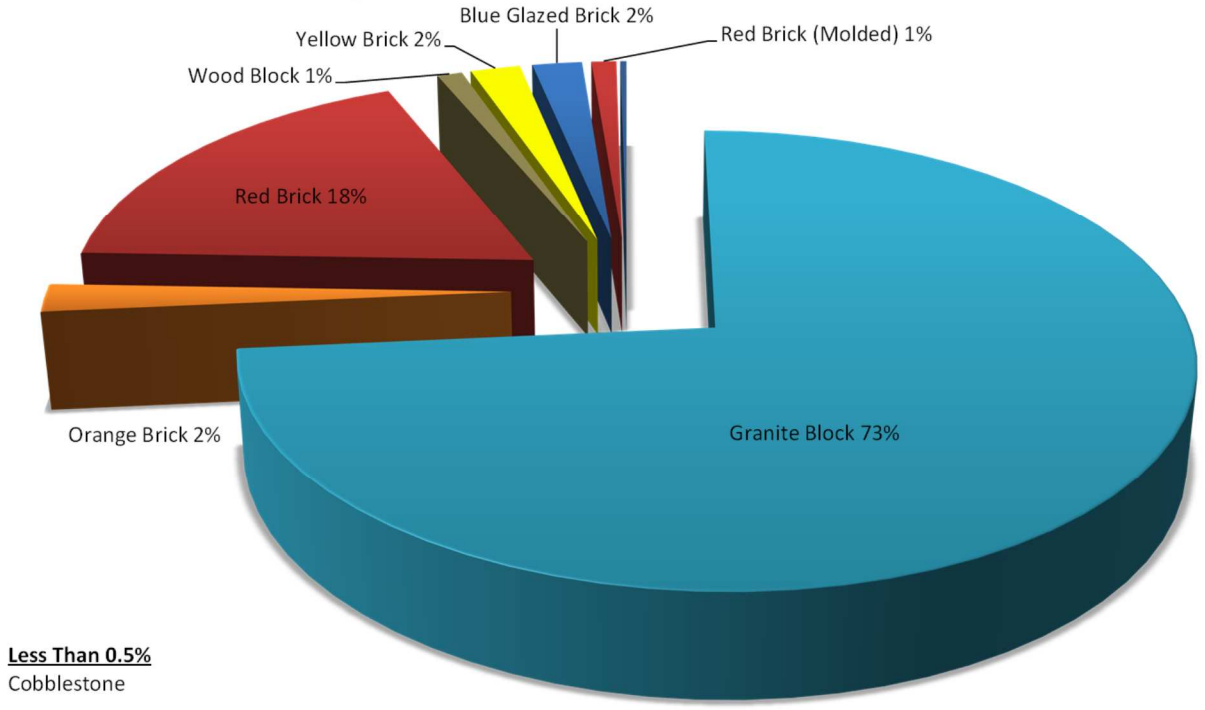
Figure 1.1: Responsible Entity



*Other entities include: DRPA, PHA, Fairmount Park, NPS, & Private

The DOS's 309 historic blocks are comprised of eight (8) distinct materials. As in the 1999 Inventory, the majority of blocks are granite block (73%) and red brick (18%). Figure 1.2 shows a breakdown of the various materials present in 2013.

Figure 1.2: Current DOS Block Material



The severity of measured repair areas for the 309 blocks was reviewed and 3 general repair categories were established: preventative repair (repair to less than 30% of the block area), partial repair (repair to 30-50% of the block area), and total repair (repair to over 50% of the block area). Excluding any additional cutback considerations for construction methods, 80% of the blocks needed preventative repair, 10% of the blocks needed partial repair, and 10% of the blocks needed total repair. For comparison, per the integrity categories identified in the 1999 Inventory, 6% of the blocks were low integrity, which is similar to the current 10%, but 45% of the blocks were high integrity as compared to 80% currently. Although it may seem that the blocks are in better condition now based on these statistics, it is unclear what method was used in 1999 to create the integrity categories and therefore this is not a true comparison; however, it should be clear that repair efforts need to be taken to reduce the number of future repairs.

1.3 Scoring

In order to assess the relative significance of repair work completed at any given block, the DOS determined it would be important to capture qualities such as a block's significance within the City's transportation network and overall historic significance. Therefore, a scoring program was designed, comprised of an objective score and a subjective score; the subjective score consisted of components from the DOS and Philadelphia Historical Commission. When summed together, a total score is generated for each block.

KMJ Consulting, Inc. created the objective scoring by comparing degradation levels among the blocks. After each of the objective criteria (depressions, patching, potholes, and inconsistent material) were calculated as a percentage of the total block area, they were multiplied by 20. Since the criteria do not overlap, an objective score of 20 represents total degradation of the block. For more detailed information on the objective scoring, refer to Appendix A: Historic Streets Inventory - Prepared by KMJ Consulting, Inc.

With a possible maximum objective score of 20, it was determined that the possible maximum subjective score should also be 20 and that even weight should be given to the DOS and historic prioritization subjective scores; therefore, the possible maximum DOS and historic prioritization subjective score is 10 and the possible maximum total score is 40.

When creating their subjective score, the DOS expressed concern regarding the anticipated number of direct users for each block and distinguishing between functionality and aesthetic issues (i.e. potholes versus inconsistent material). In this way, a block with an unpatched pothole would have a higher DOS subjective score than a similar block with a patched pothole, no matter the material. To account for these concerns, the subjective score was based on whether a block was a through street, its functional classification, number of adjoining parcels, and weighted objective criteria. Through streets were assigned a value of 2, while dead end streets were assigned a value of 0. Values assigned to roadway functional classifications also decreased with decreasing importance, with a maximum value of 3 for a roadway function classification 2 and a minimum value of 0 for functional classifications 5 and 12. The number of adjacent parcels also contributed to how the anticipated number of direct users was incorporated into the subjective score; blocks with over 40 adjacent parcels were assigned a value of 2, blocks with 21-40 adjacent parcels were assigned a value of 1, and blocks with 20 or fewer adjacent parcel were assigned a value of 0. Finally, a multiplier was added to the measured area associated with each objective criterion. The multiplier for the block area measured with missing material (potholes) was 3, depression/sagging was 2, patching was 1, and inconsistent material was 0. After summing these subjective criteria values on an individual block basis, the DOS subjective scores were weighted to a maximum score of 10.

The DOS met with representatives of the Philadelphia Historical Commission, asking them to create historic prioritization subjective scores for the blocks included in 2013 Inventory. Similar to the DOS, the Philadelphia Historical Commission chose to base a portion of their subjective score on the objective criteria measured during the fieldwork. The assigned value decreased as the required amount of repair increased, thus increasing the value of blocks which had relatively intact historic materials. For example, a block requiring 0-20% repair was assigned a value of 5, whereas a block requiring 80-90% repair was assigned a value of 1. The materials were also weighted based on historical significance, with values ranging from 10, for blue glazed brick, blue stone slab, cobblestone, orange brick, wood block, and yellow brick, to 0, for asphalt and concrete. Lastly, values were given based on whether a block was located within a local or national historic district, with higher values going to blocks within designated districts. Again, after summing the subjective criteria values on an individual block basis, the subjective scores were weighted to a maximum score of 10 to obtain the historic prioritization subjective score.

