

ROADWAY EVALUATION AND UPGRADE PROGRAM

JOHNSON'S ISLAND, OTTAWA COUNTY, OHIO

Prepared For:

JOHNSON'S ISLAND ROAD COMMISSION



Prepared By:



MICHAEL BENZA
& ASSOCIATES, INC.
CONSULTING ENGINEERS AND SURVEYORS

6860 West Snowville Road
Brecksville, Ohio 44141
Phone: 440-526-4206
www.mbenzaengr.com

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1. INTRODUCTION, AUTHORIZATION, AND SCOPE

1.1 INTRODUCTION

Michael Benza and Associates, Inc, has prepared this Report at the request of the Johnson's Island Road Commission. The purpose of this Report is to evaluate the existing roadways on Johnson's Island and develop a recommended long-term roadway upgrade program.

1.2 AUTHORIZATION

This Study has been prepared in conformance to the Agreement dated February 12, 2009, by and between Michael Benza & Associates, Inc., and the Johnson's Island Road Commission, and signed by the Chairman of the Road Commission on February 14, 2009.

1.3 SCOPE

The tasks proposed in the Agreement and requested at the subsequent meeting included the following:

- Meeting with Johnson Island representatives to discuss records, previous studies and finances for the program.
- Review and evaluate existing roadways on the island. The Causeway on the island and Gaydos Drive were included in this analysis.
- Preparation of roadway inventory and condition summary.
- Development of a recommended long term roadway upgrade program including scheduled road maintenance, needed repairs and long term plan in accordance with the "Operating Agreement For Governance of Johnson's Island Causeway and Roadways."
- Meeting with the Johnson Island Road Commission to discuss findings and to present data.
- Recommendation of household dues.
- Financial plans for upgrades.

After the Johnson's Island Road Commission reviewed the draft report dated April 17, 2009, additional items were requested. These items have been included in this report and are summarized as follows:

- Inclusion and analysis of additional scenarios. These include an acceleration of the capital improvement plan along with an increase in the homeowners dues in 2010; and the scenario of improving all of Memorial Shoreway in one project, with that project being financed by loans.
- Further explanation of the pavement condition categories outlined in the study.
- Consideration of other methods of surface treatments.
- Inclusion of a guide for road maintenance beyond the rehabilitation program outlined in the study.

2. BACKGROUND INFORMATION

The Johnsons Island Road Commission was formed in May 2007 to provide control over the Island Roads and Causeway with representation from the various groups and homeowners associations.

The “Operating Agreement for Governance of Johnson’s Island Causeway and Roadways” provides a priority list for the maintenance, repairs, and improvement of the Causeway and Island Roads. The first two priorities are the funding of the Road Commission and the maintenance and repair of the Causeway. The next two priorities are further described as follows:

“Third, to the maintenance and repair, in good or superior condition, of Confederate Drive (including Dixie), all roads in the Baycliffs Subdivision, and Memorial Shoreway from the intersection with Woodcliff Drive to the intersection with Forest Glen;”

“Fourth, to the implementation of the repair, improvement, and/or replacement of the road bed and surface of the remainder of Memorial Shoreway, with the express recognition that the Road Commission is charged with the responsibility to develop a plan to implement the plan over a period of years to bring Memorial Shoreway up to the standard of other Island Road;”

Presently, revenue to fund the Road Commission is generated by the tollgate at the Causeway and dues in the amount of \$225 per household. The revenue generated by the Causeway toll gate is expected to be used to fund the costs associated with the Causeway and the toll gate. The household dues are expected to pay for a portion of the Commission Administration costs and maintenance, repair, and improvement of the roads on the island. The roadway portion of the funding is divided into non-discretionary funding (including normal crack sealing and patching of roads) and discretionary funding (used to fund the Roadway Upgrade Program).

3. EXISTING ROADWAYS EVALUATION AND INVENTORY

On March 23, 2009, a representative of Michael Benza and Associates, Inc. visited the island and evaluated the condition of the existing roadways. Gaydos Drive, which is the roadway on the mainland north of the Island Causeway, was also included in this evaluation. Generally, the roads were evaluated in segments of approximately 200 foot lengths. The roadway distresses were identified and measured in accordance with the procedures outlined in Federal Highway Administration Report No. FHWA-RD-03-031, titled "Distress Identification Manual for Long-Term Pavement Performance Program (Fourth Revised Edition)." This method was also used in a previous evaluation performed by The Henry G. Reitz Engineering Company.

