APPENDIX A

M-139 Bridge Replacement Over The St. Joseph River

MARCH 31, 2011

DRAFT M-139 BRIDGE REPLACEMENT ENVIRONMENTAL CLEARANCE ALTERNATIVE DOCUMENT

M-139 Bridge Replacement

Alternative Document

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Section 1 – Introduction

The Wilbur Smith Associates team is providing pre-base plan engineering services for the replacement of the Main Street (M-139) Bridge over the St. Joseph River and adjacent roadway improvements as illustrated in **Figure 1**. The proposed cross section of the Main Street structure will continue to carry two-way traffic on Main Street over the St. Joseph River. This study investigates bridge options, improvements to adjoining roadway geometrics, non-motorized transportation, and the structural hydraulic opening.

This report provides discussion of the existing conditions, development of the alternatives and selection of the Preferred Alternative. Development of the alternatives is presented in two sections; **Section 3 – Initial Alternative Development** discusses the Illustrative Alternatives that were developed following the first stakeholder meeting and public information meetings and submitted to MDOT in July 2010. **Section 4 – Practical Alternative Development** discusses the alternatives that have been refined from the Illustrative Alternatives after Progress Meeting #3 which occurred on August 17, 2010. All of the alternatives evaluated as part of this report were developed with regard to estimated construction cost, future maintenance, horizontal and vertical clearances, and constructability in mind.

The structure study is based on AASHTO LRFD Bridge Design Specifications-5th Edition, MDOT Bridge Design Manual, and MDOT Bridge Design Guides. All roadway improvements will be in accordance with AASHTO Geometric Design of Highways and Streets, MDOT Road Design Manual, MDOT Geometric Design Guide, and other applicable MDOT guides for roadway design.

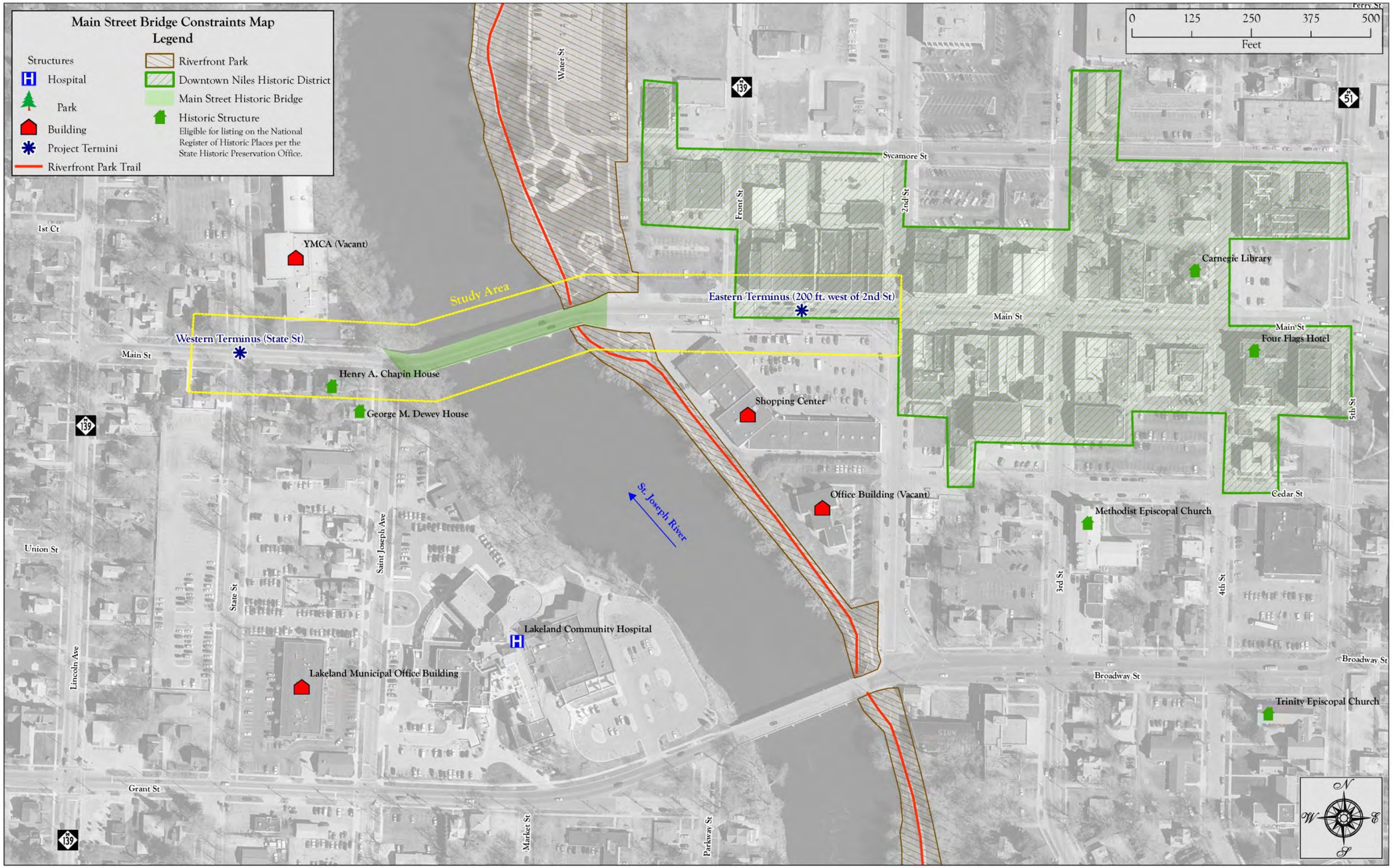


Figure 1 – Study Area

Section 2 – Existing Conditions

M-139, locally known as W. Main Street, is a two-lane street through Niles, MI. Currently the Main Street structure is comprised of one 12-foot wide lane in both directions with three-foot shy distances to the toe of the sidewalks. The WSA Team discussed future development plans with MDOT and there are currently no widening or proposed improvements to the roadway cross section planned at this time.

The existing structure is a four-span reinforced concrete earth-filled arch constructed in 1919. The bridge spans a bend in the St. Joseph River and is subject to high river velocities. The abutments and piers are founded on spread footings which are susceptible to scour. Bridge rehabilitation was performed in 1995 and included: placing riprap, replacement of sidewalks and bridge barriers, lighting alterations, pavement replacement, pier repair, and coating existing concrete.

Prior to the 1919 reinforced concrete earth filled arch structure, there was a two-span bow-string arch bridge at this location with one lane of traffic in each direction and pedestrian sidewalks. It is understood that this bridge was constructed in the mid 1800's.

The bridge connects a residential area of Niles with the Downtown Business District. This creates significant east-west traffic with current year ADT volumes of 10,000 vehicles per day. The intersections on each end of the bridge have unique operational characteristics. The western intersection of Main Street with St. Joseph Avenue marks the end of split one-way traffic for M-139, though both roads carry traffic in two directions. Westbound M-139 traffic crosses the bridge and heads west along Main Street to Lincoln Stree, where it turns south. Eastbound M-139 carries northbound traffic on Lincoln Street until Grant Street, where it heads east on Grant Street until St Joseph Avenue where it turns north to intersect with Main Street at the west end of the bridge. Due to the M-139 alignment, northbound traffic is given priority to turn right onto Main Street without traffic control. Left turns from St. Joseph Avenue to Main Street are prohibited. Similarly, westbound M-139 traffic is given priority and does not have traffic contro, enabling a free flow straight or left turn movements. The Main Street eastbound approach is controlled and must stop before proceeding through the intersection or turning right onto St. Joseph Avenue.