These scores can be reviewed in the 2013 Philadelphia Historic Streets Inventory and Engineer's Opinion of Probable Cost, attached as Appendix B.

Section 2: Engineer's Opinion of Probable Cost

Based on the Field Work Checklist data provided in the Microsoft Excel database, Gilmore & Associates, Inc. prepared a spreadsheet tool and engineer's opinion of probable costs on an individual blocks basis. Additional influences on repair work were evaluated and several adjustments and factors were incorporated, including those related to cutbacks, relative location, design and construction management, curb ramps, and reuse of existing historic material.

2.1 Adjustments and Factors

A cutback factor was meticulously considered, since it was felt to have the greatest impact on cost as it directly increased the repair areas of the roadway, gutter, and curb. To create the cutback factor, blocks were grouped by the measured amount of repairs required in ten percent (10%) intervals and a minimum ten percent (10%) sample size was taken from each group; however, it was assumed that any block requiring repairs to an area of greater than 50% would require total repair and no additional cutback factor was added to that group. The sample size was tested to develop an average percentage impact on the measured criteria from a one foot cutback on each side of an identified repair. Accounting for overlapping and/or adjacent repair areas and repairs adjacent to curbing, the calculated adjustments were each reduced by approximately 10%. As was expected, the cutback factor had the greatest impact on the 0-10% measured repair group since the cutback area was added to a smaller initial area. The cutback adjustments ranged from 110% for the 0-10% measured repairs group and 50% for the 20-30% measured repairs group.

In order to provide a more complete picture of the financial impact when considering repair of a selected block, relative location, design, and inspection costs were added. Location factors were assigned based on the proximity of a block's Planning District to Center City/the Central district to account for differences in incidental construction costs such as mobilization, maintenance and protection of traffic, and construction layout. Higher factors were assigned to districts closest to Center City/Central district and decreased as the distance from Center City/Central district increased. Values selected were 15% for several outer districts, 25% for mid-distance districts, and 35% for the Central district.

A 10% contingency adjustment for unforeseen circumstances and other minor construction costs, such as erosion and sediment control, was included. Since it is recommended that each block be individually re-evaluated when selected for construction and it was assumed that curb ramps would be designed and included in the bid package, rather than included as design-build bid items, a 15% design adjustment was added. A 15% adjustment was also added for construction management/construction inspection related expenses based on standard project costs for this service.

Grade adjustment impacts to existing utilities at street level were also considered. The number of utilities at street level was counted for each block and an average number per 100 foot of block was calculated for each Planning District to account for variations in utility density. However, when the cost associated with grade adjustments of street level utilities was added to the excavation, repair, curb ramp, and mobilization costs, it was found to account for less than 1% of the total cost. Since this cost was minimal and may be paid/recouped from the individual utility companies, this cost was removed and considered to be addressed as part of the 10% contingency.

Since curb ramps are required to be upgraded to the latest ADA requirements whenever the pedestrian path is altered, a curb ramp factor related was evaluated. A curb ramp table was created to calculate the anticipated number of curb ramps to be constructed based on ten percent (10%) intervals grouped by cutback factored repair areas. Ten percent (10%) of the historic blocks identified as needing repairs were randomly selected for the sample size. The following assumptions were then made: only curb ramps associated with the minor street would be required at 3-leg intersections; eight (8) curb ramps would be required at 4-leg intersection; and curb ramps would be divided equally between end-to-end historic blocks. With these assumptions, it was found that an average of 5 curb ramps would need to be replaced if an entire block were repaired. A relative fraction of this average number was then assigned to the ten percent (10%) interval groups.

2.2 Unit Costs

Gilmore & Associates, Inc. subcontracted with Promatech, Inc. to obtain unit costs, including costs associated with restoring blocks back to the 1999 Inventory material. This included material removal and repair to the existing subgrade, based on the specification used in a 2011 DOS bid package for historic streets repair work. The unit costs provided by Promatech, Inc. were then blended, using engineering judgment, with the 2011 DOS bid results. A heavier weight was given to the DOS's 2011 bid results. As part of their unit price information, Promatech Inc. also provided direction on a factor for reuse of existing materials, recommending to factor that 30% of the material being damaged during removal. This reuse factor was added to the percentage of historical material expected to be reused on-site.

2.3 Engineer's Opinion of Probable Cost Summaries

Based on the factors, adjustments, and unit costs described, the database provided by KMJ Consulting, Inc. was supplemented to calculate an engineer's opinion of probable cost for each of the historic blocks. The total engineer's opinion of probable cost for the 484 blocks included in the 2013 Inventory was calculated to be in the range of $80 million. The average repair cost per block is $160,000, though an average block of total repair would be just over $500,000. This information is also provided in Table 2.1 below.

Table 2.1: Opinion of Probable Cost – By Required Repair Percentage
All Blocks

Percentage of Block Being Repaired	Number of Blocks		Cost for All Blocks	Average Cost per Block	Percentage of Total Cost
No Repairs	38	8%	$0	$0	0%
00 - 10%	128	26%	$3,274,231	$25,580	4%
10 - 20%	78	16%	$9,454,630	$121,213	12%
20 - 30%	71	15%	$12,185,346	$171,625	16%
30 - 40%	63	13%	$13,849,195	$219,828	18%
40 - 50%	18	4%	$5,490,486	$305,027	7%
50 - 100%	53	11%	$16,404,505	$309,519	21%
Total Repair (100%)	35	7%	$17,644,706	$504,134	23%
Total:	484		**$78,303,099**	**$161,783**	

Total costs for the 484 blocks were also reviewed in terms of how each construction task contributed. As was expected, the largest percentage (49%) of the total cost is attributed to the actual repair work and material. Table 2.2 shows the probable breakdown in terms of general construction tasks for all blocks.

Table 2.2: Opinion of Probable Cost – Construction Tasks
All Blocks

Construction Tasks	Total Cost for All Blocks	
Removal & Excavation	$5,687,259	7%
Roadway Repair	$38,324,292	49%
Gutter Repair	$566,010	1%
Curb Repair	$8,623,632	11%
Curb Ramps	$9,218,139	12%
Mobilization	$15,883,767	20%
Total:	**$78,303,099**	

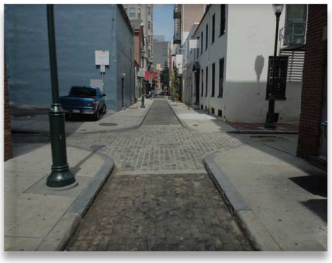
Since the blocks are not the responsibility of just a singular entity, this cost would be split among the DOS, PennDOT, SEPTA, and others. The DOS's 309 blocks (64%) account for $60 million (77%) of the total cost. The reason for this is that the DOS bears the responsibility, and therefore cost, for 30 of the 35 blocks requiring total repair. The cost breakdown for all entities can be seen here in Table 2.3.