The following distresses for pavements with asphalt concrete surfaces were identified and measured for each segment:

- Fatigue cracking; a series of interconnected cracks through the pavement.
- Edge cracking; cracks that intersect the pavement edge adjacent to the shoulder.
- Longitudinal cracking (wheel path and non-wheel path); cracks predominantly parallel to pavement centerline.
- Transverse cracking; cracks predominantly perpendicular to pavement centerline.
- Patch/patch deterioration; portion of pavement surface that has been removed and replaced, or pavement with additional material applied.
- Potholes; bowl-shaped holes in the pavement surface.
- Raveling; wearing away of the pavement surface.

Pictures taken during the field evaluation are included in the Attachments.

Within each pavement segment, the approximate amount of pavement surface exhibiting each distress was calculated as a percentage of that section. Subsequently, each of the distresses was provided a ranking based on the type and extent of the distress noted.

These rankings are summarized as follows:

DISTRESS	SEVERITY FACTORS		
	Low	Moderate	High
Fatigue Cracking	6	18	30
Edge Cracking	4	12	20
Longitudinal – Wheel Path	6	18	30
Longitudinal – Non-wheel Path	2	6	10
Transverse	2	6	10
Patch/Patch Deterioration	5	10	20
Potholes	12	20	30
Raveling	30 (regardless of severity)		

In order to maintain uniformity with the previous pavement survey prepared by The Henry G. Reitz Engineering Company, the distress rankings methodology utilized by Reitz was used in this Study.

The Pavement Rating for each segment was calculated using the severity factors listed above. Based on these Pavement Ratings, each segment was sorted into three conditions categories: good, fair, and poor. Michael Benza and Associates reviewed the range of rankings for each of these three categories and assigned the condition category based on the criteria provided in the “Pavement Condition Rating System” Manual, prepared by Ohio Department of Transportation (ODOT) and dated April 2004. The ODOT rankings were modified to reflect the difference in the severity factors in the ODOT Manual (where the maximum factor is 10) and the factors utilized in this Study (where the maximum factor is 30).

Good Condition: These roadway surfaces are showing the first signs of aging. Low severity longitudinal joints and the first signs of block cracking are apparent. There may be occasional patching and crack sealing needed. This category consists of pavement segments with a rating of 5 and less, and includes pavement segments that are considered in “superior” condition. Superior condition is used to refer to roadway segments that have

been recently improved.

Fair Condition: These roadway surfaces are showing signs of significant aging. Fatigue cracking may be occurring up to or over 50% of the surface. Longitudinal cracking is becoming apparent in the wheel paths. Patches are in fair condition. This category consists of pavement segments with a rating of between 5.1 and 12.

Poor Condition: These roadway surfaces have moderate to high fatigue cracking, and may have patches in fair to poor condition and occasional potholes. Raveling and erosion in cracks may be common. Safety to vehicles traveling at the posted speed limit is not compromised; however, motorcycles, bicycles, and pedestrians may encounter problems with the wider cracks and potholes that are present. This category consists of pavement segments with a rating of higher than 12.

A brief summation of the condition of each street based on our visual observations is as follows:

Gaydos Drive: This roadway is in poor to fair condition, with some fatigue cracking, especially at the northern end of the street. The asphalt has several longitudinal and edge cracks present. The majority of these cracks have been sealed.

Confederate Drive: According to records, this pavement was resurfaced in the 1990's. This pavement is in good condition, with edge cracks and a longitudinal crack down the center of the pavement. Most of these cracks have been sealed.

Causeway (on island): The approach from the island to the causeway is in good condition, with some sealed cracks present. In this study, the portion of the causeway on the island is included with Confederate Drive for analysis and condition rating.

Memorial Shoreway: From South Confederate Drive to Confederate Drive, this pavement is in good condition, with sealed edge and longitudinal cracks present. The pavement condition varies from Confederate Drive to Woodcliff Drive, with some segments in poor condition. Other segments have been recently repaved and exhibit few or no defects. The portions of Memorial Shoreway that were resurfaced in 2004 are in fair condition. Several segments exhibit moderate to high edge and fatigue cracking and

appear to be in need of repair. From Woodcliff Drive to the southern cul de sac, the pavement is in good condition, except for one segment (at house number 4430) where the southbound lane appears to be sinking.

South Confederate Drive: This roadway is in good condition, except for one segment (at house number 3011) where the edge of the southbound lane has broken off and the adjacent pavement has several cracks.

Baycliffs Subdivision: The streets constructed with this subdivision (Woodcliff Drive, Baycliffs Drive, Forest Glen Lane, and Quarry Stone Court) are in good condition. Sealed edge cracks are present. Each street has several utility patches that are in good condition.

