Addendum to
Citizens Oversight Flooding Committee Final Report

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Prepared for:

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INTRODUCTION

In 2004 the City of North Royalton organized a Citizens Flooding Oversight Committee and hired the firm of Stephen Hovancsek & Associates, Inc. to facilitate and moderate the Committee. A Final Report containing the findings of the Committee was published in June 2005.

In January 2007, the firm of Stephen Hovancsek & Associates, Inc. was again retained by the City of North Royalton to investigate three additional areas of flooding concern in the vicinity of the Ohio Turnpike which may have been assumed to be within the scope of study for the Ohio Turnpike 3rd Lane Expansion investigation. An Addendum to the Final Report has been prepared. The three areas of investigation included:

1. Edgerton Road over the East Branch of the Rocky River
2. Royalton Road (S.R. 82) from 3619 to 3881
3. Akins Road from 3450 to 4451

The tasks to be completed for the investigation included:

1. Researching extent of flooding;
2. Interviewing residents in flooding areas;
3. Researching available records for improvements in the area, previously completed studies and calculations;
4. Delineation of drainage areas as necessary;
5. Identification of probable causes of flooding;
6. Discussion of possible solutions to causes of flooding;
7. Prioritization of study areas with regard to existing priorities and
8. Preparation of Preliminary Cost Estimates for solutions of projects added to the Priority list.

EDGERTON ROAD OVER EAST BRANCH OF ROCKY RIVER

The area of study is located south of the Ohio Turnpike and east of State Road on Edgerton Road at its intersection with the East Branch of the Rocky River. The addresses particularly affected by flooding include 5228 through 5250 Edgerton Road. Residents that were interviewed have indicated that yard and basement flooding have occurred predominantly through overland flow when the banks of the River overflow at a bend in the channel alignment. Review of the channel profile indicates a change in slope from approximately 0.9% to a slope of approximately 0.2% just north of this bend. A culvert on private property exists at 5228 Edgerton Road. Residents that were interviewed indicated the culvert flows full and causes bank overflows at 5240 Edgerton. Fortunately for this resident, the glass block basement windows have been prohibiting water from entering the basement. The water has risen as high as the basement windows and top step at the rear of the home.

A culvert in the public right of way on Edgerton Road is planned for replacement by the Cuyahoga County Engineer in the summer of 2007. County road drainage structures are required to pass the 25-year storm event without overtopping the road.

The headwaters of the East Branch of the Rocky River are located in the vicinity of Wallings and State Roads. A defined channel can be seen beginning in the rear property at 11520 State Road. The channel flows south and parallel to State Road through a series of culverts under Creek Run Drive, Royalwood Road, Goodman Drive, the Giant Eagle parking lot and Royalton Road before crossing State Road at the Swan Lake Development. The stream continues in a southerly direction under Akins Road, the Ohio Turnpike, Valley Parkway in the Rocky River Reservation of the Cleveland Metroparks and beyond to the rear yards of the properties under consideration here. The channel makes a 45-degree bend to the east and then again a 45-degree bend to the south (see Photograph 1) in the rear properties along Edgerton Road. The stream continues through the private culvert at 5228 Edgerton Road (see Photograph 2) before crossing through another culvert 150 feet downstream under Edgerton Road. Beyond Edgerton Road, the stream

meanders in and out of the City of North Royalton eventually flowing into the City of Strongsville and towards the Rocky River. A copy of the Drainage Area Schematic can be found in ***Figure 1, East Branch of Rocky River Drainage Area***.

In 2004, The City of North Royalton hired CDM, Inc. to study the effects of the third lane expansion of the Ohio Turnpike. CDM concluded in their report that the third lane expansion did not significantly increase the runoff to this stream. The additional amount of pavement added is approximately 4 acres. The total drainage area contributing to the culvert under Edgerton Road is approximately 1,145 acres. The additional impervious area added represents only 0.35% of the entire drainage area. The contributing drainage area south of and including the Turnpike is approximately 195 acres. Hydraulically speaking, most of the runoff from the additional pavement on the Turnpike would pass through the culvert on Edgerton Road before the runoff from the remaining 950 acres would make it to the culvert. This is not to say that the increased paved area has no effect on the watershed. Any improvements upstream through the watershed will have a cumulative effect downstream.

The Federal Emergency Management Agency (FEMA) completed an engineering study or Flood Insurance Study (FIS) in March 1980 for the City of North Royalton. From the FIS, FEMA developed a Special Flood Hazard Area (SFHA) along portions of streams in the City and mapped them on the Flood Insurance Rate Maps (FIRMs). The SFHAs are approximate areas of the 100-year floodplain unless a detailed analysis is completed. A detailed analysis was completed for portions of the East Branch of the Rocky River providing actual Base Flood Elevations (BFEs) for the 100-year Floodplain. The published FIRMs depict the national regulatory floodplain standard for floodplain management and insurance requirements of the National Flood Insurance Program. ***Figure 2, Edgerton Floodplain Schematic*** is a depiction of the area currently under discussion showing the limits of the Floodplain, location of the homes in the area and approximate flooding area. It is evident which structures will be inundated with floodwater during heavy storms. Unfortunately for these residents, that is the "definition" of a floodplain.

According to the FIS, the drainage area contributing to the culvert under Edgerton Road is approximately 1.79 square miles. This has been verified for this study by the delineation of the watershed on the 1993 Cuyahoga Country Topographic Maps in Figure 1. The FIS indicates the following flows at Edgerton Road:

Storm Event	10-year	50-year	100-year	500-year
Peak Discharge (cfs)	380	600	690	930

Short-term solutions for flooding in this area will not have significant impact on the amount of water that flows through this channel. Some of the things that residents can do to minimize exposure is to keep the channel clear of debris. Footbridges over the channel could also impede water or catch debris if levels rise high enough and should be checked during and after storm events. Residents have reported the private culvert is not capable of passing the volume of water that flows through the channel during heavy and steady rain events. When the water cannot freely flow through the private culvert, it is forced around the side of the culvert and onto the adjacent property (see Photograph 3). The water also backs up in the channel causing flooding further upstream.

Visual inspection from the adjacent property indicates significant maintenance is required on the culvert. The concrete embankment on the northwest corner of the culvert has been severely undermined. The culvert does not have the capacity to pass the volume of water that drains into the channel. Preliminary calculations indicate overtopping for a 10-year event. An alternative for the property owner would be to relocate the driveway on the opposite bank of the stream and eliminate the private culvert altogether.

Long-term options to alleviate the flooding for the area under study have been identified. These options will have the most impact to the residents on Edgerton and also to properties downstream.