Table 2.3: Opinion of Probable Cost – By Responsible Entity
All Blocks

Responsible Entity	Number of Blocks		Total Cost	Percentage of Total Cost
DOS	**309**	**64%**	**$60,355,656**	**77%**
PennDOT	90	19%	$3,192,902	4%
SEPTA	57	12%	$11,973,090	15%
Other*	28	6%	$2,781,451	4%
Total:	484		**$78,303,099**	

*Other entities include: DRPA, PHA, Fairmount Park, NPS, & Private






In order to group relative levels of required repairs, 7 repair categories were established. Since, as stated above, it was assumed that any block requiring repairs to an area greater than 50% would require total repair, these blocks became one repair category. For blocks needing preventative or partial repairs, repair categories were established in 10% increments of the block area requiring repair. Lastly, categories were created for blocks needing no repair and total repair. Table 2.4 below represents the costs associated with each repair category for the City's 309 blocks. Again, this includes all factors, adjustments, and unit costs that were previously described. When the cutback area is included, 61% of the blocks needed repair to 30% or less of the block area, 20% of the blocks needed repair to 30-50% of the block area, and 20% of the blocks needed total repair.

Table 2.4: Opinion of Probable Cost – By Required Repair Percentage

DOS Blocks

Percentage of Block Being Repaired	Number of DOS Blocks		Cost for DOS Blocks	Average Cost per Block	Percentage of Total Cost
No Repairs	17	6%	$0	$0	0%
00 - 10%	60	19%	$1,832,548	$30,542	3%
10 - 20%	63	20%	$8,070,310	$128,100	13%
20 - 30%	48	16%	$8,448,356	$176,007	14%
30 - 40%	48	16%	$11,478,540	$239,136	19%
40 - 50%	12	4%	$4,170,141	$347,512	7%
50 - 100%	31	10%	$10,835,264	$349,525	18%
Total Repair (100%)	30	10%	$15,520,497	$517,350	26%
Total:	**309**		**$60,355,656**	**$195,326**	

Though they only account for 10% of the DOS' blocks, the blocks which need total repair account for just over 25% of the total opinion of probable cost. The average cost for one of these blocks is around $520,000, which is nearly triple the average cost of the 309 blocks. Without the total repair blocks included, the average cost per block drops by around $35,000, to $160,000.

Therefore, based on the engineer's opinion of probable cost, nearly 4 blocks could be repaired or 1 block could be totally repaired to historic materials for each $500,000 invested into the City's historic streets.



In order to determine the financial impact to the City, Table 2.5 was prepared. Possible funding sources for these blocks were reviewed and it was found that 20 (6.5%) of the City's 309 blocks had Federal Aid to Municipalities Identification (FAM ID) numbers and may be eligible to receive 80% in federal funds for the repair work. Assuming the FAM funds would be available for each road with a FAM ID, the City's cost responsibility would be reduced to approximately $53.5 million. This brings the City's direct cost responsibility to 68% of the total engineer's opinion of probable cost.

Table 2.5: Opinion of Probable Cost – Construction Tasks and FAM ID DOS Blocks

Construction Tasks	Cost for DOS Blocks	Total Cost for Blocks w/o FAM ID	DOS Blocks with a FAM ID			Total DOS Cost Responsibility	
			Total Cost for Blocks with a FAM ID	DOS Match (20%)	FAM Funding (80%)		
Removal & Excavation	$4,430,918	$3,737,336	$693,582	$138,716	$554,866	$3,876,052	7%
Roadway Repair	$29,818,129	$25,230,054	$4,588,075	$917,615	$3,670,460	$26,147,669	49%
Gutter Repair	$409,473	$409,465	$8	$2	$6	$409,467	1%
Curb Repair	$6,327,239	$5,653,870	$673,369	$134,674	$538,695	$5,788,544	11%
Curb Ramps	$6,392,100	$5,952,375	$439,725	$87,945	$351,780	$6,040,320	11%
Mobilization Incidentals	$12,977,797	$10,778,235	$2,199,562	$439,912	$1,759,650	$11,218,147	21%
Total:	**$60,355,656**	$51,761,335	$8,594,321	$1,718,864	$6,875,457	**$53,480,199**	

2.4 Funding Recommendations

It is our understanding that, in the past, the City of Philadelphia has budgeted $400,000 every two years for work on historic streets. The results of this report indicate that funding should be substantially increased. Even with a minimum $1 million annual budget, a five-fold increase in funding, it would take over 50 years to restore all historic blocks to a state-of-good-repair; that estimate does not include increases in cost and increase in severity and area of existing repairs.

For the purposes of this report, a state-of-good-repair is defined as the roadway being well-maintained, such that repairs made before the condition deteriorates to the point of presenting a safety risk, and the roadway can be driven on at the defined speed limit or walked on with general comfort. It is highly recommended that each responsible entity consider a program with a set-aside annual budget allowance to improve the conditions of the historic roads. Time will only serve to increase the severity of the current conditions and increase construction costs.

Furthermore, it is recommended that the City maintain the spreadsheet tool by assigning a responsible party to keep the information current. As repair work is completed, additional information such as maintenance records and unit costs from bid results could be added to this database.

Section 3: Historic Streets Prioritization

Prioritizing the assessed historic streets for repair and replacement was a central focus of the Study. While it is recommended that total repair be prioritized above partial repairs, it was concluded that selecting a priority between total and preventative repairs was a policy issue to be determined by the responsible entity. With this consideration, several Top 10 Lists were prepared to provide a broader picture of the identified repairs and costs associated with each repair category. For all Lists, only blocks open to vehicular traffic were considered since vehicular travel at established speed limits was one of the two criteria established for the state-of-good-repair and the other criteria, comfortable pedestrian movement, would apply to all blocks. The categories for which Top 10 Lists were created and the order in which they appear in the report are as follows:

- Total Score of DOS Blocks
- Objective Score of DOS Blocks
- Total Subjective Score of DOS Blocks
- DOS Subjective Score of DOS Blocks
- Historic Prioritization Subjective Score of DOS Blocks
- Total Score of DOS blocks needing preventative repair
- Total Score of DOS blocks needing partial repair
- Probable Cost of DOS Blocks

Please note that a separate Top 10 List of DOS blocks needing total repair sorted by total score was not included since the list of blocks is that same as those included in the Top 10 List sorted by Total Score in Table 3.1.

3.1 Top 10 Lists

Table 3.1 is arranged by total score of the DOS blocks that are open to vehicular traffic. The total scores for these blocks range from 30.34 to 23.62, out of a maximum score of 40. The total engineer's opinion of probable cost for these 10 blocks is $3.8 million and none of the blocks have FAM IDs. This List would require an annual investment from the City of $0.75 million over 5 years. The blocks included in this Top 10 List are as follows:

- Maiden Street, 100 block, between Mansion and Silverwood Streets
- Waverly Street, 1400 block, between 15th and Carlisle Streets
- Reno Street, 400 block, between Lawrence and Leithgow Streets
- Orkney Street, N. 800 block, between Reno and Myrtle Streets
- American Street, S. 300 block, between Spruce and Delancey Streets
- Thomas Paine Place, 200 block, between Dock and 3rd Streets
- Mermaid Lane, E. Unit block, between Germantown Avenue and Winston Road
- Leithgow Street, N. 800 block, between a dead end and Reno Street
- Delancey Street, 1500 block, between 16th Street and a dead end
- Elbow Lane, 200 block, between Bank and Bodine Streets