The complete list of pavement rating results (by segment) is included in the Attachments. The ratings varied from 0.0 (for the pavement installed in 2008) to 23.7 (for Memorial Shoreway from 560 feet to 1230 feet south of Confederate Drive). Segments along Confederate Drive and the Baycliffs Subdivision streets all had Pavement Ratings of 5 or less.

Analysis of the existing roadways indicated that approximately 4700 feet (55% of the street length) of Memorial Shoreway, and all of Gaydos Drive, are in fair to poor condition. These areas of fair to poor conditions were grouped into segments and are summarized in the following paragraphs. The stations indicated in the following tables are from the "Johnson's Island Road Right-of-Way Survey," prepared by Hoffman-Metzker, Inc. and dated August 2007.

Poor Condition: These roadway segments exhibit a Pavement Rating of higher than 12 and are candidates for upgrade by either full depth replacement or in place reclamation. The segments, listed from worst to better condition, are as indicated in the following table:

**PAVEMENT REPLACEMENT/RECLAMATION SEGMENTS
(Pavement Rating 12 or more)**

Cond. Rating	Street	From Station (Address)	To Station (Address)	Length	Rating
1	Memorial Shore.	10+85 (#3168)	17+60 (#3300)	675'	23.7
2	Memorial Shore.	38+55 (#3694)	40+90 (#3734)	235'	23.5
3	Memorial Shore.	19+80 (#3346)	22+00 (#3376)	220'	22.6
4	Gaydos Road	0+00	4+00	400'	16.1
5	Memorial Shore.	23+10 (#3406)	30+35 (#3544)	725'	15.4
6	Memorial Shore.	57+35 (#4064)	61+30 (#4144)	395'	15.0
7	Memorial Shore.	52+50 (#3956)	54+65 (#4014)	215'	13.5

Fair Condition: These roadway segments exhibit a Pavement Rating of between 5.1 and 12 and are candidates for upgrades by resurfacing. The segments, listed from worst to better condition, are as indicated in the following table:

**PAVEMENT RESURFACING SEGMENTS
(Pavement Rating 5.1 to 12)**

Street	From Station (Address)	To Station (Address)	Length	Rating
Gaydos Road	4+00	10+50	650'	10.1
Memorial Shore.	40+90 (#3734)	50+65 (#3934)	975'	7.7
Memorial Shore.	35+25 (#3638)	38+55 (#3694)	330'	7.1
Memorial Shore.	54+65 (#4014)	57+35 (#4064)	270'	6.0
Memorial Shore.	5+25 (Confederate)	10+85 (#3168)	560'	5.8

Good Condition: The remaining portions of roadway on Johnson's Island are presently in a condition that is considered "good" condition. These roadway segments exhibit a Pavement Rating of 5 and less and presently are not candidates for major repair work. Minor maintenance such as crack sealing, patching, and edge repair are recommended.

4. ROADWAY UPGRADE PROGRAM

4.1 Project Costs:

Introduction: The costs of pavement replacement and resurfacing per square yard were estimated based on 2009 dollars and were developed using prevailing wages for labor costs. The cost of Engineering for the project is also included in each type of cost.

Pavement Replacement/Reclamation: These pavement segments may be rehabilitated by either full depth removal and replacement of the existing pavement, or by pulverization of the existing pavement. These methods, and their respective costs per square yard, are summarized as follows:

- **Full Depth Removal and Replacement:** The existing pavement and portion of the subgrade are removed and disposed of. The pavement is then replaced with an aggregate stone base, an asphalt concrete base, and two courses of asphalt concrete. The pavement composition is the same as what was specified in the "Johnson's Island Road Improvements 2008 Design Year" project, prepared by Reitz Engineering. The cost per square yard for this work is as follows:

PAVEMENT REPLACEMENT COST

Item	Cost/SY (2009 dollars)
Excavation (15")	\$11.00
Aggregate base (8")	\$14.00
Asphalt Concrete base (4")	\$30.00
Asphalt intermediate course (1 ¾")	\$11.00
Asphalt surface course (1 ¼")	\$8.00
SUBTOTAL =	\$74.00
+ 40% contingencies, engineering	\$30.00
TOTAL =	\$104.00

The expected time span until the replaced pavement will require resurfacing is about 15 to 20 years.