A series of parcels fronting on State Road lie just north of the area under study and south of Valley Parkway. These parcels have depths in excess of 2,000 feet. Visual inspection of aerial photographs of the area indicates the properties contain structures within 500 feet of State Road. The northernmost property contains an orchard that stretches to the west bank of the stream. The remaining portions of the properties are mostly wooded with small areas of clearing. The channel cuts these parcels in two. The 100-year floodplain spans an average of 275 feet across the channel. It is feasible that a portion of these properties on the east bank of the stream can be cleared and leveled to expand the floodplain thus lowering the BFEs downstream. A weir structure or culvert can be constructed that would allow most or all of the runoff from small storm events to pass through the channel without impediment. Only storms beyond the 10-year storm would be "detained" in the expanded floodplain. It should be noted that a large volume of water would still pass through the channel for any storm event. The objective of detaining the water in this area is not to release it at a predetermined rate but to force a back up of water into the created flat land to lower the flood elevations downstream. The flow through the channel would have to be reduced by approximately 2 feet to provide relief for all of the residents in this area. Preliminary calculations indicate a volume of approximately 100,000 cubic yards of material would need to be excavated to create the flat lands for flooding.

A positive side effect of completing this option is the lowering of the BFEs not only in this area but also further downstream.

To construct this option, conservation easements and deed restrictions would be required from three property owners on State Road. A number of factors specific to each property should be taken into consideration for valuation of easements that are beyond the scope of this study. Professional appraisal services should be retained by the City for actual acquisition costs. For the purpose of this study and preliminary cost estimates, approximate market values for the properties have been determined from market values of surrounding properties. A preliminary

cost estimate of $1,600,000.00 for acquisition and construction has been determined for this option and is included as ***Attachment 3, Preliminary Cost Estimate, State Road***.

An additional area north of Akins Road and south of Swan Lake Estates was also considered for the construction of expanded floodplain. A drop-off in topography down to the creek bed occurs near the middle of the properties located on State Road. The rear of these properties is vacant and predominantly wooded. Approximately 693 Acres drains to the culvert at Akins Road. According to the FIS, the 100-year flow at the culvert is approximately 370 cfs.

Review of the topography indicates an average slope of 1.5% in the channel bottom upstream of the Akins culvert making it difficult to construct a flat area large enough for flooding. The 100-year floodplain is relatively narrow in this area because of the steep channel slope and surrounding topography. The 100-year BFEs are only slightly higher than the channel bank elevations. Leveling the areas adjacent to the floodplain would have limited effect. This area would have to work not as an expanded floodplain but rather a true detention basin. Extensive study and hydraulic calculations would be required to obtain permits from FEMA and the Ohio Department of Natural Resources.

The available area for this basin is also constrained by the location of the Ashley Woods detention facility to the east. The hydraulics of the existing detention basin would need to be considered during design of a proposed basin.

We do not recommend pursuing this area for consideration because of the limitations of constructing an in-line detention basin.

The second remedy to the flooding problems in this area is the acquisition of all or some of the properties located in the floodplain. The effective date of the FEMA Flood Insurance Rate Maps for the City of North Royalton is September 17, 1980. All of the habitable dwellings constructed in the floodplain in this area were built prior to the effective date of the FIRM meaning they were

built before detailed flood hazard data and elevations were compiled and before the City enacted comprehensive regulations on floodplain construction. Had data been available and regulations been adopted, these dwellings would likely have not been constructed in the floodplain. These structures are therefore eligible for flood insurance at a subsidized rate. Further information regarding flood insurance for these properties is included as Attachment 4, *Saving on Flood Insurance, Information About the NFIP's Grandfathering Rule.*

Purchasing these properties and demolishing the existing structures would return the land to its natural state. The storm runoff could flood the properties without impediment and without causing any damage. The City could place deed restrictions on the parcels so that they could never again be developed. The area could be utilized as a neighborhood park, nature preserve or open space. No excavation would be required for this option, as the properties themselves would act as the flooding area.

Market values for these properties have been taken from the Cuyahoga County Auditor's data. Relocation expenses have been calculated from the Ohio Department of Transportation's Attachment 6616, Moving Expense Schedule (Residential) and the number of rooms listed with the Auditor. The preliminary cost estimate is $1,100,000.00 for the acquisition and demolition of all five homes from 5250 through 5228 Edgerton Road (see ***Attachment 4, Preliminary Cost Estimate, Edgerton Road)***. The City may choose to purchase only some of the properties that have experienced structural flooding thus decreasing the final cost. A minimal amount of grading could be completed on the lots that are purchased to allow for additional area to be flooded if the City chooses. Professional appraisal services should be retained to provide more accurate costs based on comparable sales in the area.

The disadvantage to this option is the required relocation of residents that may be attached to their homes and properties. The advantages to this option include elimination of flooding complaints in this area as well as increased open space in the City.

Retrofitting the existing structures is an option for residents that do not want to leave their properties. Retrofitting techniques include elevation or relocation of the structure, closures of openings, dry flood-proofing or sealing, utility protection and construction of levees or floodwalls. Selection of technique must be based upon flooding, site and building characteristics for retrofitting to be successful. Costs for retrofitting structures varies widely based upon the retrofitting technique chosen and the size, shape, type of construction and condition of the existing structure to be retrofitted.

Elevation of structures can be accomplished on extended foundation walls, piers, post or columns, piles or on fill. Any type of elevation should be very carefully considered if the structure is in less than "good" condition. Extending foundation walls will not work in this area because of the potential for flash floods. Elevation on fill can only be used in areas of shallow flood depths with very low velocities therefore it too has to be eliminated as a retrofitting technique for this area. Elevation on piles cannot be completed if the structure is located on a slab on grade or if it is constructed of concrete or masonry materials. Elevation can also be completed by filling in the basement and constructing an additional living space above.

Building relocation cannot be accomplished for slab on grade construction. For structures that are in fair to poor condition relocation should be carefully considered. All other structures can be relocated. Although relocation out of the floodplain is the only guaranteed way to eliminate flooding, it is the most disruptive and likely the most expensive technique. If additional area outside of the floodplain is not available on the property, a new lot will have to be purchased. Relocation can take weeks to complete requiring the occupants to find temporary lodging.

Closures and dry flood-proofing or sealing can be completed in combination with floodwalls or levees. These techniques utilize a permanent or temporary closure of openings that allow flood water to enter a structure. Examples of closures and sealing include construction of water-tight gates on a floodwalls, bricking in non-essential doors or windows, aluminum panels over doors and windows, and construction of a small floodwall around window well openings. Closures and

sealing mechanisms are subject to large hydrostatic pressures that must be considered during the design.

Utility and appliance protection is the cheapest form of retrofitting. It does not however eliminate flooding of structures. A qualified contractor can raise utility connections above the base flood level. Floodwalls constructed around appliances can shield them from water damage. Elevation of air conditioning units on walls on the exterior of the structures is also feasible however will only work for low level flooding with little velocity. Some utilities such as furnaces can be suspended from the ceiling, others can be anchored to the floor. Check valves, gate valves or a combination of the two can be installed to prevent backflow flooding.

Levees and floodwalls keep floodwaters and corresponding hydrostatic and hydrodynamic pressure away from structures. Levees can usually be constructed to blend into the surrounding landscape however the required footprint may become large depending on the height of protection required. Floodwalls take up less space but require more detailed engineering to ensure sufficient strength to endure the forces that will be present during a flood and are usually more expensive.