The Front Street intersection with Main Street is a tee intersection with three lanes along Main Street and three lanes on the Front Street approach from the north. The west side of the intersection consists of a wide receiving lane, a dedicated left turn lane, and one through lane. The east side of the intersection consists of a dedicated right turn lane, a dedicated through lane, and a wide receiving lane that tapers from two lanes to one lane prior to the on-street parking. The north approach consists of a dedicated right turn lane, a dedicated left turn lane, and one receiving lane. The uniqueness of this intersection is the location of a commercial drive on the south of the intersection. It is located in the intersection but the lanes of the drive do not line up correctly with the road lanes. Left turns from westbound Main Street into this drive are prohibited and only right turns are permitted from this drive.

Along the east bank of the St. Joseph River the city of Niles has created a linear park which contains a walkway/bike path. The park consists of memorials, a gazebo, and parking facilities in the northeast quadrant of the bridge. Adjacent to the roadway and in coordination with the park, a streetscape project has been constructed with decorative lighting, brick pavers, and other amenities along Main Street.

The walkway/bike path passes under the existing bridge at the easternmost arch. At this location the path provides access to the park property to the north but does not meet most current design standards for bike path design. Horizontal clear width and vertical clearance are not met for the path under the bridge.

Two historic homes reside in the study area. Both homes are located at the southwest quadrant of St. Joseph Avenue and Main Street at the western limits of the project. These homes are a constraint as they cannot be impacted. A large retaining wall just behind the sidewalk, as seen in **Figure 2**, is also considered historic. Improvements may occur to this quadrant but must limit impacts within the existing right-of-way (ROW).

Figure 2 – Historic House Retaining Wall

Section 3 – Initial Alternative Development

The following information in this section was originally submitted to MDOT in July of 2010 and will contain monetary figures and design parameters for conditions as they were examined at that time. The text has been modified to reflect the initial design process, items of clarificaton, and identify the Illustrative Alternatives as initial alternatives. **Section 4 – Practical Alternative Development** provides updated cost estimates and design parameters for the preferred alternative and the practical alternatives. The initial alternatives were developed prior to the Road Safety Audit, meeting with the MDNR (MDEQ), and Maintenance of Traffic Meeting with the city of Niles. These were necessary to provide initial discussion points and identification of design constraints and existing issues.

Illustrative Roadway Alternatives

The WSA Team initially investigated two roadway alternatives and four bridge alternatives. The roadway alternatives included an in-kind roadway option and an improved geometrics roadway option which would shift the alignment of the bridge to improve operation and safety as shown in **Appendices 1 and 2**. The roadway options are independent of the bridge alternatives analysis, which is discussed later in this section, and each roadway alternative can be applied to any of the bridge alternatives.

In-Kind Geometrics Option

This alternative is the replacement of the bridge on existing alignment with either a two-span or three-span structure and the reconstruction of only the necessary roadway to facilitate this replacement (see **Appendix 1**). Vertical grades would not change and minor horizontal improvements would be made to facilitate the new bridge and the improved sidewalk widths. Additionally, the bridge approaches would be reconstructed to allow the bridge expansion joint to be relocated behind the abutment. This reconstruction would include all approach retaining walls and railings associated with the bridge.

Reconstruction of the Main Street and St. Joseph Avenue intersection would be performed to facilitate connecting the existing grade limits along the west and southern legs of the intersection to the new construction. New curb and gutter from the bridge would tie into the existing curb line along the east side of St. Joseph Avenue and north side of Main Street. In order to avoid impacts to the historic homes, work would be limited within the existing ROW. No new impacts outside the ROW line would be required.

Reconstruction of Main Street on the east bridge approach would be performed to allow construction of the new bridge approaches and necessary roadwork to transition this work into the existing roadway.

During the initial alternatives investigation, seven-foot wide sidewalks were anticipated to be carried from the bridge and tied immediately to the existing sidewalks with a transition ratio of 1:10. The existing area is landscaped with decorative retaining walls, brick paths, lighting, and other amenities. Impacts to amenities would be minimized and limited to the improvements connecting new construction to existing features.

Improved Geometrics Option

This alternative improves geometrics based on current design standards, safety, and operation changes relative to the flow of traffic (see **Appendix 2**). A detailed safety study has been prepared by the WSA team under separate title which discusses in more detail the traffic and crash analysis.

Based on 2035 projected traffic volumes, the existing signalized intersection at Main Street and Front Street operates at an overall level-of-service (LOS) C; all turning movements operate at LOS C or better. Based on the crash summary there is a history of collisions between eastbound Main Street traffic turning left and westbound through traffic. To reduce this collision potential, a protected left-turn phase is proposed for the existing signal. The dedicated phase would provide a safe movement for left turn traffic to clear the intersection without searching for gaps in the opposing traffic. This issue is further detailed in the Safety Analysis under separate cover.

The existing roadway alignment has a deflection of approximately 19 degrees at both ends of the bridge where it ties into the roadway. This creates a sight distance issue and requires the driver to make an

aggresive turn correction to follow the contour of the roadway. To address this issue it is proposed to rotate the bridge about the east abutment by approximately five degrees and add 510 foot radius curves at both ends of the bridge to smooth the travel path and enhance sight distance. This improvement would also correct the northern alignment of the pavement edge that currently intrudes into the through lane of traffic at the St. Joseph Avenue intersection.

As part of the bridge realignment, a vertical grade improvement can be implemented to create a consistent grade from the St. Joseph Avenue intersection to a sag vertical curve at the park and drive entrances along the east approach, then match the existing grade near the Front Street intersection. Currently the grade in this area is made up of several independent grades with minimal or no vertical curves. These grades create a blind spot for traffic on the eastbound bridge as they do not see vehicles crossing the bridge. Similarly, westbound vehicles entering the bridge do not see cars on the bridge ahead of them.

Realignment of the bridge involves impacts to Riverfront Park and the YMCA property located in the northwest quadrant. In the southest quadrant there is insufficient ROW for widening and relocating the bridge. Impacts caused by improvements made near the MDOT ROW such as landscaping, retaining walls, walkway/bike path, and other aesthetic improvements associated with Riverfront Park will be mitigated through the construction process. Similar impacts to the northeast quadrant (Riverfront Park) will occur to tie the new construction to existing amenities, and restoration would need to be included in the construction project.

New retaining walls will be needed in the northwest quadrant to support the bridge fill, new roadway, and sidewalk improvements. These improvements, including the retaining wall, will be located out of the existing MDOT ROW and would require a ROW acquisition from the YMCA parcel. This parcel is currently for sale as the YMCA relocated to a new facility. The property was rezoned for high density residential, anticipating future development. Impacts to the southwest quadrant (Lakeland Hospital Property) are limited to the removal of the existing bridge, retaining walls, and railings with no additional ROW impacts.

Current operational characteristics of this intersection conflict with the traffic volumes recorded by MDOT staff during their data collection of the intersection turning movement counts. The current intersection configuration requires eastbound Main Street traffic to stop, prohibits left turns from St. Joseph Avenue, and does not regulate any other movements. This provides free flowing movement for the right turn from St. Joseph Avenue and all movements from westbound Main Street. Traffic counts show the predominant traffic volumes to be the through movements eastbound and westbound. Each of these movements are three times the volume of traffic turning right from St. Joseph Avenue.