Maiden Street


Waverly Street

Table 3.1: Top Ten List by Total Score

DOS Blocks

Total: $3,757,577 ● 5yr Annual Cost: $751,515

2013 Block Number	Street	Cross Streets	2013 Primary Roadway Material	Percentage of Roadway Repair (w/Cutback)	Objective Score	Total Subjective Score	Total Score	Total Opinion of Probable Repair Cost
118	Maiden St.	Mansion & Silverwood	Red Brick	100%	19.64	10.70	**30.34**	$361,219
205	Waverly St.	15th & Carlisle	Blue Glazed Brick	100%	15.45	14.87	**30.32**	$283,273
167.03	Reno St.	Lawrence & Leithgow	Granite Block	100%	20.00	9.13	**29.13**	$191,743
145.02	Orkney St.	Reno & Myrtle	Granite Block	100%	16.33	10.67	**27.00**	$530,084
8	American St.	Spruce & Delancey	Granite Block	100%	11.60	15.09	**26.70**	$293,323
38	Thomas Paine Pl.	Dock & 3rd	Granite Block	100%	15.05	11.11	**26.16**	$759,139
129.01	Mermaid Ln.	Germantown & Winston	Granite Block	100%	16.11	9.54	**25.65**	$370,348
111.01	Leithgow St.	Dead End & Reno	Granite Block	100%	20.00	5.43	**25.43**	$261,602
64	Delancey St.	16th & Dead End	Blue Glazed Brick	100%	13.97	11.33	**25.30**	$541,568
68.02	Elbow Ln.	Bank & Bodine	Granite Block	100%	12.43	11.19	**23.62**	$165,278

Table 3.2 is arranged by objective score of the DOS blocks that are open to vehicular traffic. The objective scores for these blocks range from 20.00 to 14.25, out of a maximum score of 20. The total engineer's opinion of probable cost for these 10 blocks is $4.1 million and none of the blocks have FAM IDs. Seven of these blocks are also included in the Top 10 List by Total Score. This List would require an annual investment from the City of $0.82 million over 5 years. The blocks included in this Top 10 List are as follows:

- Reno Street, 400 block, between Lawrence and Leithgow Streets
- Leithgow Street, N. 800 block, between a dead end and Reno Street
- Maiden Street, 100 block, between Mansion and Silverwood Streets
- Orkney Street, N. 800 block, between Reno and Myrtle Streets
- Skidoo Street, between Stanton and Calumet Streets
- Mermaid Lane, E. Unit block, between Germantown Avenue and Winston Road
- Cuthbert Street, 2200 block, between 22nd and 23rd Streets
- Waverly Street, 1400 block, between 15th and Carlisle Streets
- Thomas Paine Place, 200 block, between Dock and 3rd Streets
- Cuthbert Street, 900 block, between Hutchinson and 10th Streets


Reno Street


Leithgow Street

Table 3.2: Top Ten List by Total Objective Score
DOS Blocks
Total: $4,097,158 ● 5yr Annual Cost: $819,432

2013 Block Number	Street	Cross Streets	2013 Primary Roadway Material	Percentage of Roadway Repair (w/Cutback)	Total Objective Score	Total Subjective Score	Total Score	Total Opinion of Probable Repair Cost
167.03	Reno St.	Lawrence & Leithgow	Granite Block	100%	**20.00**	9.13	29.13	$191,743
111.01	Leithgow St.	Dead End & Reno	Granite Block	100%	**20.00**	5.43	25.43	$261,602
118	Maiden St.	Mansion & Silverwood	Red Brick	100%	**19.64**	10.70	30.34	$361,219
145.02	Orkney St.	Reno & Myrtle	Granite Block	100%	**16.33**	10.67	27.00	$530,084
183	Skidoo St.	Stanton & Culmet	Granite Block	100%	**16.24**	6.25	22.49	$366,386
129.01	Mermaid Ln.	Germantown & Winston	Granite Block	100%	**16.11**	9.54	25.65	$370,348
56	Cuthbert St.	22nd & 23rd	Granite Block	100%	**15.59**	5.77	21.36	$675,544
205	Waverly St.	15th & Carlisle	Blue Glazed Brick	100%	**15.45**	14.87	30.32	$283,273
38	Thomas Paine Pl.	Dock & 3rd	Granite Block	100%	**15.05**	11.11	26.16	$759,139
55.01	Cuthbert St.	10th & Hutchinson	Granite Block	100%	**14.25**	5.88	20.13	$297,820

Table 3.3 is arranged by total subjective score of the DOS blocks that are open to vehicular traffic. The subjective scores for these blocks range from 15.09 to 14.09, out of a maximum score of 20. The total engineer's opinion of probable cost for these 10 blocks is $1.7 million; however, 4 of these blocks have a FAM ID so the DOS's probable cost may be closer to $1.2 million. This List would require an annual investment from the City of $0.35 million over 5 years without FAM funds or $0.25 million over 5 years with FAM funds. The blocks included in this Top 10 List are as follows:

- American Street, S. 300 block, between Spruce and Delancey Streets
- Waverly Street, 1400 block, between 15th and Carlisle Streets
- Panama Street, 2400 block, between 24th and 25th Streets
- Philip Street, S. 300 block, between Spruce and Delancey Streets
- 2nd Street, S. 400 block, between Lombard and Stamper Streets
- 2nd Street, S. 300 block, between Delancey and Spruce Streets
- 2nd Street, S. 300 block, between Pine and Delancey Streets
- Cypress Street, 500 block, between 6th and Reese Streets
- Panama Street, 1800 block, between 18th and 19th Streets
- 2nd Street, S. 400 block, between Stamper and Pine Streets


American Street


Waverly Street

Table 3.3: Top Ten List by Total Subjective Score

DOS Blocks

Total: $1,740,576 ● 5yr Annual Cost: $348,115

2013 Block Number	Street	Cross Streets	2013 Primary Roadway Material	Percentage of Roadway Repair (w/Cutback)	Total Objective Score	Total Subjective Score	Total Score	Total Opinion of Probable Repair Cost
8	American St.	Spruce & Delancey	Granite Block	100%	11.60	**15.09**	26.70	$293,323
205	Waverly St.	15th & Carlisle	Blue Glazed Brick	100%	15.45	**14.87**	30.32	$283,273
149	Panama St.	24th & 25th	Granite Block	34%	3.63	**14.31**	17.94	$139,995
154	Philip St.	Spruce & Delancey	Granite Block	28%	3.02	**14.30**	17.32	$68,518
214.01	2nd St.*	Lombard & Stamper	Granite Block	19%	2.60	**14.26**	16.87	$81,141
213.02	2nd St.*	Delancey & Spruce	Granite Block	33%	4.34	**14.19**	18.53	$278,683
213.01	2nd St.*	Pine & Delancey	Granite Block	30%	4.05	**14.18**	18.23	$190,179
58.01	Cypress St.	6th & Reese	Granite Block	22%	2.41	**14.16**	16.57	$148,841
148	Panama St.	18th & 19th	Granite Block	23%	2.52	**14.11**	16.63	$155,235
214.02	2nd*	Stamper & Pine	Granite Block	23%	2.49	**14.09**	16.58	$101,388