Residents have inquired about creating a berm on their property to prevent the overflow from flooding their yards. Construction of a berm is possible however the City of North Royalton's Codified Ordinance Chapter 1466 Flood Damage Prevention requires an application for a permit to complete such work. The City's regulatory standard allows for "no-rise" in Base Flood Elevations. If calculations can be submitted to show that the BFEs will not increase, a permit may be issued. ***Section 1466.32 Assurance of Flood Carrying Capacity***, which is included as ***Attachment 5***, specifies the standards that must be met to obtain a permit.

Additional information and publications regarding retrofitting of structures can be found on FEMA's website www.fema.gov.

ROYALTON ROAD FROM 3619 TO 3881

This study area (See ***Figure 6, Royalton Road Schematic***) is located on Royalton Road (S.R. 82) west of the Corporation Limit with Broadview Heights and directly south of the Hunter's Creek Subdivision. The residents of this study area are served by septic systems and roadside ditches. A high point in the terrain of Royalton Road is located approximately 370 feet west from the intersection of Stoney Creek Drive. The terrain slopes from this point east and south into the City of Broadview Heights. Two 12" storm sewers, one on each side of Royalton Road, run parallel with the roadway. The north side of Royalton Road has roadside ditches with catch basins. The south side has no ditches. Catch basins are present however they do not catch much runoff as the terrain slopes towards the homes on the south side with no distinct point of collection (see Photograph 4).

A number of residents on Royalton Road from 3611 through 3881 were interviewed to obtain data regarding flooding in this area. A field visit was also made to a number of properties on the south side of Royalton Road.

The residents have reported a river of runoff pouring down the pavement of Stoney Creek Drive (see Photograph 5) during heavy rain events. Review of the subdivision plans indicates an average slope of approximately 4% down the hill towards Royalton Road for a distance of 825 feet. One set of catch basins is located approximately 600 feet north of the intersection with Royalton Road. The next pair of catch basins is located at the bottom of the hill. Visual observation of the Royalton Road cross section indicated very little cross slope on the pavement. Where the Royalton and Stoney Creek pavements meet, there is little sag to prevent water from overtopping Royalton Road. The intersection detail for the subdivision from 1978 depicts a low point in the west curb line of Stoney Creek Drive approximately 27 feet south of the catch basin. The existing elevations in this area promote the direction of runoff towards Royalton Road and not towards the existing basin located behind the pavement in the ditch on Royalton Road. No low point is indicated by the intersection detail on the east side of Stoney Creek Drive rather, an

inlet basin sits just beyond the edge of pavement. A rill in the soil in the direction of the inlet basin was observed in the field however observation also indicated the basin and roadside ditch at the intersection with Stoney Creek Drive contained debris (see Photograph 6). These factors explain why it is feasible that runoff crosses Royalton Road and flows through the properties on the south side of the road.

To substantiate this occurrence, catch basin spacing calculations were completed for the existing basin locations and are included as ***Attachment 7, Stoney Creek Existing Catch Basin Spacing Form.*** Current Cuyahoga County requirements for spacing include a minimum of 4 feet of "dry" pavement in the curb lane for a 2-year design storm. The 5-year and 10-year events have also been calculated to determine the amount of bypass of the catch basin for these storms. Attachment 6 indicates the current catch basin spacing does meet the County's current standards. The bypass, however, is excessive. For the 2-year event, 13% of the runoff or 0.62 cfs from the drainage area bypasses the storm sewer system and runs down the hill towards Royalton Road. For the 5-year event, this figure increases to 16% or 0.99 cfs, for the 10-year event, the figure increases to 19% or 1.32 cfs. The storm sewers on Stoney Creek Drive were designed to accept the runoff from the drainage area however, the existing configuration and conditions do not allow all of the water to enter into the system prior to spilling over Royalton Road.

An existing storm manhole sits approximately 200 feet north from the intersection of Royalton Road and Stoney Creek Drive. Catch basins spacing calculations have also been completed for a pair of proposed catch basins that can be constructed in the pavement and connected to this manhole. ***Attachment 7, Stoney Creek Proposed Catch Basin Spacing Form*** indicates that for the 2-year event, virtually no runoff would by-pass the catch basins. For the 5 and 10-year events, the by-pass amount is negligible. A preliminary cost estimate for construction of these two basins is approximately $15,300 and is included as ***Attachment 9, Stoney Creek Catch Basin Improvement Preliminary Cost Estimate.***

Constructing these catch basins however won't completely solve the issues in this area. While the sewer on Stoney Creek was sized correctly for the drainage area and can accept the runoff for a 10-year storm event, the sewer on Royalton Road that it ties into does not have sufficient capacity. Storm sewer calculations were prepared assuming elevations from topographic maps to determine preliminary sizes of sewers required to service this area and are included as ***Attachment 10, Royalton Road Proposed Storm Sewer Calculations***. The calculations assume that inlet basins will be constructed upstream of every drive apron on the north side of Royalton Road and the roadside ditches will remain. Drive pipes however will be eliminated. Because Royalton Road is a State Route, storm sewers were sized for a 10-year storm event. The cost estimate was prepared assuming S.R. 82 will be reconstructed in the future. A preliminary cost estimate, ***Attachment 11, Royalton Road Storm Sewer Improvement Preliminary Cost Estimate***, for the project is $300,000.

The outlet for this storm sewer is through an existing 3' x 3' box culvert under Royalton Road (see Photographs 7 and 8) connected to an existing 18" sewer that discharges to the rear yard of 3257 Royalton Road. The box culvert under the road has sufficient capacity for the runoff however the existing 18" pipe is undersized for the drainage area. The City has televised the existing 18" sewer and found it to be in fair to good condition. No known sewer easement exists for this section of pipe therefore, to replace the pipe, the City would require an easement from the property owner. A portion of the existing outlet pipe lies underneath the driveway on the property and the sewer runs fairly close to the structures on this property. To replace the existing pipe, the City could consider extending the storm sewer on the north side of Royalton Road an additional 150 feet, construct a new culvert under Royalton Road and through an easement obtained from 3075 (rear) Royalton Road along the east side of their driveway (see Photograph 9). The runoff would outlet into the same drainage channel on the south side of the road just 100 feet upstream from its original outlet. The preliminary cost for the extension would be an additional $145,000.00 (see Attachment 10). The total cost to upgrade the sewer and outlet would be approximately $445,000.00. The proposed easement is the first area downstream with adequate clearance around existing homes and garages to allow for construction of the new

sewer. The proposed outlet could also be relocated between 3257 and 3151 Royalton Road. The existing box culvert under Royalton Road can remain thus eliminating the cost for pavement repair and structure removal. No driveway repair would be necessary with this option. Approximately $35,000 can be saved by constructing the outlet pipe between these two homes however it should be noted that the residences are barely 20 feet from each other. Construction will be difficult in this area thus escalating the unit prices for construction and materials.