Altering the bridge alignment and the radii as discussed previously will address this issue by providing an intersection which would give a free-flow movement to east and west traffic and require the northbound leg to stop and the westbound left movement to yield to eastbound traffic. This results in a more traditional, less expansive intersection with stop control which will be further north away from the existing ROW and will improve both operations and safety. Further detail on this is provided in the Safety Analysis under a separate cover.

Functional Improvement

The operation of the roadway includes the road being intuitive to drive, less confusing to pedestrians and drivers, and is safe to drive with fewer conflict points. By replacing the bridge on existing alignment, no work is being done to improve any of the current issues and there will still be driver confusion at the St. Joseph Avenue intersection. The limited sight distance to the commercial drive in the southwest quadrant of the bridge would still exist. The Improved Geometrics alternative would significantly improve all these situations.

Geometric Improvement

The Improved Geometrics option is the only option that addresses the geometric deficiencies of this roadway. The current roadway does not have curves for vertical or horizontal alignments and does not provide smooth transitions from the roadway to the bridge. The current profile of the bridge and the profile of the roadway east of the bridge create a blind spot for eastbound vehicles that cannot see vehicles turning at the River Front Square in the southeast quadrant of the bridge.

Significant improvements could be performed with the improved geometrics alternative. With this design, a constant grade would occur from the St. Joseph Avenue intersection to just prior to the Front Street intersection. This alignment would provide clearance to the bike path but also cause more impacts to the roadway on the east side of the bridge. Further analysis will be done to determine the limits of these impacts to the driveways, sidewalks, and amenities of Riverfront Park.

The profile of the bridge will vary due to the roadway geometrics decided upon during this study. If the bridge is replaced in kind with the new bridge structure, no major vertical alignment changes would occur. The new bridge design, using concrete or steel beams, will improve the clear width of the bike path and provide more vertical clearance. The ten-foot minimum underclearance requirement will be looked at in detail during the design phase based on the beam type chosen. The deck would replicate the existing 1.5% slope as close as possible.

Vertical Underclearance

The proposed minimum required vertical underclearance for this bridge is two foot of freeboard over the river. However, the bike path on the east bank will require a ten-foot minimum underclearance, which is based on the AASHTO Guide for the Development of Bicycle Facilities. This results in a desired optimal underclearance of 12 feet over the 100 year flood elevation of the river.

Safety Improvements

Safety improvements are implemented for the improved geometrics alternative by:

- Implementing horizontal and vertical curves to improve sight lines
- Changing the skew of bridge alignment to improve sight lines
- Reprioritizing movements at St. Joseph Avenue and Main Street to reduce confusion and potential vehicle and pedestrian conflict points
- Protecting eastbound left-turn movement at Front Street to reduce the risk of collisions (recommended for both roadway alternatives)

Safety improvements at Front Street can be done with this project or separately as the construction limits will not encompass this intersection. Pavement markings, signal improvements, and driveway

improvements/closure can be constructed under a separate contract and would be independent of the bridge replacement. These elements are detailed in the separate Safety Analysis report.

Implementation of Road Safety Audit (RSA)

At the time of the submittal of the initial alternatives document, the RSA had not been completed. Therefore, the incorporation of RSA recommendations could not be evaluated. **Section 4 – Practical Alternatives Development** incorporates the RSA into the preferred alternative and practical alternatives.

Minimize Impacts to Riverfront Park

Riverfront Park is a Section 4F property and minimizing the impacts is a key factor of the alternatives development. Replacing the bridge in-kind without making other geometric improvements will provide the least impact to the park. The construction process will impact the park as the walkway/bike path, block retaining walls, and landscaping is all adjacent to the abutment that will be replaced. Similarly, the realignment option will require removing this abutment and sliding the bridge southerly on the east bank of the river. This option conflicts with more of the retaining wall and other park amenities than the replace in-kind option. In both options the walkway/bike path could be replaced underneath the bridge to accommodate new standards for path width and horizontal clearance.

Impacts to the walkway/bike path should include only those necessary to facilitate the construction of the bridge abutment and setting of the beams, which is anticipated to be within current MDOT ROW. During the intial alternatives development, investigation into whether the walkway/bike path could be elevated to provide proper clearance and reduce the risk of seasonal flooding was performed and only one foot of elevation change was discussed. Determination of the actual flood level that the walkway/bike path would be elevated to avoid is still to be made. The practicality of this improvement would be evaluated against the availability of crossing Main Street using the existing, adjacent sidewalk/path system. Currently, the path that passes under Main Street is connected to the surface system of sidewalks and bike facilities; however, the nearest crosswalk is located at the Front and Main Street intersection.

To facilitate potential future widening of the bicycle path, the location of the east abutment may be moved further eastward. Current AASHTO bike path standards require a ten-foot wide path with two-foot shoulders/clear zone on the outside of the path. This offset provides room for passing bicycle handlebars and room for bikers to recover if they stray from the path. This improvement will widen the path from 10 feet to 14 feet.

Right-of-way Acquisition

The in-kind geometric alternative retains the existing ROW impact at the southwest quadrant of the bridge. The roadway, sidewalk, and barrier extend out of the ROW at this location. The improved geometrics alternative would need a grading or temporary permit to remove the existing encroaching items from the ROW, and would require ROW in the northwest quadrant to construct the new bridge, sidewalk, roadway, and retaining walls. This parcel is currently for sale as the old YMCA building is located here.

The improved geometrics alternative would also create a ROW encroachment on the southeast quadrant of the project. The additional bridge width and alignment change results in an encroachment. Possible grade changes in the profile would create a grading encroachment that could be mitigated by

extending retaining walls along the roadway in this quadrant. Sidewalk connections to the walkway/bike path would still require grading permits to tie the sidewalks to the proposed grade. Realignment of the abutment will cause impacts to the walkway/bike path, retaining walls, and other amenities in the vicinity of the existing abutment outside the existing ROW.

Both alternatives have ROW impacts to reconstruct or replace a section of the walkway/bike path under the bridge near the east abutment. Impacts could also be necessary to tie in the sidewalks that are adjacent to the bridge into any new grades of the bridge and its approaches. These can be covered by permits to grade sidewalk.

Utilities

Correspondence and existing plans received prior to the submittal of the initial alternatives document indicate the presence of the following utilities:

- Six inch conduit in the deck
- Sanitary sewer above footing on west side of bridge

Additional utility information has been requested and will be incorporated as available prior to completion of this study. **Section 4 - Practical Alternative Developement** provides for more detail on utilities received after submission of the illustrative alternatives.

Illustrative Bridge Alternatives

The proposed bridge structure will have two 12-foot lanes (one in each direction) and a three-foot shy distance to the toe of the proposed sidewalks. This will match existing bridge width.

Minimum sidewalk width is five foot, two inches per MDOT Bridge Design Guide 6.29.10C. Discussion with MDOT during the intial alternatives development regarding pedestrian traffic has resulted in proposing a seven foot minimum sidewalk on both sides of the bridge to accommodate the potential for two pedestrians to comfortably pass in opposite directions. Further discussion on the sidewalk width occurred during the practical alternatives development and this has been reduced to six-foot wide sidewalks. More detail on the Illustrative Bridge Analysis can be found in **Section 4 – Practical Alternatives Development**.

The proposed aesthetics associated with bridge rail will be developed in conformance with the Context Sensitive Solutions (CSS) and historic process, which will be implemented at a later date as part of this study.

The bridge is designed for Michigan standard HL-93 Mod loading. This loading consists of a 20% increase over HL-93 (standard) loading, and substitution of one 60-kip axle instead of the design tandem load.

The proposed bridge will be aligned horizontally with the existing Main Street geometrics or improved geometrics as presented earlier.