- **Pavement Pulverization and Resurfacing:** Where full depth replacement of the pavement is necessary, pulverization of the existing pavement is an option. Pulverization involves in-place recycling of the entire existing pavement. After the roadway has been pulverized, aggregate and asphalt emulsion are added and the material is shaped and graded. After final grading, the pavement is compacted and new asphalt surface courses are placed over the pulverized base. The cost per square yard for this work is as follows:

PAVEMENT PULVERIZATION COST

Item	Cost/SY (2009 dollars)
Pulverization, asphalt emulsion	\$31.00
Asphalt intermediate course (1 ¾")	\$11.00
Asphalt surface course (1 ¼")	\$8.00
SUBTOTAL =	\$50.00
+ 40% contingencies, engineering	\$20.00
TOTAL =	\$70.00

The expected time span until the pulverized pavement will require resurfacing is about 12 to 15 years.

The Roadway Upgrade Program uses the pavement pulverization option and associated costs for the segments presently in poor condition.

Pavement Resurfacing: This work consists of placing an asphalt surface course on the existing pavement surface. The cost per square yard for this work is as follows:

PAVEMENT RESURFACING COST

Item	Cost/SY (2009 dollars)
Asphalt surface course (1 1/4")	\$8.00
+ 40% contingencies, engineering	\$3.00
TOTAL =	\$11.00

Drainage Improvements: In 2007 the Henry G. Reitz Engineering Company prepared a Drainage Report for the Road Commission. This report identified areas where adverse drainage conditions impacted the condition of the roads and recommended drainage improvements. Several of the pavement replacement segments identified in this report are also identified in Reitz' report as areas in need of drainage improvements. The Operating Agreement provides for the maintenance, repair, and/or replacement of the road bed and surface. The cost of limited drainage improvements (adjacent to and crossing the roads), necessary to protect the pavement, including pipe, and drainage structures is included in our estimated project costs under the contingency item. However, the costs for extensive outfall piping to the lake or easement acquisitions are not included in our estimates.

4.2 Roadway Upgrade Program and Costs:

4.2.1 Introduction

The project scope includes preparation of a Roadway Upgrade Program to accomplish the objectives outlined in the Operating Agreement.

4.2.2 10-Year Capital Program with Dues Increase from \$275 to \$450

In this section Michael Benza & Assoc., Inc. proposes a multi-year, prioritized program for construction. The order in which we have listed the projects is based on the priority needs and the anticipated amount of money available in the discretionary fund for that year. However, it should be recognized that as in any capital improvements program a certain amount of flexibility must be retained.

Where practical and where funding will allow, the pavement resurfacing was scheduled to coincide with an adjacent rehabilitation project.

In developing the area used for pavement pulverization and resurfacing, we assumed that the pavement will be widened to 18 feet (where necessary). We recommend that pavement resurfacing areas would maintain the existing width.

All unit costs for years 2 to 10 have been increased by a 5% annual factor to account for inflation of construction costs.

Year 1 (2009): Due to the repayment of the funds for a previous project on Memorial Shoreway, the available discretionary funding for this year's projects have been reduced accordingly.

Work	Cond. Rating Number	Area	Unit Cost	Total Cost
Pulverize and Resurface Memorial Shoreway 19+80 to 22+00	3	440 sy	\$70.00/sy	\$ 30,800
TOTAL COST, YEAR 1			USE	\$ 31,000

Year 2 (2010):

Work	Cond. Rating Number	Area	Unit Cost	Total Cost
Pulverize and Resurface Memorial Shoreway 38+55 to 40+90	2	470 sy	\$73.50/sy	\$ 34,545
Resurface Memorial Shoreway 35+25 to 38+55	-	590 sy	\$11.50/sy	\$ 6,785
TOTAL COST, YEAR 2			USE	\$ 42,000

Year 3 (2011):

Work	Cond. Rating Number	Area	Unit Cost	Total Cost
Pulverize and Resurface Memorial Shoreway 57+35 to 61+30	6	790 sy	\$77.00/sy	\$ 60,830
Resurface Memorial Shoreway 54+65 to 57+35	-	480 sy	\$12.00/sy	\$ 5,760
TOTAL COST, YEAR 3			USE	\$ 67,000

Year 4 (2012):

Work	Cond. Rating Number	Area	Unit Cost	Total Cost
Pulverize and Resurface Memorial Shoreway 10+85 to 17+60	1	1350 sy	\$81.00/sy	\$ 109,350
TOTAL COST, YEAR 4			USE	\$ 110,000

Year 5 (2013): We recommend that before 2013 (five (5) years after the implementation of the Roadway Upgrade Program), an updated analysis of the program should be performed. This analysis should evaluate the pavement conditions, as they exist at that time, reanalyze the deficiencies, and reassess the priorities of the program. The re-evaluation should also review the funding of the program based on the amount of revenue actually being generated, the non-discretionary spending that is taking place, and the actual construction costs for the previous years projects. An estimated cost of \$10,000 has been included in the discretionary spending budget in this year for the collection of data and preparation of the updated report.