In addition to the drainage from the Hunter's Creek Subdivision, the properties on the south side of Royalton Road also have two drainage swales dissecting their properties. It is imperative that these two channels remain free flowing. The City of North Royalton's Codified Ordinance 1468.01 passed in 1992 prohibits grading change of any property by more than one inch without first applying for a permit and only after review and approval by the City Engineer. This ordinance does not prohibit grading of properties but rather requires sufficient data be submitted to the City for review to verify any grading won't have adverse impacts on surrounding properties. Review of aerial orthophotos taken in 2002 versus topographic maps in 1993 indicates one of the streams downstream of the study area may have been culvert-ed or diverted for a vehicle storage area. The Building Department should investigate whether un-permitted filling took place on this property. The property owner should restore the property or obtain a permit by submitting drainage calculations and installation of a culvert with sufficient capacity to maintain flow if grading has taken place. Based upon the topography, mapped drainage area and preliminary analysis, it appears a 24" culvert a 1% slope minimum is needed assuming the flow from Royalton Road is directed into the existing storm sewer system on the north side and not across the road through the yards.

While performing the field visits to the area, a number of septic system outlets were observed. Some of the outlets were in good condition with elbow fittings pointing in the direction of flow. Others were in poor condition with cracked or smashed pipes. The residents should try to keep the outlets in good repair. Elevation of the outlets is also critical. The pipe should outlet at or above the high water elevation of the creeks or ditches they flow into whenever possible. An

inexpensive option that may help some residents is a flap gate installed at the outlet. The force of water exiting the pipe pushes the gate open to allow free flow however, the gate prevents forces from pushing it open when pressure is exerted from the opposite direction. The caveat for these fittings is the need to be checked regularly to ensure proper clearance for operation and to clear any obstructions that would prohibit opening and closing. A 6" flap gate costs approximately $50 and can be purchased from a number of manufacturers on the Internet.

AKINS ROAD FROM 3450 TO 4451

This study area (***See Figure 12, 3450 to 4451 Akins Road Schematic***) can be broken up into three distinct flooding areas comprised of approximately 11 properties. **The first area of discussion** is located from 3501 to 3413 Akins Road on the south side of the street. The topography slopes generally from the south at the Turnpike towards the east into Broadview Heights. Review of the 1948 topographic map of the area indicates a channel originating from a culvert that crossed Akins Road into the front yard of 3819 Akins Road. The channel flowed southeasterly to 3453 Akins Road where an additional watercourse joined from the south and then turned in a more easterly direction flowing towards the City Limit. The 1948 topographic map also indicates a swampy area at approximately 3479 Akins Road.

When the homes in this area were constructed, a pipe was constructed along the existing channel. Field observation revealed two small open grates in the rear yard at 3479 Akins Road (see Photograph 10). The shallow pipe could be seen through the grates. The next visual confirmation of the culvert can be seen in the rear yard at 3465 Akins Road where the pipe has been exposed. The resident at 3453 Akins Road pointed out a structure with removable lid. The pipe must make a bend between these two properties (See ***Figure 13, 3501 to 3413 Akins Road Schematic***). A clean-out was found at the next address to the east along the same alignment as the old channel.

Residents indicated the problem only began when a septic systems was constructed in the rear yard of 3413 Akins Road last year. The existing sewer runs through the area that was excavated during construction of the tile field. The entire run of sewer from 3819 Akins to its termination at the Corporation Limit should be televised to determine if any damage or blockage has occurred to the existing pipe. Special attention should be given to the property where construction has occurred recently. If damage or blockage is evident, the homeowner should replace the section of pipe where the obstruction has been located.

The current topographic map and aerial photography indicate a depression still exists along the old channel alignment (see Photograph 11). During rain events, the residents should expect some collection of water in this depression however the water should continue to flow to the east as it always has. A ridge was noted between 3479 and 3465 Akins Road (see Photograph 12) that may have been caused by recent excavation. Ponding in the rear yard of 3479 could be reduced if this ridge was cut down to allow the water to continue to flow to the east.

It is vital to the drainage of the rear yards in this area that existing grades be maintained. Any future improvements to be constructed on the properties to the east that includes re-grading of a property requires a plan designed by a Professional Engineer. When North Royalton was a rural community, many runs of sewer were constructed through farmer's field or large properties. Records of these sewers, often constructed without plans, were not maintained. As land was split and developed, ditches were enclosed one property at a time. On occasion, the property owner's and neighbors may be the only ones aware of pipes through fields, woods or rear yards. It is imperative that if a property owner wishes to construct an improvement near a sewer or watercourse or change the topography of his or her property, he or she applies for a permit. The application should reveal the location of any sewers or drainage courses in the vicinity so that the Engineering Department can verify the improvement would not adversely affect neighboring properties.

The second area of discussion is located from 3448 to 3554 Akins Road due north of the first area of discussion on a flat section of Akins Road. A schematic of the area is included as ***Figure 14, 3448 to 3554 Akins Road Schematic.*** Properties on the north side of the road slope away from Akins Road. Roadside ditches exist at 3448, 3566 and 3554 Akins Road. The resident enclosed the roadside ditch at 3450 Akins Road with a 12" perforated pipe wrapped in filter fabric sometime in the past. The fabric was used to prevent sediment from filtering through the perforation and clogging the pipe. The entire trench was backfilled with gravel to allow runoff to flow into the pipe below.

The ditches along these properties flow east to a vacant lot between 3554 and 3300. The water flows diagonally across the vacant parcel to a low point (see Photograph 13) in the middle of the front section of the property. No ditch exists across the front of the vacant parcel to continue the flow down the hill and into Broadview Heights. The 1948 and 1993 topographic maps show the land gradually slopes from the southwest corner of the vacant property towards the northeast. Residents in this area report front yard flooding. During rain events, as water reaches the vacant parcel, it fills a low spot and backs up into the ditches. The ditches overflow into the front yards (see Photograph 14).

Residents of this area should consider construction of side yard swales and re-grading of the front yards directing runoff to these swales. The topography at these properties falls away rapidly, north of the homes, to a creek running through the back yards. A side yard swale was evident between 3450 and 3566 Akins Road. Another swale was under construction during the investigation for this study between 3448 and 3450. These swales should help alleviate the front yard flooding for the resident at 3450. The runoff should be diverted from the front yards to the creek in the back that is generally 4 to 6 feet lower than the homes.

The vacant parcel owner should re-grade the low area to promote positive drainage. This would be another feasible improvement option. A distinct ditch would not be necessary, rather a swale that would move the water across the property to where it naturally wants to flow. A small

depression is already evident in the soil across the rear portion of the property (see Photograph 15). Re-grading this property would not result in an un-buildable lot or prevent development on it. Any future development on this parcel would require the owner to continue to consider positive drainage in their design. The City may be able to orchestrate an agreement with the vacant parcel owner and the affected residents to allow re-grading of the parcel. Re-grading of the vacant parcel would be relatively inexpensive and can be completed by the residents upon approval from the Engineering Department.