*FAM Eligible Block

Table 3.4 is the Top 10 List sorted by the DOS subjective score of the DOS blocks that are open to vehicular traffic. The subjective scores for these blocks range from 10.00 to 7.53, out of a maximum score of 10. The total engineer's opinion of probable cost for these 10 blocks is $3.6 million; however, 2 of these blocks have a FAM ID so the DOS's probable cost may be closer to $3.2 million. This List would require an annual investment from the City of $0.73 million over 5 years without FAM funds or $0.35 million over 5 years with FAM funds. The blocks included in this Top 10 List are as follows:

- Orkney Street, N. 800 block, between Reno and Myrtle Streets
- Germantown Avenue, 8600 block, between Bethlehem and Rex Streets
- Maiden Street, 100 block, between Mansion and Silverwood Streets
- American Street, S. 300 block, between Spruce and Delancey Streets
- Abbottsford Avenue, W. 100 block, between Wayne and Green Streets
- Leithgow Street, N. 800 block, between Parrish and Reno Streets
- Reese Street, S. 500 block, between Rodman and Lombard Streets
- Hutchinson Street, S. 200 block, between Irving and Latimer Streets
- Sheldon Street, between Hermitage and Fountain Streets
- 2nd Street, S. 300 block, Delancey and Spruce Streets


Orkney Street


Germantown Avenue

Table 3.4: Top Ten List by DOS Subjective Score

DOS Blocks

Total: $3,630,952 ● 5yr Annual Cost: $726,190

2013 Block Number	Street	Cross Streets	2013 Primary Roadway Material	Percentage of Roadway Repair (w/Cutback)	Total Objective Score	DOS Subjective Score	Total Subjective Score	Total Score	Total Opinion of Probable Repair Cost
145.02	Orkney St.	Reno & Myrtle	Granite Block	100%	16.33	**10.00**	10.67	27.00	$530,084
90.21	Germantown Ave.*	Bethlehem & Rex	Granite Block	37%	4.94	**9.24**	12.57	17.52	$221,972
118	Maiden Ln.	Mansion & Silverwood	Red Brick	100%	19.64	**9.03**	10.70	30.34	$361,219
8	American St.	Spruce & Delancey	Granite Block	100%	11.60	**8.76**	15.09	26.70	$293,323
1	Abbottsford Ave.	Wayne & Green	Red Brick	4%	.37	**8.58**	11.91	12.28	$95,984
111.02	Leithgow St.	Parrish & Reno	Granite Block	71%	8.64	**8.03**	9.36	18.00	$254,199
165.02	Reese St.	Rodman & Lombard	Granite Block	65%	7.47	**7.89**	9.55	17.02	$261,122
101.03	Hutchinson St.	Irving & Latimer	Granite Block	100%	10.18	**7.86**	10.86	21.04	$234,257
300.21	Sheldon St.	Hermitage & Fountain	Red Brick	80%	9.70	**7.65**	10.32	20.02	$1,100,109
213.02	2nd St.*	Delancey & Spruce	Granite Block	33%	4.34	**7.53**	14.19	18.53	$278,683

*FAM Eligible Block

Table 3.5 is the Top 10 List sorted by the historic prioritization subjective score of the DOS blocks that are open to vehicular traffic. The subjective scores for these blocks range from 10.00 to 7.00, out of a maximum score of 10. The total engineer's opinion of probable cost for these 10 blocks is $1.5 million. This List would require an annual investment from the City of $0.30 million over 5 years. The blocks included in this Top 10 List are as follows:

- Mascher Street, N. Unit block, between Cuthbert and Arch Streets
- Perth Street, S. 400 block, Lombard and Addison Streets
- Filbert Street, 200 block, between 3rd and American Streets
- Waverly Street, 1400 block, between 15th and Carlisle Streets
- Delancey Street, 1500 block, between 16th Street and a dead end
- Station Street, 4400 block, between Levering and Gay Streets
- Leithgow Street, S. 200 block, between Locust Street and north dead end
- Reese Street, S. 300 block, between Delancey and Cyprus Streets
- Bouvier Street, between North and Melon Streets
- Panama Street, 2400 block, between 24th and 25th Streets


Mascher Street


Perth Street

Table 3.5: Top Ten List Sorted by Historic Prioritization Subjective Score
DOS Blocks
Total: $1,455,633 ● 5yr Annual Cost: $291,127

2013 Block Number	Street	Cross Streets	2013 Primary Roadway Material	Percentage of Roadway Repair (w/Cutback)	Total Objective Score	Historic Prioritization Subjective Score	Total Subjective Score	Total Score	Total Opinion of Probable Repair Cost
124	Mascher St.	Cuthbert & Arch	Blue Glazed Brick	17%	1.66	**10.00**	13.40	15.06	$54,992
153	Perth St.	Lombard & Addison	Yellow Brick	12%	1.18	**10.00**	13.57	14.76	$40,000
76.01	Filbert St.	3rd & American	Blue Glazed Brick	11%	1.05	**10.00**	10.27	11.31	$74,187
205	Waverly St.	15th & Carlisle	Blue Glazed Brick	100%	15.45	**9.00**	14.87	30.32	$283,273
64	Delancey St.	16th & Dead End	Blue Glazed Brick	100%	13.97	**9.00**	11.33	25.30	$541,568
191	Station St.	Levering & Gay	Red Brick	27%	2.88	**8.33**	12.20	15.08	$54,316
112	Leithgow St.	Locust & N. Dead End	Red Brick	0%	0.00	**8.33**	11.73	11.73	$0
164	Reese St.	Delancey & Cyprus	Red Brick	65%	7.37	**8.00**	12.51	19.88	$124,165
300.03	Bouvier St.	North & Melon	Granite Block	57%	6.47	**8.00**	9.13	15.60	$143,137
149	Panama St.	24th & 25th	Granite Block	34%	3.63	**7.00**	14.31	17.94	$139,995

Table 3.6 is the Top 10 List sorted by the total score of the DOS blocks that need preventative repair (less than 30% of the block) and are open to vehicular traffic. The total scores for these blocks range from 18.78 to 16.71, out of a maximum score of 40. The total engineer's opinion of probable cost for these 10 blocks is $1.9 million; however, 5 of these blocks have a FAM ID so the DOS's probable cost may be closer to $1.0 million. This List would require an annual investment from the City of $0.37 million over 5 years without FAM funds or $0.20 million over 5 years with FAM funds. The blocks included in this Top 10 List are as follows:

- 2nd Street, S. 400 block, between Lombard and Pine Streets
- 2nd Street, S. 300 block, between Delancey and Spruce Streets
- 2nd Street, S. 300 block, between Pine and Delancey Streets
- Chadwick Street, S. 300 block, between Pine and Cypress Streets
- Panama Street, 2400 block, between 24th and 25th Streets
- Germantown Avenue, 8600 block, between Bethlehem and Rex Streets
- Philip Street, S. 300 block, between Spruce and Delancey Streets
- Ionic Street, 100 block, between Front and 2nd Streets
- 2nd Street, S. 400 block, between Lombard and Stamper Streets
- Bodine Street, S. 900 block, between Montrose and Christian Streets