Structure Options and Span Arrangements

The proposed bridge must span the St. Joseph River and accommodate an existing walkway/bikepath beneath the east end of the bridge.

The following span options were considered:

- Span Option 1 – Two-span bridge (approximate 166 ft spans), see **Appendix 3**
- Span Option 2 – Three-span bridge (approximate 111 ft spans), see **Appendix 4**

From discussions with MDOT's historical representative, a four-span bridge would not be desirable as a replacement option to match the existing bridge as it leads to confusing the history of the bridge and therefore was not considered for this study.

Superstructure Types

Several concrete and steel superstructure types were considered and evaluated for this bridge as described below.

Steel Plate Girders (Alternative 1) This superstructure type is more advantageous when spans reach lengths of 120 feet and longer due to the lighter beam weight and shallower profile. This superstructure type can reduce the load on the substructure but generally requires future maintenance in the form of recoating the beams every 30 to 40 years. It is generally more costly for shorter spans due to higher material and fabrication costs.

Six 75-inch welded steel plate girders were evaluated for Span Option 1. The cost of a steel superstructure is greater than the concrete alternates, so steel was not investigated for Span Option 2. More details for Alternative 1 can be found in **Appendix 5**. Cross sections have been prepared for both a raised sidewalk with a single rail and an at-bridge grade walk with double rails.

Steel Box Girders were not considered due to the relatively high fabrication costs. This superstructure type does provide a shallower option than comparable plate girder options; however the offset in savings for earth fill is not anticipated to be worthwhile. Further, inspection of these girders poses challenges due to confined spaces.

Concrete I Beams (Alternative 2) - This superstructure type is generally inexpensive to fabricate and erect. The preliminary design indicates that six Michigan 1800 beams are adequate for Span Option 2. More details can be found in **Appendix 6**. *Cross sections have been prepared for both a raised sidewalk with a single rail and an at-bridge grade walk with double rails.* Concrete beams for the two-span alternate are not readily available due to the long span length required.

Spliced Bulb Tee Girders - The spliced bulb tee beam bridge is a viable option at this location. Available beam spans of up to 145 feet are fabricated and spliced and post tensioned longitudinally to obtain the required bridge superstructure. This type of beam configuration has not previously been used in Michigan. The required false work in the river for construction of the beam segments over the piers will add cost and complexity for the project and it is unlikely that this will be the most cost effective solution.

Adjacent Concrete Box Beams (Alternative 3) - This superstructure type is most beneficial when the required depth of the superstructure is critical. It is generally more costly due to the higher number of

beams required (12) to be fabricated and can increase the costs of the substructure due to the higher weight needing to be supported. This superstructure type would be transversely post tensioned.

One disadvantage of the box beams is future deck replacement and potential damage to the beams during removal of the deck from the beams. In addition, this superstructure type has an adverse impact on future widening. For this bridge, 48 inch adjacent concrete box beams were investigated for Span Option 2.

Concrete Spread Box Beams (Alternative 4) - Concrete spread box beam superstructures are also cost effective solutions for these span ranges. For this bridge, six 54 inch spread concrete box beams were investigated for Span Option 2.

This superstructure type has a slight advantage over the adjacent concrete boxes in that the outside of the bottom and sides of the box beams are visible for inspection. The inside of the boxes and top flange are not visible for inspection which is a disadvantage.

Future Maintenance

Concrete superstructure alternatives provide a more desirable long-term solution than steel alternatives in that the concrete alternatives do not require maintenance painting. Steel superstructures also require additional maintenance for a bridge over water.

Substructure Types

Several types of abutments were considered and are listed in this section. It is desired to propose substructure configurations that take joints away from abutment elements to ensure long life of the substructure and minimize repairs to beam ends.

Full height cantilever abutments with semi-integral back walls - The full height abutment is suitable for this location as it provides for the multiuse path and maintains (increases) the hydraulic opening for the bridge. This type of abutment is also stable in the event of high water conditions. Semi-integral back walls are proposed here to get expansion joints off of the deck into the approaches.

Integral abutments - This option was not considered due to the wall height requirements and proximity to the water. In order to use this type of abutment, the superstructure length would need to be increased, thereby increasing costs.

MSE wall abutments with cantilever pile supported stub abutments - MSE walls are not used along river banks due to erosion concerns.

Curtainwall abutments - This is not a viable option due to the height of the abutment needed would be greater than the maximum curtainwall height of nine foot, six inches.

Existing Masonry Walls

On the north and south sides of the east end of the existing bridge, there are masonry walls that help to protect path users from the arch abutment. Upon reconstruction of the bridge, these walls will need to be reconstructed for some length to pull them back. The walls may be masonry or cast in place retaining walls. Aesthetic alternatives will be considered at a later date as part of this study.

Foundation Types

Soil borings obtained to date (mid 1990's) near the Main Street Bridge indicate that the foundations will need to be pile supported. The scour critical nature of this bridge would also necessitate the use of deep foundations. Drilled shafts may be an option; however, it is anticipated that the length would be quite long and thus expensive. This will be investigated further upon receipt of the new soil borings and foundation recommendations.

Drainage

Due to the length of the bridge, deck drains and an enclosed drainage system is anticipated and is included in the bridge cost estimate.

Hydraulics

Preliminary investigation shows that the two-span and three-span bridges have nearly the same elevation for the 100 year storm event (two span El. 648.37, three-span El. 648.38). Thus, either the two-span or three-span bridge will improve the hydraulics at this location. The existing 100 year elevation is 648.43.

Scour

It is anticipated that scour protection will be provided at piers and abutments for the replacement bridge. This will consist of graded rip rap placed at each pier. Scour calculations will be included in the Engineering Report.

Constructability

Constructability of both roadway alternatives are relatively equal. With the road closed and detoured, the contractor will have room for constructing the bridge and roadway. Storage of materials on-site will be difficult for the contractor as there is limited space available. Materials will not be allowed to be stored on park property.

Construction of the three-span bridge will require more cofferdams to be constructed than a two-span structure. Cofferdams will be required for removal of the three piers existing in the river in addition to each required for the new pier construction.

The bridge alternatives that have been described are structure types that are easy to fabricate and construct. Stay-in-place metal forms can be used on any of the proposed superstructures with the exception of the adjacent concrete box alternatives. Construction of piers and abutments will require cofferdams and tremie pours to construct these foundations.

Aesthetics

With the history of Niles being reflected in the adjacent Downtown Business District and the historical significance of this arched bridge to the city and to transportation history in Michigan, it is necessary to have designs which allow the character of the city and the history of the bridges to be incorporated. This bridge will act as more than a bridge for the roadway but also a bridge for the community by joining residential areas west of the bridge with the commercial district to the east. The history of Niles has also been incorporated into the Riverfront Park, so the bridge should blend in with the improvements already completed. Each bridge alternative has been studied with standard construction items which

allow for aesthetic treatments to be added to the appearance of the bridge as well as allowing for amenities to be provided on the bridge.

Selection of the bridge type has a direct affect on the aesthetics of the project. Rustications, reveals, texturing, accent lighting, pendant lighting, pigments, emblems, imprints, and other items can be used to enhance the bridge and tie it to the surroundings and local culture.

Aesthetic treatments, including texturing of the concrete, are anticipated for the proposed structure. The limits of the texturing are unknown at this time. However, an aesthetic cost equaling 1% of the bridge cost is included in the cost estimate for this bridge. Any specific aesthetic requirements are to be determined by MDOT through the CSS and historic process.