Work	Cond. Rating Number	Area	Unit Cost	Total Cost
Resurface Memorial Shoreway 5+25 to 10+85	-	1000 sy	\$13.50/sy	\$ 13,500
Resurface Memorial Shoreway 40+90 to 50+65	-	1740 sy	\$13.50/sy	\$ 23,490
TOTAL COST, YEAR 5			USE	\$ 37,000

Year 6 (2014):

Work	Cond. Rating Number	Area	Unit Cost	Total Cost
Pulverize and Resurface Gaydos 0+00 to 4+00	4	935 sy	\$89.00/sy	\$ 83,215
Resurface Gaydos 4+00 to 10+50	-	1520 sy	\$14.00/sy	\$ 21,280
TOTAL COST, YEAR 6			USE	\$ 105,000

Year 7 (2015):

Work	Cond. Rating Number	Area	Unit Cost	Total Cost
Pulverize and Resurface Memorial Shoreway 52+50 to 54+65	7	430 sy	\$94.00/sy	\$ 40,420
TOTAL COST, YEAR 7			USE	\$ 41,000

Year 8 (2016):

Work	Cond. Rating Number	Area	Unit Cost	Total Cost
Pulverize and Resurface Memorial Shoreway 23+10 to 30+35	5	1450 sy	\$99.00/sy	\$ 143,550
TOTAL COST, YEAR 8			USE	\$ 144,000

Year 9 (2017): At this time, the fair and poor condition pavements identified in this Study's Roadway Evaluation will have been rehabilitated or resurfaced. Therefore, in this year, a program to resurface the roads that were found to be in good condition in this Study may need to

be implemented. It is recommended that the Roadway Upgrade Program should again be updated at this time. An estimated cost of \$12,500 has been included in the discretionary spending budget for this year for the collection of data and preparation of the updated report.

Work	Cond. Rating Number	Area	Unit Cost	Total Cost
Resurface South Confederate, Memorial to Confederate (including parking area)	-	1750 sy	\$16.00/sy	\$ 28,000
Resurface South Confederate, north end to Memorial	-	400 sy	\$16.00/sy	\$ 6,400
TOTAL COST, YEAR 9			USE	\$ 35,000

Year 10 (2018): By 2018, Confederate Drive may be nearing the end of its design life, and a program to resurface this street should be implemented. It would be assumed that the entire length of Confederate Drive should be resurfaced at the same time.

Work	Cond. Rating Number	Area	Unit Cost	Total Cost
Resurface Confederate Drive, Causeway to cul-de-sac	-	8750 sy	\$17.00/sy	\$ 148,750
TOTAL COST, YEAR 10			USE	\$ 149,000

Funding: As stated earlier in the report, the primary source of funding for the improvements contained in the Roadway Upgrade Plan will be generated from annual dues charged to the homeowners on the Island. The Roadway Upgrade Plan, as outlined in the previous section, could be funded according to the homeowner's dues schedule contained in the following table:

HOMEOWNER'S DUES SCHEDULE

Year	Annual dues
2009-2010	\$275
2011-2012	\$350
2013-2015	\$375
2016 – 2017	\$400
2018	\$450

The 10-year Budget Plan containing the costs in the Roadway Upgrade Plan and the preceding dues schedule is included in the Attachments.

4.2.3 Roadway Upgrade Program with One-Time Adjustment and 5% Annual Increase:

The funding for this Program was developed by the Johnson's Island Road Commission. It assumes that the \$225 annual homeowner's dues in 2009 will have a one time sustainability adjustment to \$300 in 2010. After 2010, the dues will increase by 5% per year. This program also assumes no Capital Improvement work will be performed in 2009, and that the order of improvements is the same as for the previous program. This program also includes costs for the re-evaluation and updating of the Program in 2013 and 2017.

The Budget Plan for this Program is included in the Attachments.

4.2.4 Short-Term Roadway Upgrade Program and Costs:

This program would rehabilitate the roads on the Island in the order that they appear in the Condition Ratings. That is, Condition Ratings 1 and 2 would be constructed in Year 2, Condition Rating 3 in Year 3, etc. This would continue until Year 7 (2015), at which time the seven worst rated segments will have been addressed. In order to fund this program the dues would have to be raised to \$425 per household in 2009 and be sustained at that amount through

the length of the program.

The Budget Plan for this program is included in the Attachments.