2nd Street, S. 400 block

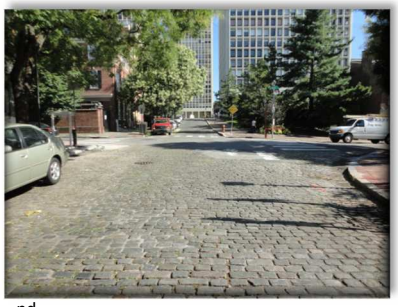

2nd Street, S. 300 block

Table 3.6: Top Ten List for Preventative Repair by Total Score

DOS Blocks

Total: $1,860,642 ● 5yr Annual Cost: $372,128

2013 Block Number	Street	Cross Streets	2013 Primary Roadway Material	Total Objective Score	Total Subjective Score	Total Score	Total Opinion of Probable Repair Cost
214.03	2nd St.*	Lombard & Pine	Granite Block	4.69	14.09	**18.78**	$307,391
213.02	2nd St.*	Delancey & Spruce	Granite Block	4.34	14.19	**18.53**	$278,683
213.01	2nd St.*	Pine & Delancey	Granite Block	4.05	14.18	**18.23**	$190,179
37	Chadwick St.	Pine & Cypress	Granite Block	4.09	13.92	**18.00**	$215,735
149	Panama St.	24th & 25th	Granite Block	3.63	14.31	**17.94**	$139,995
90.21	Germantown Ave.*	Bethlehem & Rex	Granite Block	4.94	12.57	**17.52**	$221,972
154	Philip St.	Spruce & Delancey	Granite Block	3.02	14.30	**17.32**	$68,518
84	Ionic St.	Front & 2nd	Granite Block	5.99	10.96	**16.95**	$243,330
214.01	2nd St.*	Lombard & Stamper	Granite Block	2.60	14.26	**16.87**	$81,141
19	Bodine St.	Montrose & Christian	Red Brick	4.63	12.08	**16.71**	$113,698

*FAM Eligible Block

Table 3.7 is the Top 10 List sorted by the total score of the DOS blocks that need partial repair (30 -50% of the block) and are open to vehicular traffic. The total scores for these blocks range from 20.75 to 17.88, out of a maximum score of 40. The total engineer's opinion of probable cost for these 10 blocks is $3.3 million. This List would require an annual investment from the City of $0.66 million over 5 years. The blocks included in this Top 10 List are as follows:

- Quarry Street, 200 block, between Bread and 3rd Streets
- Sheldon Street, between Hermitage and Fountain Streets
- Reese Street, S. 300 block, between Delancey and Cyprus Streets
- Bonsall Street, S. 200 block, between Locust and Chancellor Streets
- Black Horse Alley, 100 block, between Letitia and 2nd Streets
- St. James Street, 500 block, between St. James Court and 5th Street
- St. James Street, 500 block, between Randolph Street and St. James Court
- Bread Street, N. 100 block, between Quarry and Race Streets
- Leithgow Street, N. 800 block, between Parrish and Reno Streets
- Lofty Street, 200 block, between Boone and Terrace Streets


Quarry Street


Sheldon Street

Table 3.7: Top Ten List for Partial Repair by Total Score

DOS Blocks

Total: $3,306,594 ● 5yr Annual Cost: $661,319

2013 Block Number	Street	Cross Streets	2013 Primary Roadway Material	Total Objective Score	Total Subjective Score	Total Score	Total Opinion of Probable Repair Cost
158.01	Quarry St.	Bread & 3rd	Granite Block	9.80	10.95	**20.75**	$438,539
300.21	Sheldon St.	Hermitage & Fountain	Red Brick	9.70	10.32	**20.02**	$1,100,109
164	Reese St.	Delancey & Cyprus	Red Brick	7.37	12.51	**19.88**	$124,165
22	Bonsall St.	Locust & Chancellor	Red Brick	7.75	11.64	**19.39**	$325,685
15.01	Black Horse Alley	Letitia & 2nd	Granite Block	8.34	10.99	**19.33**	$233,337
172.022	St. James St.	St. James & 5th	Granite Block	9.56	9.74	**19.30**	$249,033
172.021	St. James St.	Randolph & St. James	Granite Block	9.56	9.74	**19.29**	$149,765
24.03	Bread St.	Quarry & Race	Granite Block	8.53	10.38	**18.91**	$225,347
111.02	Leithgow St.	Parrish & Reno	Granite Block	9.62	9.36	**18.00**	$254,199
116	Lofty St.	Boone & Terrace	Red Brick (Molded)	9.90	7.98	**17.88**	$206,415

Table 3.8 is the Top 10 List sorted by the total probable repair cost of the DOS blocks that are open to vehicular traffic. The total scores for these blocks range from 17.43 to 11.14, out of a maximum score of 40. The total engineer's opinion of probable cost for these 10 blocks is $12.1 million; however, 3 of these blocks have a FAM ID so the DOS's probable cost may be closer to $8.2 million. This List would require an annual investment from the City of $2.42 million over 5 years without FAM funds or $1.65 million over 5 years with FAM funds. The blocks included in this Top 10 List are as follows:

- Front Street, 500 block, between Water and Noble Streets
- Noble Street, Unit block, between Delaware Avenue and Front Street
- Front Street, 600 block, between Spring Garden Street and Fairmount Avenue
- Front Street, 900 block, between Poplar and Ellen Streets
- Sheldon Street, between Hermitage and Fountain Streets
- Canal Street, N. 900 block, between Poplar and Laurel Streets
- Duval Street, W. 300 block, between Sherman and Greene Streets
- Trenton Avenue, 2200 block, between Susquehanna and Dauphin Streets
- Wolf Street, between Vandalia and Wecaccoe Streets
- Water Street, S. 900 block, between Christian Street and Washington Avenue


Front Street


Noble Street

Table 3.8: Top Ten List by Total Probable Cost

DOS Blocks

Total: $12,079,383 ● 5yr Annual Cost: $2,415,877

2013 Block Number	Street	Cross Streets	2013 Primary Roadway Material	Percentage of Roadway Repair (w/Cutback)	Total Objective Score	Total Subjective Score	Total Score	Total Opinion of Probable Repair Cost
78.03	Front St.*	Water & Noble	Granite Block	100%	10.76	6.67	17.43	**$2,421,123**
139	Noble St.	Delaware & Front	Granite Block	100%	12.49	5.80	18.29	**$1,658,842**
79.01	Front St.*	Spring Garden & Fairmount	Granite Block	100%	13.30	8.05	21.35	**$1,218,176**
79.05	Front St.*	Poplar & Ellen	Granite Block	67%	8.68	8.11	16.79	**$1,131,546**
300.21	Sheldon St.	Hermitage & Fountain	Red Brick	80%	9.70	10.32	20.02	**$1,100,109**
31	Canal St	Poplar & Laurel	Granite Block	19%	2.21	5.68	7.89	**$992,499**
67	Duval St.	Sherman & Greene	Orange Brick	32%	3.48	12.48	15.96	**$960,626**
197.05	Trenton Ave.	Susquehanna & Dauphin	Granite Block	40%	5.28	7.33	12.61	**$931,095**
300.27	Wolf St.	Vandalia & Wecaccoe	Granite Block	69%	7.86	7.52	15.39	**$880,204**
204	Water St.	Christian & Washington	Granite Block	34%	3.71	7.43	11.14	**$785,163**

*FAM Eligible Blocks

Additional Top 10 Lists were reviewed to evaluate how the DOS's 309 blocks relate to all 551 blocks, regardless of the responsible entity; however, it was found that the DOS is the responsible entity for the top 10 blocks when sorted by total score and total probable repair cost.