It is anticipated that bridge lighting will be included with the project for this bridge replacement and costs are included. Aesthetic lighting options will be considered at a later date as part of this study.

Cost

Due to the current economic climate of the country and of the State of Michigan cost can be the deciding factor on projects. But for this project, the cost difference between the alternatives is not significant compared to the overall cost of the project. The In-Kind Geometric Alternative ends up being only six percent cheaper than the Geometric Improvement Alternative.The cost difference comes from the geometric improvements requiring a six percent longer bridge than the In-Kind Alternative. Road improvements are approximately the same cost with the realignment reconstructing more roadway while improving the vertical profile. Tightening the intersection of Main Street and St. Joseph Avenue reduces the amount of roadway constructed for the intersection and removes the existing ROW encroachment in the southeast quadrant. Individual costs for each alternative are shown in **Table 1**.

Preliminary cost estimates have been developed for the initial bridge alternatives based on a bridge length of 331’ 9” which accommodates both initial roadway alternatives:

- Alternative 1 - two-span steel plate girder bridge
- Alternative 2 - three-span PPC I (Michigan 1800) beam bridge
- Alternative 3 - three-span PPC adjacent box beam bridge
- Alternative 4 - three-span PPC spread box beam bridge

Cost comparisons of these bridge construction alternatives are shown in **Table 1**. Each bridge type has been shown with each scenario of roadway improvements to provide a total project cost.

Table 1 – Illustrative Alternative Cost Comparison

Alternate	Bridge Option	Roadway Option	Approximate Cost
1	Two Span, Full Height Abutments with Semi-Integral Backwalls, Six 75" Steel Plate Girders	In-Kind Geometrics	$7,522,000
		Improved Geometrics	$7,935,000
2	Three Span, Full Height Abutments with	In-Kind Geometrics	$5,509,000

	Semi-Integral Backwalls, Six Prestressed Concrete Michigan 1800 Girders	Improved Geometrics	$5,801,000
3	Three Span, Full Height Abutments with Semi-Integral Backwalls, Twelve 48" Adjacent Prestressed Concrete Box Beams	In-Kind Geometrics	$5,699,000
		Improved Geometrics	$6,002,000
4	Three Span, Full Height Abutments with Semi-Integral Backwalls, Six 54" Spread Prestressed Concrete Box Beams	In-Kind Geometrics	$5,442,000
		Improved Geometrics	$5,730,000
All costs include an approximate 20% contingency.			

Maintenance of Traffic

For all the illustrative construction alternatives the maintenance of traffic (MOT) will remain the same (see **Appendix 8**). Due to the type of bridge there is no alternative method of maintaining traffic on the bridge during construction using part width construction. Constructing the new bridge, or part of the new bridge off alignment and within the existing ROW, while keeping the existing bridge in operation cannot be performed without major ROW impacts. Furthermore, maintaining an earth-filled arch bridge during construction is costly and unsafe. Due to adjacent alternate routes, the Main Street bridge construction would be done using a complete closure and a full detour route for all traffic.

The initial detour route developed during the illustrative alternative development as illustrated in **Appendix 7** will consist of routing westbound M-139 traffic east along Wayne Street (the existing truck route) to M-51, south along M-51 to Main Street, then west on Main Street to 4th street, south on 4th street to Broadway/Grant Street, and then west to Lincoln Avenue (M-139). Eastbound M-139 would continue straight on Grant/Broadway Street, rather than turning onto St. Joseph, until 5th street. Traffic would then turn left onto 5th Street, which becomes M-51 at Main Street, and follow this road until Wayne Street, turn left onto Wayne Street heading west until it meets back up with M-139 (Front Street). This detour would offer the best radii for truck turning movements; however, some minor modifications would need to be made to the existing road network. North 4th Street is in relatively poor condition and may need a two-inch overlay to accommodate additional truck traffic. Also, a parking spot in the northwest corner of Broadway and 4th Street would need to be closed in order to improve the truck turning movement.

For the westbound detour route, it is proposed to temporarily make North 5th Street one way from Cedar Street north to Main Street. Since there is no on-street parking on North 5th Street larger vehicles will have enough room to make the right turn back onto Main Street (M-51) if needed. Making North 5th Street one way will shut off access to one alleyway that can also be accessed from North 4th Street. It is anticipated that this detour will not add any additional length for emergency vehicles going to the Lakeland Community Hospital located at the northeast intersection of Grant Street and North St. Joseph Avenue. The total length of detour is less than one and one quarter miles.

Pedestrian facilities that cross under and over B02 of 11021 will also be accommodated with detours. Pedestrians wanting to cross over the St. Joseph River using Main Street can be detoured along North 2nd Street to Grant/Broadway Street, along North St Joseph Avenue and then back to Main Street. The total length of this pedestrian detour is roughly one-half mile. During the intial alternatives development it was assumed that the river walk crossing under B01 of 11021 could be detoured onto the path that comes up to grade at Main Street where a temporary cross walk will be installed connecting to Riverfront Park.

Further discussion has occurred with MDOT and the city of Niles regarding detours and the maintenance of traffic, including a specific maintenance of traffic meeting with the city staff. Several changes have occurred and are summarized in the Practical Alternatives section and is further detailed in the Maintenance of Traffic technical memorandum.

Section 4 – Practical Alternative Development

The practical alternative development began after progress meeting #3 where the illustrative alternatives document was discussed and comments were received. Based on this meeting, additional alternatives were developed based on recommendations from the Coloma TSC staff, refinement of unused alternatives from the illustrative alternatives development process, and combinations of other alternatives. Also included in these alternatives were recommendations from the Road Safety Audit, geometric changes based on MDOT review, incorporation of city recommendations for the detour route, and input from the study team.

Based on the study teams preference for a practical alternative, additional meetings were conducted with representatives from different review departments within MDOT to verify design parameters of what became the preferred alternative. The second public information meeting presented the practical alternatives and the preferred alternative for public input and review.

Practical Alternatives

After presentation of the illustrative alternatives, the MDOT team provided feedback and comments that led to further alternative development resulting in two additional alternatives being moved forward into the practical alternatives. This section provides a overview of each practical alternative, initial alternatives (#1 & #2) and the two new alternatives (#3 & #4). Alternative #3 was further refined to produce Alternatives #3A & #3B, which will be discussed in detail under the Alternative #3 analysis.

Practical Alternative #1

Alternative #1 is the In-Kind Geometrics option presented in the illustrative alternatives and consists of the replacement of the bridge on existing alignment with either a two-span or three-span bridge structure, and the reconstruction of only the necessary roadway to facilitate this structure (**Figure 3**). Vertical alignment would not be modified and minor horizontal improvements would be made only to facilitate the new bridge and the improved sidewalk widths. Additionally, the bridge approaches would be reconstructed to allow the bridge expansion joint to be relocated behind the abutment. This reconstruction would include replacement of all approach retaining walls and railings associated with the bridge. Section 3 Initial Alternative Development provides more detail for Practical Alternative #1.

Practical Alternative #2

Alternative #2 is the Improved Geometrics option presented in the illustrative alternatives and improves geometrics based on current design standards, safety, and operation changes relative to the flow of traffic (**Figure 4**). Under this alternative, it is proposed to rotate the bridge about the east abutment by approximately five degrees and to add a 510 foot radius curve at both ends of the bridge to smooth the travel path and enhance sight distance. This improvement would also correct the northern alignment of the pavement edge that currently intrudes into the through lane of traffic at the St. Joseph Avenue intersection. Section 3 Initial Alternative Development provides more detail for Practical Alternative #2.