4.2.5 Memorial Shoreway One-Year Improvement Program and Costs:

Introduction: This program would rehabilitate all segments of Memorial Shoreway from Confederate Drive to House Number 4144 (Sublot 60) in one project. The various sections of Memorial Shoreway within these limits that have been recently rehabilitated and are presently in good condition are not included in this work. The remainder of Memorial Shoreway would be rehabilitated with pulverization and resurfacing of the entire pavement. This includes the segments of pavement that are currently in fair condition and were only to be resurfaced as part of the Long Term Capital Improvement Program. This will minimize the number of joints between pavement segments, which will reduce future maintenance and crack sealing costs.

The approximate cost to perform this work (in 2010 dollars) is as follows:

Work	Area	Unit Cost	Total Cost
Pulverize and Resurface Memorial Shoreway	9200 sy	\$73.50/sy	\$ 676,200
TOTAL COST		USE	\$ 680,000

It should be noted that if this program is constructed, the maintenance of the Memorial Shoreway pavement would be different than if one of the other programs are used. The other segmental programs would create a series of pavements along Memorial Shoreway of differing age, pavement section, etc., thus creating a need to consider future maintenance strategies by segment. The One-Year Improvement Program would allow future maintenance strategies to address the overall pavement of Memorial Shoreway, which may create a greater selection of treatments (such as asphalt sealing, future resurfacing projects, etc.).

Funding: Assuming that the Road Commission obtains a 10-year loan at 5% annual

interest to cover the cost of construction, the required homeowner's annual dues to pay off the loan would be \$288.50. In addition to this cost, the annual dues to cover the roadway maintenance program would be \$71.50 in 2010, with that figure increasing by 5% per year throughout the length of the program. The repayment schedule for the loan and the Budget Plan for the Roadway Maintenance costs are included in the Attachments.

5. PAVEMENT MAINTENANCE

5.1 Introduction:

Pavement maintenance is the key to pavement preservation and extension of pavement life. An effective pavement maintenance program integrates many maintenance strategies and treatments. This portion of the Study is presented to assist the Road Commission in making decisions related to the maintenance and preservation of the pavement surfaces.

The following paragraphs contain the most common distresses found on the pavements on Johnson's Island, their possible causes and maintenance treatments. It should be noted that in many instances, multiple types of distresses will occur within the same portion of pavement, so the treatment selected must be appropriate for all distresses that are present. Also, the amount and severity of distresses may require a combination of treatments and, in some cases, total reconstruction may be the most appropriate strategy.

5.2 *Fatigue Cracking:*

Description: Series of interconnected cracks in an asphalt layer forming a pattern, which resembles an alligator's hide or chicken wire. The cracks indicate fatigue failure of the asphalt layer generally caused by repeated traffic loadings. This distress allows water to penetrate the surfacing materials and subgrade, which furthers the damage. Fatigue cracking usually begins as a single longitudinal crack in the wheel path.

Possible causes:

- Insufficient pavement structure.
- Inadequate base support.
- Poor base drainage.
- Aging and traffic loading.

Severity Levels:

- **Low:** Longitudinal disconnected hairline cracks no greater than 1/8-inch wide.
- **Moderate:** Longitudinal cracks in wheel paths forming an alligator pattern; cracks may be lightly spalled and about 1/8- to 1/4- inch wide.
- **High:** Pieces appear loose with severely spalled edges; cracks are 1/4-inch or greater and pumped fines may appear on the surface.

Maintenance Treatments:

Severity Level	Maintenance
Low	Do Nothing/Microsurfacing/Resurfacing*
Moderate	Microsurfacing/Resurfacing*
High	Repair or Replacement

* = Effectiveness of treatments other than repair or replacement is generally minimal and short-lived.

5.3 *Edge Cracking:*

Description: Edge cracking is similar to fatigue cracking only located within 1 to 2 feet of the edge of pavement. Failure begins at the edge of the pavement and progresses toward the wheel path. Pavement edge distress can result in worsening of the wheel path condition and allow moisture into the subgrade soils and base materials.

Possible causes:

- Traffic loading.
- Construction Related.
- Low Shoulder.
- High Shoulder Holding Water.

Severity Levels:

- **Low:** Hairline cracks just beginning to show; random with no pattern; may be up to 1/8-inch wide.
- **Moderate:** Cracks 1/8- to 1/4- inch wide located 1 to 2 feet from the edge of the road; may have an alligator pattern.
- **High:** Cracks greater than 1/4-inch; may have loose or missing pieces or potholes or alligator cracking.