Continuation of the ditch easterly down Akins Road is feasible but not advisable. The topographic maps indicate a fall of just 2 feet in approximately 850 feet or a slope of less than 0.25% along the road in this area before sloping down the hill into Broadview Heights. Because of the lack in elevation difference, the roadside ditches would still back up.

The last of the three areas is from 4451 to 3806 Akins Road. A schematic of the area is included as ***Figure 15, 4451 to 3806 Akins Road Schematic***. The properties on the north side of Akins Road drain towards a roadside ditch. The properties on the south side of Akins Road from 3831 to 4107 flow from the south towards a ditch near the back of the homes. The ditch enters into an existing 12" pipe at 4161 that flows diagonally through the front yards of 4161 to 4261 outletting into the roadside ditch along Akins Road. Before the pipe daylights into the roadside ditch, it makes an approximate 90-degree bend at a stand of brush just outside of the Right of Way. A structure in need of repair was discovered near this bend at the property line between 4261 and 4317 Akins. A number of bricks were observed to be falling into the structure.

The remaining properties on the south side of Akins Road flow from the south to the roadside ditches on Akins. The drainage paths for the north and south side of Akins combine at a stream that begins near the road at 4387 Akins Road. The stream flows southwest towards the Turnpike where it joins with the East Branch of the Rocky River.

Residents have reported the roadside ditches and private sewer pipes back up during heavy or steady rains resulting in yard and basement flooding. Basement flooding has occurred both from overland flow through windows, walls and doors and backup through basement floor drains.

Beginning at the east end of this drainage area, preliminary calculations were completed for each culvert in the drainage system. It should be noted that no survey work was completed. Elevations were estimated from topographic maps and visual inspection. Results of the analysis are approximate.

The calculations indicate the existing private 12" concrete drive culvert at 3945 Akins Road (see Photograph 16) is sufficient for a 10-year storm event of 3.2 cfs. A small amount of overflow is expected for the 25-year storm event. The culvert flows into an open channel through the yards at 4053 and 4107 Akins Road.

The next culvert downstream, from 4107 to 4317 Akins on private property, cannot pass the runoff from a 10-year event without overtopping. The calculations were completed for both current conditions, 7.3 cfs for a 10-year event and assumed conditions, 5.2 cfs for a 10-year event, prior to development upstream. Neither scenario was able to pass through the culvert without overtopping.

The visible ends of the culvert are 12" concrete. Because each property was developed separately, the culvert was likely constructed in pieces, one property at a time. It has been assumed that the entire run of sewer was constructed with concrete pipe. Calculations indicate a 21" smooth-walled pipe would be required to pass the discharge for a 10-year event with no overtopping.

This culvert pipe is located entirely on private properties. No record of a sewer easement was uncovered during the investigation. Visual inspection revealed a large concrete ornament blocking the culvert entrance at 4107 Akins Road (see Photograph 17). The ornament should be

removed to provide free flow into the culvert. While not all of the flow will be carried by the existing culvert, the flooding downstream will be lessened. The structure at the outlet should be inspected and repaired by the homeowner to insure free flow (see Photograph 18). Televising the line to confirm no obstructions and to inspect the condition of the culvert is recommended. The resident at 4161 Akins is currently grading a swale between his home and the property to the east (see Photograph 19). The swale is directing water away from his sunken patio and towards the front yard. Although this will not eliminate the flooding of the front yard, it will alleviate flooding at the structure.

Review of the topographic maps indicates a general depression that follows the diagonal path of the existing culvert pipe towards the roadside ditches. Field observation however revealed a "bowl" in the front yard of 4215. A depression has been formed by a ridge at the roadside ditch, the driveway at 4161, and the house and driveway at 4215. More than a few inches of water must fill this depression before it overtops the driveway and continues towards the roadside ditch. When the culvert starts overtopping at 4107, the water flows to the bowl and then stops until it fills sufficiently to continue along its natural path. The resident at 4215 should consider re-grading the front yard to allow water to continue to flow towards the ditch, installing a catch basin and sewer to discharge towards the ditch or installing a culvert under the driveway to allow the water to continue towards the ditch.

Another option for these residents instead of replacing the culvert pipe is to remove the pipe and restore the open channel through the yards. Culvert pipes under each driveway would still be required but the correct pipe size should be installed to eliminate overtopping and flooding.

The runoff of an additional 3.4 acres of area joins the discharge of the previous culvert just before passing under the drive at 4317 Akins Road (see Photograph 20). Calculations indicate a 21" culvert is also required at the driveway crossing however, if the culvert does overtop the driveway, the topography allows the overflow to continue down the roadside ditch.

The existing drive pipes at 4501, 4451 and 4387 Akins Road and the existing 18" culvert crossing Akins Road (see Photograph 21) were analyzed in series because of their proximity to each other. The headwater or water surface elevation at the inlet of the culverts is related to the tailwater or water surface elevation at the outlet of the previous culvert. The existing culverts at the driveways are two (2) 36" concrete pipes at 4501 Akins (see Photograph 22), one 36" corrugated metal pipe at 4451 Akins Road and one 33" corrugated metal pipe at 4387 Akins Road (see Photograph 23). The drainage area for this series of pipes is approximately 34 acres. A 10-year storm event for this watershed produces approximately 25 cfs of runoff; the 25-year storm event produces approximately 32 cfs. The runoff to the 18" culvert is approximately 11 cfs for a 10-year event and 13.5 cfs for a 25-year event.

Review of the analysis indicates the culverts have sufficient capacity to pass the 10-year storm event without overtopping the road or driveways. It should be noted that the 18" culvert across Akins Road does have a headwater approximately 2 feet higher than the inlet elevation thus it is submerged. If the Akins Road culvert inlet is submerged water will back up into the ditches.

Homes on the north side of Akins Road in this area average approximately 3 feet higher than and are set back approximately 185 feet from the roadway. Assuming the ditches are approximately 12-18 inches deep and downspouts from the homes are buried approximately 3 feet deep, there is only 12-18 inches of fall between the homes and the bottom of the ditch or less than 1% slope. Any pipes that discharge to the ditch will back up with water when the ditch is flowing full. The resident at 4408 Akins reported yard flooding from the roadside ditch backing up during heavy rains and water coming up through the downspout. The City has since reworked the ditches which has helped the flooding. The resident could consider, with the approval of the Engineering Department, disconnecting downspouts. Elephant trunk pipe should be connected to the spouts to force water away from the building foundations. Rain barrels are also an option to collect the roof runoff. The resident at 4420 Akins did report basement backup but it was determined that a utility company broke the service connections during excavations for its lines. The resident reported no further problems since.

PRIORITIZATIONS

There are a number of projects that can be completed by the City to ease flooding however the funds for these projects are not endless. Project prioritization should be based on the magnitude of flooding but more importantly on the consequences if no remediation takes place.