3.2 Funding Recommendations

Since the engineer's opinion of probable cost computes the City's financial impact at $60 million to repair all historic blocks, in the condition they are at the time of this report, it is greatly encouraged that the City begin to take the additional financial steps to protect and preserve this unique infrastructure. Assuming an annual budget of $1 million for 5 years, 7 of the 8 Top Ten Lists presented would be addressed and work on another Top 10 List or other blocks needing repair could start to be addressed; however, the City would need to spend $1 million annually for 12 years to complete the 10 blocks with the highest probable costs.

Section 4: Repair Recommendations

Roadway maintenance, while in large part reliant on the resurfacing efforts of the responsible owner, also relies on how well any utility repair work is conducted in the interim years. The fieldwork showed that around 75% of the areas needing repair were due to previous plumber's ditches and utility repairs. Therefore, the City of Philadelphia's current and recent past policies were reviewed in addition to the policies set by New York City and Boston. Boston was selected for its detailed requirements for excavation activities and New York City was selected since it has similar freeze-thaw cycles, weather patterns, and historic blocks. Repair recommendations were broken into plumber's ditches and total repair since these types of work have very different scopes and consequences if completed the wrong way.

4.1 Permitting

Based on the information available on the DOS' website (www.philadelphiastreets.com), the City's street openings permit process is not as detailed as most other cities of comparable size. For example, the City of Boston has an extensive "Rules and Specifications for Excavation Activity within the City of Boston" [2] document published by the Public Works Department with input from utilities and various agencies [3], while the DOS' process appears to be limited to general street opening regulations. [4,5]

It seems that effective management of excavation repair is Philadelphia's greatest opportunity to reduce the number and severity of future repairs. To improve plumber's ditch and utility repairs, we recommend the DOS formalize a more detailed street opening permit process. This could include, in one document, the permit requirements (application, contractor licensing and insurance, maintenance and protection of traffic plans, maintenance period escrow, City inspection and discretionary authority) and technical standards (excavation and backfill, temporary pavement restoration, timelines for completion).

We strongly recommend that the DOS consider instituting a one year escrow requirement to monitor the temporary restoration as part of the permit requirements. Then, if the work shows signs of failure, the contractor must fix the work to have the escrow funds returned at the end of the year or the City can use those funds to help offset the cost of completing the repair themselves. We believe this would act as an incentive for contractor's to complete the work correctly the first time and provide additional quality assurance to the City.

The City and its residents would have a more uniform protocol for the safe, planned opening of streets, appropriate traffic and safety provisions, specification for work and materials, restoration and financial assurance provisions. This would provide a decisive step towards ensuring work on Philadelphia's streets is properly completed.

4.2 Plumber's Ditch

In 2014, the DOS launched an initiative for plumber's ditch repairs on historic streets [5], which is a modification of the DOS' standard regulations for roadway patches. [4] The DOS website defines a plumber's ditch as "rectangular excavations in the road made by utilities and plumbers to reach underground lines" [6] and "a hole that is dug by a plumber in order to repair the service lateral or sewer line." [7]

We agree with the DOS' approach that the wearing course layer of the initiative applies to granite block and brick, since this addresses the material of over 91% of the existing historic streets, and the recommendation to contact the DOS for all other materials, such as stone slab, cobblestone and wood block, since these materials need individual direction and care during repair.

While this new program is a clear improvement over the previous requirement to place material equivalent to clean excavated soil, loam, sandy clay, sand and gravel in maximum 6 inch compacted layers, this report respectfully suggests an additional update. Since the most important component of trench repair is proper backfill, it is recommended that excavated materials be prohibited as backfill and that only PennDOT 2A aggregate, or a similar material and gradation such as recycled concrete, be permitted when backfilling an excavated trench. Installation of permitted material should require mechanical compaction in layers of no more than 8 inches. This recommendation is based on PennDOT 2A aggregate's uniform compaction and drainage properties.

4.3 Total Repair

When considering the City's specification used in a 2011 roadway reconstruction bid, it was determined to be a well-suited method for reconstructing historic blocks. The cross-section of an 8 inch high early strength concrete base course and a minimum 1 inch thick setting bed of one part cement and four parts sand for brick and granite blocks provides a structurally stable base and flexible support for the historic material. Using a grout made of one part cement and four parts sand for joints keeps the setting bed in place and also allows for flexibility between the individual units. The combination of a sound base and the flexibility of a thin sand layer are keys to these materials maintaining a state-of-good repair. This cross-section is incredibly similar to the cross-section approved by New York City Department of Transportation for its granite roadways. [8]

4.4 Materials

It is recommended that the City formalizes a material management program to preserve the availability of historic materials since it is certain that the historic blocks will need continued maintenance as long as they exist. Regardless of current availability, the DOS should stockpile the historic materials that in relatively good condition for future use. Planning in this manner will improve the overall authenticity of the pavers and could reduce construction costs.

Once the roads are restored to a state-of-good-repair, the City should insist that any road openings are properly restored to their original condition. Doing so will not only help preserve the historic character of the roads but, equally as importantly, help prevent the roads from falling into a state of further disrepair.

Section 5: Conclusion

This report provides an overall condition assessment of the historic blocks within the City. Repair areas were identified in four objective categories: depressions, potholes, patching, and inconsistencies with the historic material from the 1999 Inventory. 80% of the DOS' blocks needed preventative repair (repair to less than 30% of the block area), 10% of the DOS' blocks needed partial repair (repair to 30-50% of the block area), and 10% of the DOS' blocks needed total repair (repair to over 50% of the block area).

This data is provided in a Microsoft Excel spreadsheet tool and, to maximize the worth of this report, it is hoped that future repair records and unit costs are updated in the spreadsheet tool by the DOS when work is completed.

The DOS is responsible for maintaining 309 of the historic blocks. The engineer's opinion of probable cost to repair those blocks to a state-of-good-repair is $60 million, or $53.5 million if FAM funds are made available. Financial investment in the repair of the historic blocks now will prevent the currently identified repair areas, and therefore costs, from increasing.

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Appendix A

Historic Streets Inventory – Prepared by KMJ Consulting, Inc., can be found on the following pages.

Historic Streets Inventory

City of Philadelphia Contract No. 1220084-01
General Engineering Services WO# 11

Submitted To:

Gilmore & Associates, Inc.
and
City of Philadelphia
Department of Streets

Prepared By:

KMJ Consulting, Inc.
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NOVEMBER 21, 2013

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1.0 Introduction

In 1999, the City of Philadelphia Department of Streets undertook an internal study to inventory and categorize the historic street blocks of the time. At that time there were a total of 328 blocks identified (146 were of high integrity – completely or nearly intact; 161 of moderate integrity – some patching and noticeable repairs; and, 21 of low integrity). The roadways were primarily Granite/Belgian Block (68%); red brick (25%) and the remainder yellow or orange brick; “Belgian Blues”; Cobblestone; Bluestone or Wood.

In the years since, there have been changes to the integrity of the blocks and a need arose for a study to be conducted to not only determine the integrity of the historic blocks, but also to estimate the cost to restore them to their historic origin for budgeting purposes and then to provide a rank priority order based upon the findings of the objective rating analysis.