Practical Alternative #3

Alternative #3 uses available land at the former YMCA parcel to remove the impact to the park on the east side of the bridge (**Figure 5**). By extending the length of the tangent and bridge, the roadway is pushed to the north and removes the encroachment to the linear park on the east side of the bridge. Relocation of the Main Street and St. Joseph Avenue intersection to the north would require additional retaining wall and fill or construction of additional bridge length. In discussion with the MDOT team, the historic homes are impacted by moving the roadway away from the original location of the road. This changes the character and setting of the historic house.

This alternative also introduces a 9.4 degree deflection into the intersection of Main Street and N. State Street at the west end of the project. St. Joseph Avenue has a curve introduced to provide a perpendicular intersection with Main Street. A large turning radius was provided in the southeast quadrant for large right turning vehicles. With this design the west abutment could be completely constructed without impacting the existing bridge, allowing for a shorter closure time.

Practical Alternative #3A

Alternative #3A refined the concept of Alternative #3 to remove the deflection at the intersection of Main Street and N. State Street by adding a curve into the alignment prior to the intersection(**Figure 6**). This reduces the impact to the YMCA property while still removing impacts to the park on the east side

of the bridge. With this alternative the roadway is brought further to the south and does not allow for the west abutment to be built completely off alignment.

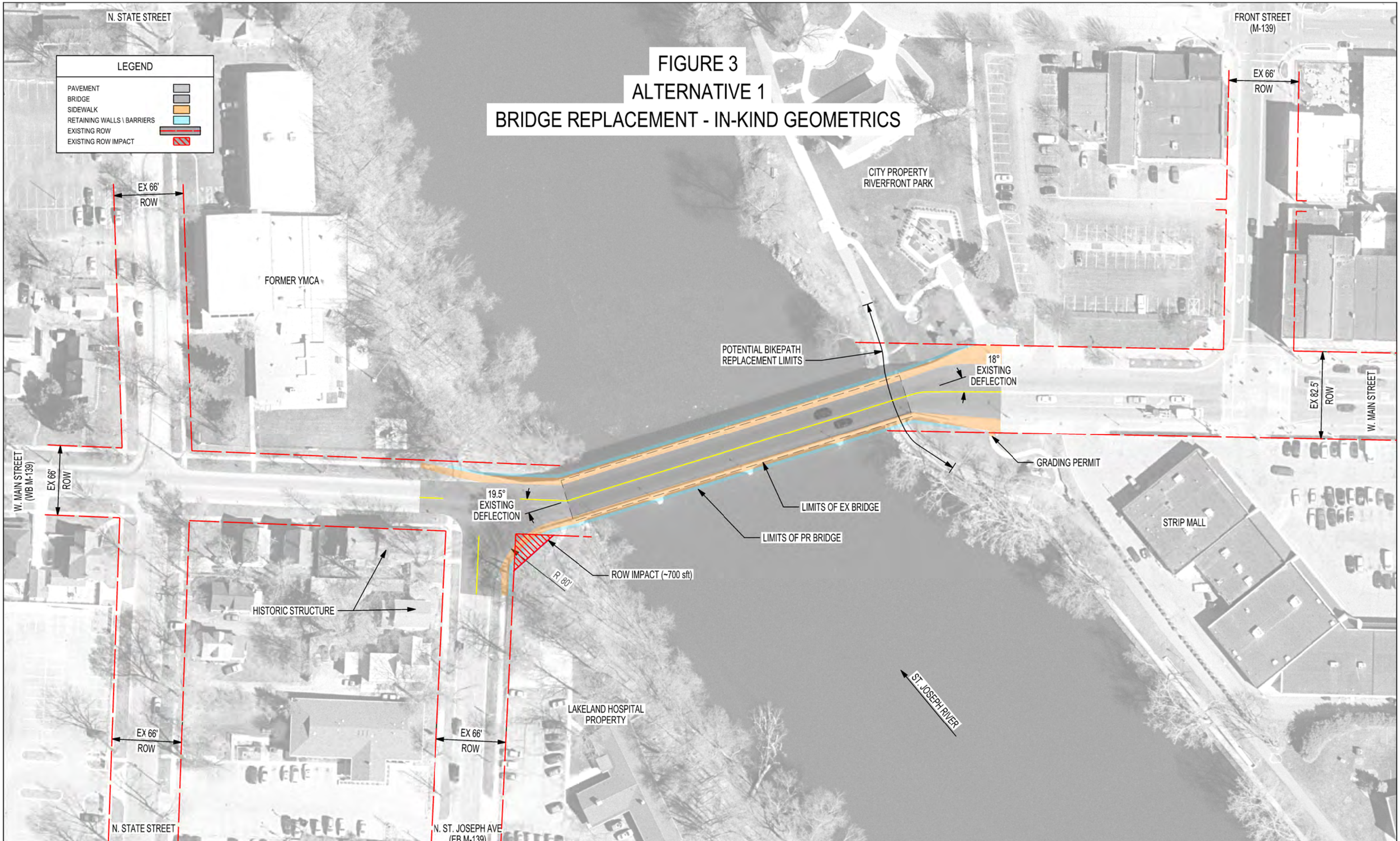
Practical Alternative #3B

Alternative #3B, the preferred alternative, is a refined concept combining Alternatives #2 and #3A. By extending the length of the bridge to the west, ROW impacts can be avoided at the east abutment(**Figure 7**). If the YMCA parcel is able to be utilized the deflection angle of the bridge can be reduced, allowing the west end of the bridge to move north from its current position. St. Joseph Avenue is left to its current alignment, as the intersection angle is within MDOT guidelines for intersection angles at approximately 79 degrees. The right turning radius from St. Joseph Avenue is also smaller due to discussion of removing the truck traffic from it. This bridge is being built mostly within the limits of the old bridge, therefore a full closure must occur during construction.