Although the City of North Royalton has many types of flooding, structural flooding particularly homes, should continue to be the City's top flooding concern. Structural flooding can cause structural damage as well as damage to its contents, harmful living conditions and financial hardships for the residents and/or property owners. One exception to this tenet is in areas where a large volume of water is concentrated. Equal, if not greater priority should be given where loss of life is possible particularly in the Edgerton Road area where a flash flood would not allow sufficient time for residents to vacate the premises. While localized yard flooding may be a nuisance and may cause property damage, the assets of the City are better spent solving more serious problems at this time. Much of the yard flooding could be taken care of by the residents. Indeed, some residents are completing projects to help their yard flooding problems. As referenced in the 2005 Final Report use of rain gardens, rain barrels, lawn aeration and re-grading should be encouraged by the City where appropriate.

The Edgerton Road and Royalton Road projects should be added to the City's list of future projects at this time for immediate consideration as projects No. 12 and 13 respectively. Although the Edgerton project is costly, the effect of remediation would be extensive. The construction of a pair of catch basins on Stoney Creek and construction of sewers on Royalton Road would have a significant impact for structures downstream. The catch basin installation is relatively inexpensive, quick to construct and would alleviate some of the more frequent flooding issues. The installation of storm sewers on Royalton Road however are much more costly and complicated as Royalton Road has significant difficulties such as large traffic volumes, challenging topography, private property issues, and future widening construction projects in planning. The completion of both of these projects would only benefit a few residents in each

case; thus, the costs versus benefits would need careful consideration before making final decisions to allocate City funds.

The three Akins Road areas should be included in the Miscellaneous Localized Areas on the City's list of priorities.

REFERENCES

The data obtained to identify sources and reasons for flooding in different areas of the City included:

a) An AutoCAD base map of the City including detention basin locations and sanitary sewer facilities from the Engineering Department;
b) Locations of flooding complaints from storms on May 10, 2003, May 20-22, 2004 and June 9, 2004;
c) Federal Emergency Management Agency Flood Insurance Rate Maps and Flood Insurance Study;
d) Record plans for various improvements throughout the City;
e) 1948 and 1993 Cuyahoga County Topographic Maps;
f) 2002 Cuyahoga County Orthophotos;
g) Cuyahoga County Tax Maps;
h) Cuyahoga County Recorder Property Information;
i) Cuyahoga County Auditor Property Information;
j) Ohio Department of Transportation Real Estate Policies and Procedures Manual 6616 Moving Expense Schedule (Residential)
k) Resident interviews;
l) Field observation;

and other miscellaneous data obtained from various sources over the course of the study period.

Photograph 1
Bend at 5240 Edgerton Road looking east towards 5228 Edgerton Road
East Branch of Rocky River (Floodplain)

Photograph 2
Private culvert at 5228 Edgerton Road looking southeast towards Edgerton Road
East Branch of Rocky River (Floodplain)

Photograph 3
Rear yard at 5240 Edgerton Road looking south towards Edgerton Road
High Watermark on Garage – 4th row of siding from ground level
East Branch of Rocky River (Floodplain)

Photograph 4
Looking north towards Royalton Road from front yard at 3719 Royalton Road

Photograph 5
Looking north towards Stoney Creek Drive hill from Royalton Road

Photograph 6
Catch basin at intersection of Royalton Road and Stoney Creek Drive (east)
Notice additional basin in upper right corner.

Photograph 7
3' x 3' Box culvert inlet looking south
Royalton Road (north side of Right of Way)

Photograph 8
3' x 3' Box culvert end (connected to 18" outlet) looking north
Royalton Road (south side of Right of Way)

Photograph 9
Possible outlet relocation along drive at 3075 Royalton Road looking south

Photograph 10
Rear yard at 3479 Akins Road looking northwest towards Akins Road
Notice white stakes marking cleanouts on sewer.

Photograph 11
Rear yard at 3479 Akins Road looking south

Photograph 12
Rear yard of 3465 Akins Road looking southeast
Note new septic system in rear, ridge near trees at right
Ponding east and west of property

Photograph 13
Low spot at vacant parcel between 3554 and 3300 Akins Road looking northeast

Photograph 14
Ponding at 3450 Akins Road front yard looking north

Photograph 15
Rear of vacant parcel between 3554 and 3300 Akins Road looking towards Akins Road
Notice existing depression along property line.

Photograph 16
Drive pipe at 3945 Akins Road looking east

Photograph 17
Concrete Ornament at entrance to 12" Culvert looking north
4107 Akins Road

Photograph 18
Structure at 4317 Akins Road looking into basin

Photograph 19
Swale construction at 4161 Akins Road looking north towards Akins Road

Photograph 20
Outlet of 12" Culvert at 4317 Akins Road looking south down property line
Notice structure located just left of trees.

Photograph 21
18" Culvert across Akins Road looking northeast from 4387 Akins Road

Photograph 22
Double 36” RCP Culverts at 4501 Akins Road looking southwest

Photograph 23
Ex. 33” CMP at 4387 Akins Road looking southwest

FIG. 1: EAST BRANCH OF ROCKY RIVER DRAINAGE AREA

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TWO MERIT DRIVE
RICHMOND HEIGHTS, OHIO 44143
PH: (216) 731-6255 FAX: (216) 731-4483

REVISIONS

No.	DESCRIPTION	DATE	BY
6.)			
5.)			
4.)			
3.)			
2.)			
1.)			

0 800
SCALE IN FEET (HORIZONTAL)