This report describes the process to determine and record the integrity of the historic blocks, including the objective criteria and method of data collection. A detailed spreadsheet analysis tool was created to rate and rank order the blocks assessed. By the end of the study there were, in fact, approximately 520 unique historic blocks that were assessed.

The primary deliverable for this effort is the spreadsheet analysis tool (electronic version) provided previously under separate cover.

Special thanks are extended to the City of Philadelphia Department of Streets staff for their partnership in this project. The time schedule was compressed and all participants contributed in a professional and effective manner to complete the effort within the budget allocated and the required timeframe.

2.0 Data Gathering and Analysis

2.1 Data Gathering

This was a three-staged effort to establish and test the objective rating criteria (features), gather data, rate the features and prepare the analysis spreadsheet tool.

> *Develop an objective method through which to gather data and prioritize pavement concerns for the approximate 520 historic street blocks in the City of Philadelphia.*

The initial task in this effort was to identify and establish a set of objective and measurable criteria from which to assess the integrity of the approximate 520 historic blocks in the City of Philadelphia. In addition to these criteria, there were other qualitative characteristics that were noted as part of the field investigation. The team, including consultants and City of Philadelphia staff tested the criteria in the field to ascertain the relevance, usefulness and viability as a measureable and objective data point. Table 1 presents the objective criteria used for this effort. The specific criteria are presented here with a brief explanation.

Table 1 - Objective Rating Criteria

Measureable Criteria	***Description***
1. Depressed/sagging road issues	Depressions/upheavals in roadway; drainage issues causing ponding
2. Block/brick missing	Damaged or missing historic material
3. Patching/paved over	Asphalt or concrete patching
4. Inconsistency with historic material	Different type of historic material within same block

The conditions' assessment fieldwork was conducted between August 14, 2013 and October 18, 2013 and included approximately 520 blocks (street segments) in the Central, Lower North, Lower Northeast, Lower Northwest, North, Upper North, North Delaware, River Wards, South, University Southwest, and Upper Northwest planning districts. Steps were taken during the field visit to ensure that all relevant information was gathered and documented. Below is a summary of the steps taken in the field.

1. The street segment was located and background information was gathered for the field work checklist (date, field inspectors, cross streets, block number, segment ID, roadway materials, through traffic, adjacent land use, planning district, council district)

2. Dimension (length of street, width of street, width of sidewalks) was measured
   a. Length of the street was measured from curb line to curb line unless historic material did not extend the length of the street segment; in that case, measurements only included the length of historic material.

b. If there were multiple segments within a street, the length of the street was measured from centerline to centerline or obtained later.
c. Width of sidewalk was measured from the start of the curb to the property line. Multiple measurements were used depending on the situation.
d. Width of street was measured from curb line to curb line. Multiple measurements were used depending on the situation.

3. Pictures were taken at the beginning, middle, and end of the segment. Pictures were taken from South to North or West to East depending on street direction.
   a. Pictures included the entire pathway and were aligned with the horizon.

4. A sketch was drawn including street label, utilities, manholes, trolley-freight tracks, cardinal directions, and cross streets.

5. The areas of depressions/upheavals, block/brick missing, patching/paved over, and inconsistency with the historic material were measured.
   b. Cross sections were adequate to measure the various shapes.

6. Block/brick joint widths were measured and classified. The type and percentage of joint material was also noted.

7. Curb gutters were noted with width, type, and other details.

8. Curb type and percentage were noted along with qualitative details.
   a. Missing curbs were noted as a type and percentage.
   b. Poor was considered broken or cracked.
   c. Fair was considered deteriorating but maintaining form.
   d. Good was considered aesthetically pleasing and maintaining form.
   e. Excellent/New was considered a recent construction.

9. Sidewalk type and percentage were noted along with qualitative details.
   a. Missing sidewalks was noted as a type and percentage.
   b. Poor was considered broken or cracked.
   c. Fair was considered deteriorating but maintaining form.
   d. Good was considered aesthetically pleasing and maintaining form.
   e. Excellent/New was considered a recent construction.

10. Community and resident complaints were noted. Field inspectors did not interview local individuals.

11. Specific cases of construction, overgrowth, roadway issues beyond classification, useful observation, etc., were noted in the engineering discretion section of the form.

Figure 1 presents the input form that includes both the objective criteria and the qualitative characteristics that were observed and noted.

2.2 Analysis

Each of the objective features/criteria were field measured to determine the total block area for which they applied. That area (as a percentage of the total block) was multiplied by 20. A total maximum score of 100 was initially anticipated (80 points for the four features and an additional 20 for subjective criteria). However, in the field it was determined that, these criteria were generally not additive. Therefore, the maximum objective score for a block is about 20. This score of 20 would translate to the highest level of degradation.

Cost to restore the blocks to their original condition was provided by Gilmore and Associates, Inc. and the entire spreadsheet tool was transmitted electronically to the Streets Department for their use in ranking the blocks for budgeting purposes.

The analysis spreadsheet tool is designed to filter on any category to provide a rank order based upon councilmanic district, planning district and a variety of other features. This user friendly tool can be easily updated on an as-needed basis and maintained by the Streets Department or its designee. Input from the Historic Commission on adjacent land use may be desirable to provide additional guidance.

3.0 Conclusions

The historic blocks in the City of Philadelphia had not been evaluated since 1999. This effort and the resulting decision- making tool along with the subjective input from various departments is a first step in determining the need and budget required to restore the historic streets to their original condition.

Figure 1 - Field Work Checklist

Date:	**Block sketch noting roadway characteristics, curb,**
Field Inspectors:	**and sidewalk (include north arrow):**
Street:	
Cross Streets:	
1999 Block Number:	
2013 Block Number:	
Segment ID:	
Roadway material:	
Length of Street:	
Width of Street:	
Width of Sidewalks:	
Street open to through traffic (yes/no):	
Adjacent Land Use (Residential/Commercial):	
Planning District:	
Council District:	

Criteria	Description	Yes/No	Notes	Total Area
Roadway Issues:				
1. Depressed/sagging road Issues	Drainage issues causing ponding (Area - % of street)			
2. Block/brick missing	Damaged/missing of block/brick (Area - % of street)			
3. Patching/Paved Over	With asphalt or concrete (Area - % of street)			
4. Inconsistency with the historic material	E.G. Different type/color brick (Area - % of street)			
5. Block/brick joint width	Narrow (1/4 - 1/2"), Medium (1/2 - 1"), or Wide (>1"); Note joint type (sand/concrete)			
6. Curb Gutters	If exists, condition, in need of repair, etc.			
7. Utilities/Manholes/Trolley-Freight Tracks	Note existence and approximate location within the block on sketch above			
Curb Issues:				
8. Curbs	Present along entire block - Inconsistency with construction and materials used, missing curbing, not consistent with historical parameters			
Sidewalk Issues:				
9, Condition of Sidewalks	Sidewalks present - Non-existing, inconsistent, in need of repair. Note general condition (% type - asphalt/ concrete/ brick/stone)			

Appendix B

2013 Philadelphia Historic Streets Inventory and Engineer's Opinion of Probable Cost will be sent via Dropbox.