Practical Alternative #4

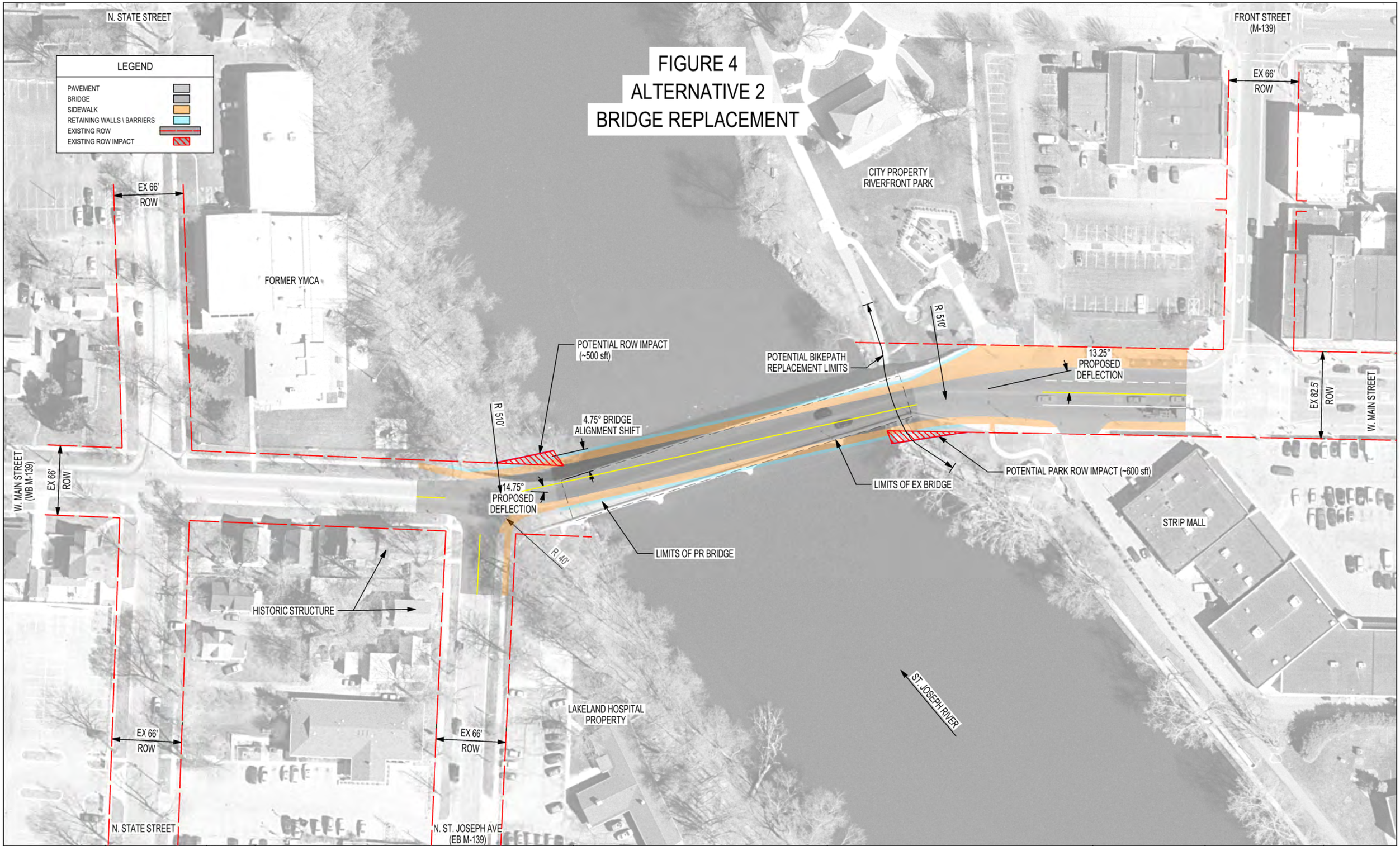
Alternative #4 introduces deflections into both intersections and uses a straight line to connect the intersections, simplifying the alignment of the roadway (**Figure 8**). ROW impacts are introduced in opposite quadrants in the southeast and northwest quadrants. Simplification of the alignment allows for safety improvements by improving the sight distance of vehicles as they traverse the bridge. Inflections at the intersections counter some of the safety advantages of this simple alignment. Due to the realignment of the east end of the bridge to the south, the improvements to the bicycle path and adjacent drives will need to be extended.

FIGURE 3
ALTERNATIVE 1
BRIDGE REPLACEMENT - IN-KIND GEOMETRICS



WilburSmith Associates	MDOT Michigan Department of Transportation	N W E S	MAIN STREET BRIDGE RECONSTRUCTION	FIGURE 3	0 VERT. (FT) 80 / 0 HORZ. (FT) 80	DATE:03/28/11 · DESIGN UNIT: WOOLCOCK · TSC: COLOMA · CS: 11021 · JN: 104152

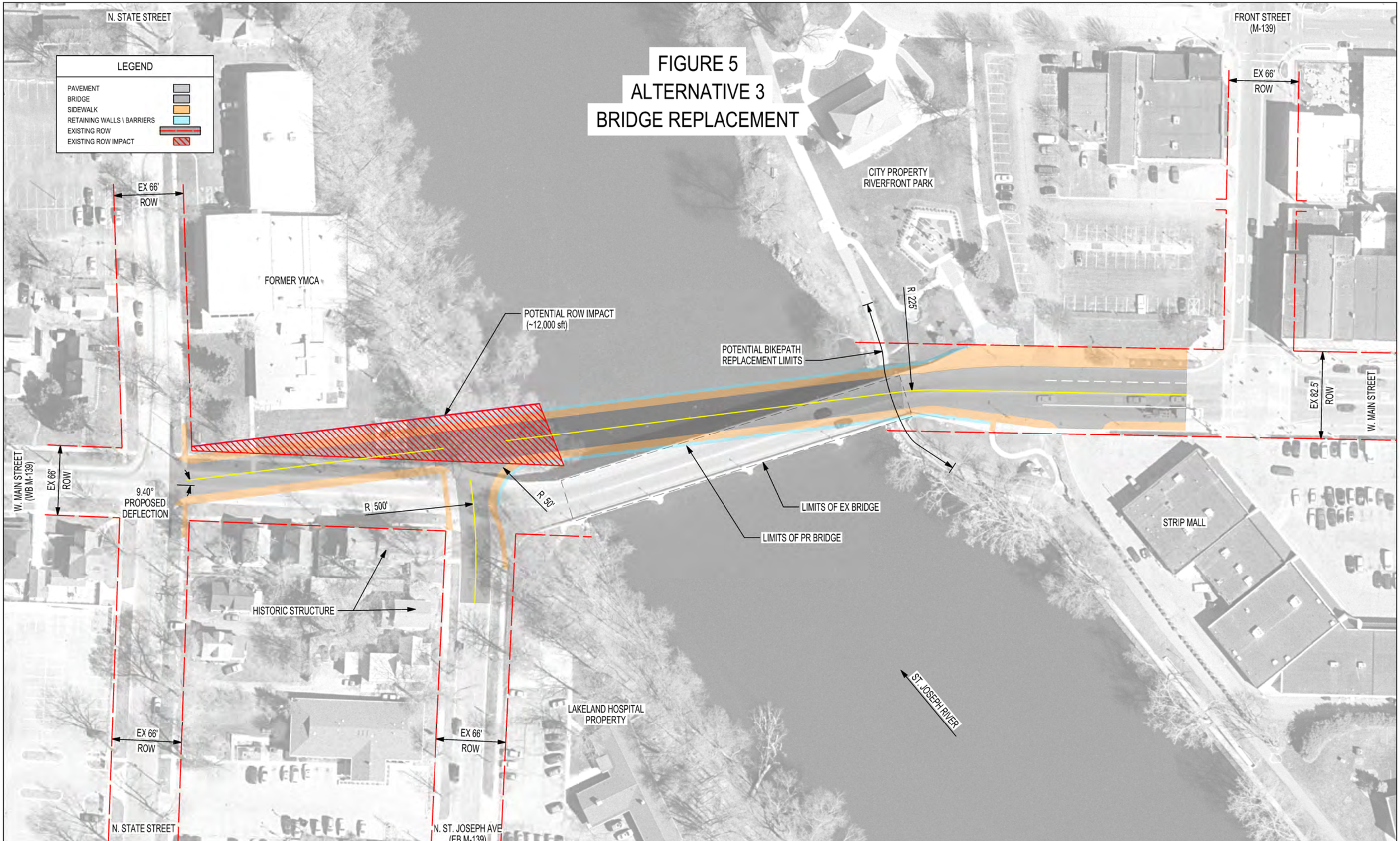
FIGURE 4
ALTERNATIVE 2
BRIDGE REPLACEMENT



WilburSmith Associates	MDOT Michigan Department of Transportation	N W E S	MAIN STREET BRIDGE RECONSTRUCTION	FIGURE 4	0 VERT. (FT) 80 / 0 HORZ. (FT) 80