NORTH

04-16-07
04-207

FIGURE 01

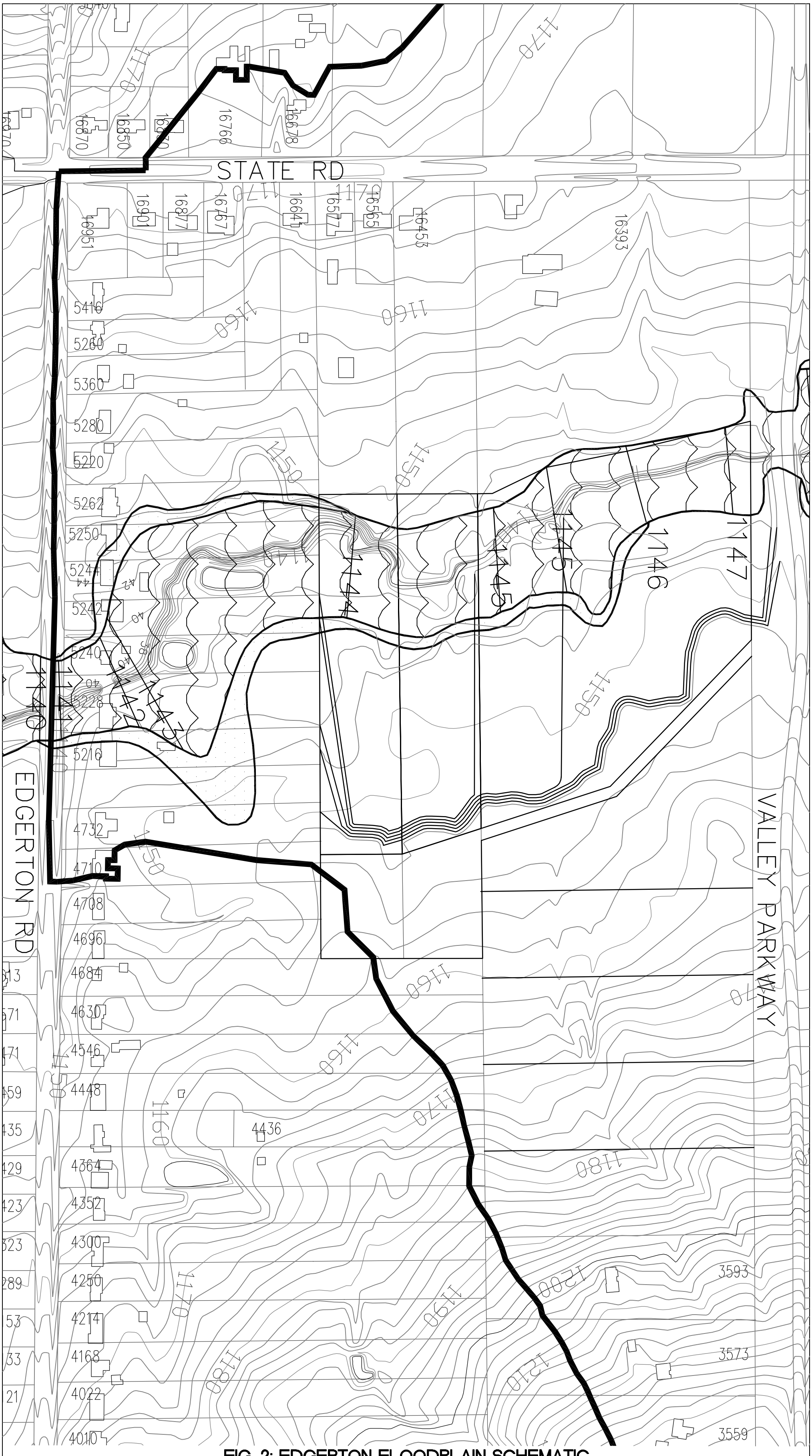

FIG. 2: EDGERTON FLOODPLAIN SCHEMATIC

FIGURE 02

04-16-07
04-207

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REVISIONS			
6.)			
5.)			
4.)			
3.)			
2.)			
1.)			
No.	DESCRIPTION	DATE	BY

0 200
SCALE IN FEET (HORIZONTAL)

NORTH

City of North Royalton
2007 Addendum
Attachment 3
Preliminary Cost Estimate - State Road

For Comparison to obtain Land Market Values:			
3593 Valley Parkway			
487-25-015			
Land Market Value:	$ 56,600.00		
Total Land Area:	3.76	Acres	
Price per Acre:	$ 15,053.19		
3573 Valley Parkway			
487-25-001			
Land Market Value:	$ 54,900.00		
Total Land Area:	3.33	Acres	
Price per Acre:	$ 16,486.49		
Average Price per Acre:	$ 15,769.84		
Use:			$ 20,000.00

City of North Royalton
2007 Addendum
Attachment 3
Preliminary Cost Estimate - State Road

Land Value Calculations:			
16577 State Road			
487-29-005			
Conservation Easement:	4.47	Acres	
Area in floodplain:	1.3	Acres	
Area for compensation:	3.17	Acres	
Land Value for Compensated Area:	$ 63,400.00		
Permanent Easement Compensation @ 50%:	$ 31,700.00		
Use:			$ 32,000.00
16393 State Road			
487-29-006			
Conservation Easement:	4.32	Acres	
Area in floodplain:	1.35	Acres	
Area for compensation:	2.97	Acres	
Land Value for Compensated Area:	$ 59,400.00		
Permanent Easement Compensation @ 50%:	$ 29,700.00		
Use:			$ 30,000.00
16453 State Road			
487-23-001			
Conservation Easement:	12.84	Acres	
Area in floodplain:	4.49	Acres	
Area for compensation:	8.35	Acres	
Land Value for Compensated Area:	$ 167,000.00		
Permanent Easement Compensation @ 50%:	$ 83,500.00		
Use:			$ 84,000.00
Total Easement Acquisition for 487-29-005, 487-29-006, 487-23-001:			**$ 146,000.00**
Excavation (CY):	100,000	$ 10.00	$ 1,000,000.00
Clearing & Grubbing (Ac):	14.5	$ 3,000.00	$ 43,500.00
Seeding & Planting (Ac.):	14.5	$ 5,000.00	$ 72,500.00
Weir Structure:	1	$ 30,000.00	$ 30,000.00
Permitting/Review/Acquisition Fees:	1	$ 30,000.00	$ 30,000.00
Total Improvement:			**$ 1,322,000.00**
Contingencies:			$ 264,400.00
Total Option 1:			**$ 1,586,400.00**

City of North Royalton
2007 Addendum
Attachment 4
Preliminary Cost Estimate - Edgerton Road

5250 Edgerton Road		
487-29-021		
Land Market Value:	$ 34,800.00	
Building Market Value:	$ 154,200.00	
Total Market Value:		$ 189,000.00
Relocation Expense:	6 rooms	$ 1,250.00
Demolition:		$ 15,000.00
5244 Edgerton Road		
487-29-020		
Land Market Value:	$ 35,100.00	
Building Market Value:	$ 119,900.00	
Total Market Value:		$ 155,000.00
Relocation Expense:	5 rooms	$ 1,100.00
Demolition:		$ 15,000.00
5242 Edgerton Road		
487-29-022		
Land Market Value:	$ 34,800.00	
Building Market Value:	$ 134,700.00	
Total Market Value:		$ 169,500.00
Relocation Expense:	7 rooms	$ 1,400.00
Demolition:		$ 15,000.00
5240 Edgerton Road		
487-29-019		
Land Market Value:	$ 34,800.00	
Building Market Value:	$ 89,200.00	
Total Market Value:		$ 124,000.00
Relocation Expense:	5 rooms	$ 1,100.00
Demolition:		$ 15,000.00
5228 Edgerton Road		
487-29-008		
Land Market Value:	$ 44,800.00	
Building Market Value:	$ 162,200.00	
Total Market Value:		$ 207,000.00
Relocation Expense:	7 rooms	$ 1,400.00
Demolition:		$ 15,000.00
Total Acquistion & Demolition:		**$ 925,750.00**
Contingency:		$ 185,150.00
Total Option 2:		**$ 1,110,900.00**

1466.32 ASSURANCE OF FLOOD CARRYING CAPACITY.

Pursuant to the purpose and methods of reducing flood damage stated in these regulations, the following additional standards are adopted to assure that the reduction of the flood carrying capacity of watercourses is minimized:

(a) Development in Floodways.