Maintenance Treatments:

Severity Level	Maintenance
Low	Crack sealing
Moderate	Crack sealing
High	Repair, Shoulder Maintenance

5.4 Longitudinal Cracking:

Description: Longitudinal cracking denotes cracks that run predominantly parallel to the center line. These cracks may be in the wheel paths and/or at lane joints such as the pavement center line.

Possible causes:

- Traffic loading (wheel path cracks).
- Environmental (frost action).
- Improper construction practices (joint cracks).
- Poor drainage.

Severity Levels:

- **Low:** Hairline crack(s) running parallel to center line
- **Moderate:** Cracks parallel to center line that are about 1/8-inch wide.
- **High:** Single crack greater than 1/8-inch wide.

Maintenance Treatments:

Severity Level	Maintenance
Low	Crack sealing
Moderate	Crack sealing
High	Crack sealing

5.5 Transverse Cracking:

Description: Transverse cracks are those considered to extend three-fourths of the width of the pavement or more, generally perpendicular to the pavement center line.

Possible causes:

- Environmental (thermal).
- Swelling or shrinkage of the subgrade.
- Settlement of trench.

Severity Levels:

- **Low:** Hairline to ¼-inch wide cracks perpendicular to center line with no distortion.
- **Moderate:** Cracks ¼- to ½- inch in width, perpendicular to center line and the full width of the pavement; slight distortion.
- **High:** Cracks ½- to 2-inch wide; larger cracks often are spalled and/or have noticeable distortions near them.

Maintenance Treatments:

Severity Level	Maintenance
Low	Crack sealing
Moderate	Crack sealing
High	Crack sealing

5.6 Raveling:

Description: Raveling is the progressive wearing away of the pavement from the surface downward caused by the loss of asphalt binder and the dislodging of aggregate particles.

Possible causes:

- Poor mixture quality.
- Asphalt hardening due to aging.
- Insufficient asphalt content.
- Improper construction methods.

Severity Levels: None. The presence of raveling indicates potential mixture related performance problems.

Maintenance Treatments: Resurfacing of the existing pavement.

5.7 Potholes:

Description: Bowl-shaped holes of various sizes in the pavement surface.

Possible causes:

- Water penetrating the surface and causing the base and/or subgrade to become wet and unstable.
- Surface course is too thin or lacks sufficient asphalt content, lacks sufficient base, or has too many or too few fines.

Severity Levels:

- **Low:** Less than 1-inch deep.
- **Moderate:** 1-inch to 2 inches deep.
- **High:** Greater than 2 inches deep.

Maintenance Treatments: Full depth asphalt repair. When a pothole needs to be filled immediately and weather conditions do not allow for full depth hot-mix asphalt repair, an emergency repair of placing asphalt patch material into the pothole may be performed, with full depth asphalt repair performed when conditions allow.

6. TREATMENT PRACTICES AND FUNDING

6.1 Treatment Practices:

Introduction: The following sections provide a definition of the various treatment practices outlined in the previous section. The approximate unit price for each practice is based on Ohio Department of Transportation prices, are in 2009 dollars, and do not include costs for Engineering. The extended service life gains are from the "Pavement Preventive Maintenance Guidelines," prepared by the Ohio Department of Transportation Office of Pavement Engineering and dated May 1, 2001.

Crack Sealing: Placement of mixture of an asphalt binder, mixed with polyester or polypropylene fibers, into the existing cracks, Crack sealing is used to minimize the intrusion of water into the pavement. Crack sealing operations are most effective when pavement temperatures are cool to cold. Crack sealing should not be done on wet or damp pavements and should be applied on pavements when both surface temperature and ambient air temperature are above 40 degrees F.

Crack sealing will have little effect on the current pavement condition. The intent of crack sealing is to seal these defects and slow the rate of deterioration and prolong the life of the pavement.

The approximate unit price for crack sealing is \$0.50 per foot. Crack sealing is expected to last 2 to 3 years before re-application is needed.

Microsurfacing: Constructing a cold laid polymer modified emulsified asphalt pavement course. The paving mixture is composed of a polymer modified emulsified asphalt binder, crushed aggregate, mineral filler, water, and other additives. Microsurfacing can be effectively applied at a thickness of 3/8-inch or less.

Traffic is not allowed on the surface until it has cured sufficiently. The new surface is generally capable of carrying normal traffic within one to two hours after application. Specifications require microsurfacing to take place between May 1 and September 30. Proper pavement temperature and air temperature is critical to the success of the application.

The approximate unit price for microsurfacing is \$2.00 per square yard. The expected service life of microsurfaced pavements is 5 to 8 years.