DATE:03/28/11	CS: 11021
DESIGN UNIT: WOOLCOCK	JN: 104152
TSC: COLOMA	

FIGURE 5
ALTERNATIVE 3
BRIDGE REPLACEMENT



WilburSmith Associates	MDOT Michigan Department of Transportation	N W E S	MAIN STREET BRIDGE RECONSTRUCTION	FIGURE 5	0 VERT. (FT) 80 / 0 HORZ. (FT) 80	DATE:03/28/11 · DESIGN UNIT: WOOLCOCK · TSC: COLOMA · CS: 11021 · JN: 104152

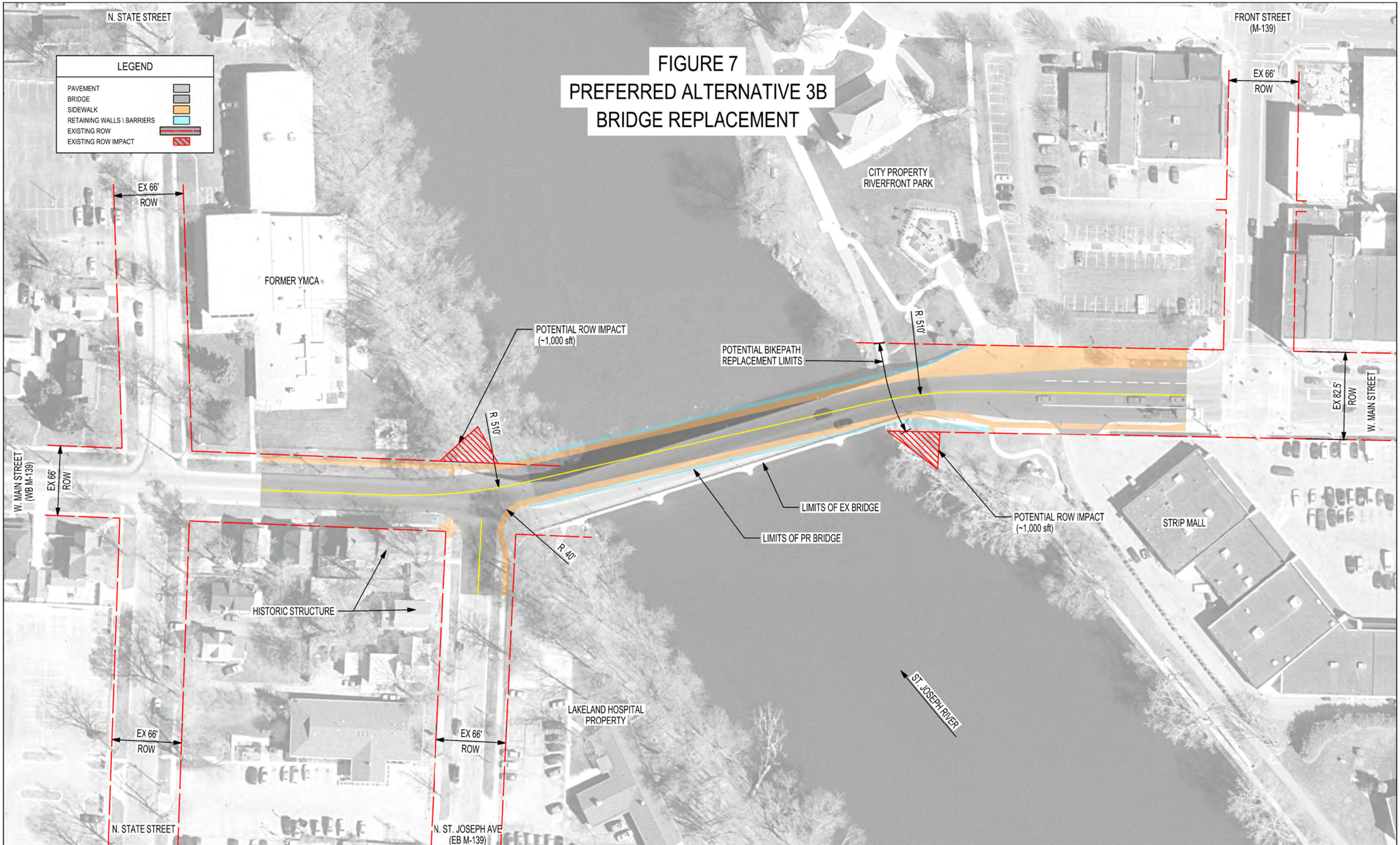
FIGURE 6
ALTERNATIVE 3A
BRIDGE REPLACEMENT

LEGEND
- PAVEMENT
- BRIDGE
- SIDEWALK
- RETAINING WALLS \ BARRIERS
- EXISTING ROW
- EXISTING ROW IMPACT

N. STATE STREET
FRONT STREET (M-139)
EX 66' ROW
CITY PROPERTY RIVERFRONT PARK
FORMER YMCA
POTENTIAL ROW IMPACT (~6,100 sft)
POTENTIAL BIKEPATH REPLACEMENT LIMITS
R 510'
EX 82.5' ROW
W. MAIN STREET
W. MAIN STREET (WB M-139)
R 50'
LIMITS OF EX BRIDGE
LIMITS OF PR BRIDGE
STRIP MALL
HISTORIC STRUCTURE
ST. JOSEPH RIVER
LAKELAND HOSPITAL PROPERTY
N. ST. JOSEPH AVE (EB M-139)

WilburSmith Associates	MDOT Michigan Department of Transportation	N W E S	MAIN STREET BRIDGE RECONSTRUCTION	FIGURE 6	0 VERT. (FT) 80 / 0 HORZ. (FT) 80	DATE:03/28/11 DESIGN UNIT: WOOLCOCK TSC: COLOMA	CS: 11021 JN: 104152

FIGURE 7
PREFERRED ALTERNATIVE 3B
BRIDGE REPLACEMENT



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MDOT Michigan Department of Transportation

N W E S

MAIN STREET BRIDGE RECONSTRUCTION

FIGURE 7

0 VERT. (FT) 80
0 HORZ. (FT) 80

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TSC: COLOMA	

FIGURE 8
ALTERNATIVE 4
BRIDGE REPLACEMENT

LEGEND
- PAVEMENT
- BRIDGE
- SIDEWALK
- RETAINING WALLS \ BARRIERS
- EXISTING ROW
- EXISTING ROW IMPACT

N. STATE STREET
FRONT STREET (M-139)
EX 66' ROW
CITY PROPERTY RIVERFRONT PARK
FORMER YMCA
POTENTIAL PARK ROW RETURN (~4,800 sft)
POTENTIAL BIKEPATH REPLACEMENT LIMITS
POTENTIAL ROW IMPACT (~7,700 sft)
6.76°
EX 82.5' ROW
W. MAIN STREET
W. MAIN STREET (WB M-139)
8.33°
R 50'
LIMITS OF EX BRIDGE
LIMITS OF PR BRIDGE
POTENTIAL ROW IMPACT (~1,200 sft)
POTENTIAL PARK ROW IMPACT (~3,200 sft)
STRIP MALL
HISTORIC STRUCTURE
ST. JOSEPH RIVER
LAKELAND HOSPITAL PROPERTY
N. ST. JOSEPH AVE (EB M-139)

WilburSmith Associates	MDOT Michigan Department of Transportation	N W E S	MAIN STREET BRIDGE RECONSTRUCTION	FIGURE 8	0 VERT. (FT) 80 / 0 HORZ. (FT) 80	DATE:03/28/11 DESIGN UNIT: WOOLCOCK TSC: COLOMA	CS: 11021 JN: 104152