Resurfacing: The placement of a mixture of asphalt binder and aggregate on the existing surface of the pavement.

The approximate unit price for resurfacing with a 1 ¼ -inch minimal thickness is \$8.00 per square yard. Pavements that are resurfaced are expected to last 8 to 12 years.

Shoulder Maintenance: Earth shoulders of the roadway should be graded to the height of the pavement edge and covered with sufficient vegetation. The shoulder must be graded so that water flows away from the edge of the pavement. In areas where edge cracking is severe (such as the inside of curves), the existing shoulder should be removed and replaced with compacted aggregate.

The approximate unit price for re-grading and seeding of the earth shoulders is \$1.00 per foot per side of the pavement, and the approximate unit price for replacement of the shoulders with compacted aggregate (assuming a 1 foot wide shoulder is used) is \$2.00 per foot per side of the pavement.

Full-depth Asphalt Repair: Removal of the asphalt surface and base around a pothole or other surface defect as deep as necessary to reach firm support. The vertical faces of the asphalt are then tack coated and the excavation backfilled with asphalt concrete. The asphalt is compacted thoroughly to the level of the surrounding pavement.

The approximate unit price for full-depth asphalt repair is \$45 per square yard.

Chip Sealing: This treatment consists of spraying an emulsified asphalt on the existing surface, then immediately covering with aggregate and compacted by rolling. Chip sealing should not be performed in cool weather, and should be placed between May 1 and September 1.

The main disadvantages associated with chip seals include:

- Cure Time: May take several hours (depending on the climatic conditions) to reach a stage where they can tolerate unrestricted traffic.
- Flying Chips: Chip seals must be swept to remove excess stone to avoid broken windshields and vehicle damage.
- Noise Considerations: Chip seals can be noisy to travel on.

Because of these disadvantages, as well as the short construction season, chip sealing was not considered as a maintenance treatment for segmental programs. However, we have included it as an option should the Road Commission choose to consider it.

The approximate unit price for chip sealing is \$6.00 per square yard. The expected service life for chip sealed pavements is 5 to 7 years.

6.2 *Pavement Maintenance Funding:*

The Road Commission's budget contains funding for the maintenance of the existing roads. The maintenance items funded by the Road Commission include crack sealing, patching, and shoulder maintenance. This section analyzes the roadway maintenance budget to determine if the funding is sufficient or if additional money should be set aside in the future for this work.

In 2009, the amount budgeted for maintenance work was \$7000.

Crack Sealing: During the field visit the length of cracks requiring sealing (longitudinal, edge, and transverse), as well as the joints created by pavement repair areas (such as utility trenches) were measured. On that date, the cracks were measured as follows:

Street	Limits	Long.	Edge	Trans.	Patch	Total
Gaydos	Bayshore to Causeway	640	1,345	30	0	2,015
Confederate	Causeway to cul de sac	1,535	1,395	290	160	3,380
Memorial	S. Confederate to Confederate	10	130	0	0	140
Memorial	4144 to cul de sac	145	1,185	220	20	1,570
S. Confederate	North end to Confederate	75	210	30	0	315
Woodcliff	Memorial to Baycliffs	85	690	85	120	980
Baycliffs	Woodcliff to Confederate	45	1145	110	360	1,660
Forest Glen	Woodcliff to Memorial	0	390	220	430	1,040
Quarrystone	Forest Glen to cul de sac	20	305	50	45	420
TOTAL MEASURED LENGTH OF CRACKS =						11,520

As noted in the “Crack Sealing” discussion in this section, crack sealing should be performed every 2 to 3 years and costs \$0.50 per foot. Assuming that half of the cracks are sealed every year, approximately 5800 feet of cracks will be sealed, at an annual cost of \$2,900.

Patching existing potholes: Again, during the field visit the number and size of potholes were measured. Approximately 250 square feet of various severity was measured, primarily on Memorial Shoreway. Assuming that the amount of pavement being removed and replaced is twice the measured area of each pothole, the total full-depth asphalt replacement area is about 60 square yards. At a cost of \$45 per square yard, the cost to repair all potholes is \$2,700.

Shoulder Maintenance: The amount of shoulder maintenance for the island’s roads was determined by the length of high severity edge cracking. During the field visit, 700 feet of edge cracking with high severity was observed. At a cost of \$2.00 per foot to place and install aggregate along the shoulder, the total cost for this work is \$1,400.

Summary: Using the above assumed work and estimated costs, the total annual cost for pavement maintenance is approximately \$7,000. Therefore, the amount budgeted by the Road Commission for pavement maintenance work appears to be adequate.