(1) In floodway areas, development shall cause no increase in flood levels during the occurrence of the base flood discharge. Prior to issuance of a floodplain development permit, the applicant must submit a hydrologic and hydraulic analysis, conducted by a registered professional engineer, demonstrating that the proposed development would not result in any increase in the base flood elevation; or

(2) Development in floodway areas causing no increases in the base flood elevation may be permitted provided all of the following are completed by the applicant:

A. Meet the requirements to submit technical data in Section 1466.20(a);

B. An evaluation of alternatives which would not result in increased base flood elevations and an explanation why these alternatives are not feasible;

C. Certification that no structures are located in areas which would be impacted;

D. Documentation of individual legal notices to all impacted property owners within and outside the community, explaining the impact of the proposed action on their property; and

E. Concurrence of the Mayor of the City and the Chief Executive Officer of any other communities impacted by the proposed actions.

(b) Development in Riverine Areas with Base Flood Elevations but No Floodways. In riverine special flood hazard areas identified by FEMA where base flood elevation data are provided but no floodways have been designated, the cumulative effect of any proposed development, when combined with all other existing and anticipated development, shall not increase the base flood elevation at any point. Prior to issuance of a floodplain development permit, the applicant must submit a hydrologic and hydraulic analysis, conducted by a registered professional engineer, demonstrating that this standard has been met.

(c) Alterations of a Watercourse. For the purpose of these regulations, a watercourse is altered when any change occurs within its banks. The extent of the banks shall be established by a field determination of the "bankfull stage." The field

determination of "bankfull stage" shall be based on methods presented in Chapter 7 of the *USDA Forest Service General Technical Report RM-245, Stream Channel Reference Sites: An Illustrated Guide to Field Technique* or other applicable publication available from a Federal, State, or other authoritative source. For all proposed developments that alter a watercourse, the following standards apply:

(1) The bankfull flood carrying capacity of the altered or relocated portion of the watercourse shall not be diminished. Prior to the issuance of a floodplain development permit, the applicant must submit a description of the extent to which any watercourse will be altered or relocated as a result of the proposed development, and certification by a registered professional engineer that the bankfull flood carrying capacity of the watercourse will not be diminished.

(2) Adjacent communities, the U.S. Army Corps of Engineers, and the Ohio Department of Natural Resources, Division of Water, must be notified prior to any alteration or relocation of a watercourse. Evidence of such notification must be submitted to the Federal Emergency Management Agency.

(3) The applicant shall be responsible for providing the necessary maintenance for the altered or relocated portion of said watercourse so that the flood carrying capacity will not be diminished. The Floodplain Administrator may require the permit holder to enter into an agreement with the City specifying the maintenance responsibilities. If an agreement is required, it shall be made a condition of the floodplain development permit.

(4) The applicant shall meet the requirements to submit technical data in Section 1466.20 (a)(1)C. when an alteration of a watercourse results in the relocation or elimination of the special flood hazard area, including the placement of culverts.

Ord. 04-212. Passed 2-1-05.)

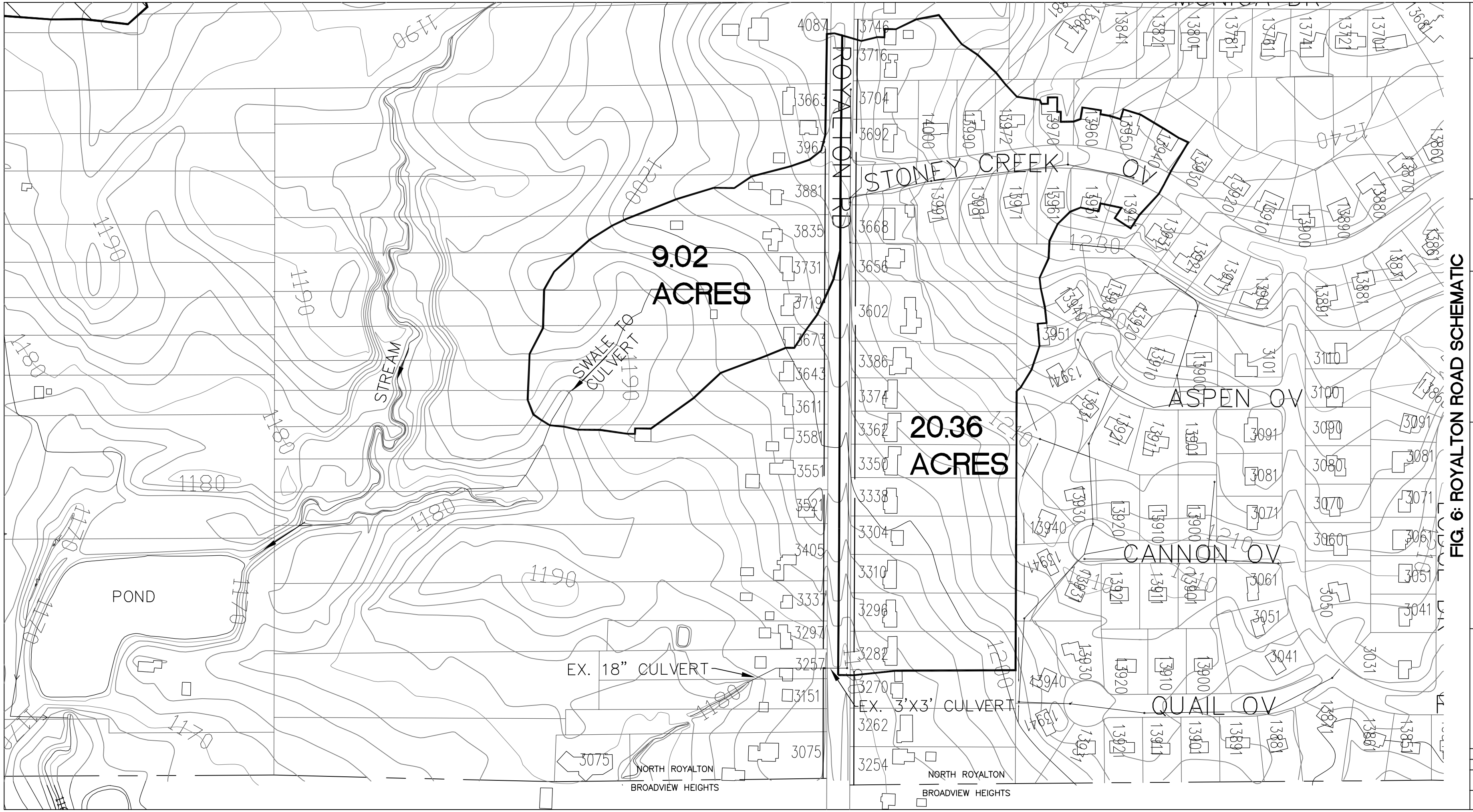

FIG. 6: ROYALTON ROAD SCHEMATIC

REVISIONS			
No.	DESCRIPTION	DATE	BY
1.			
2.			
3.			
4.			
5.			
6.			

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04-16-07
04-207

FIGURE 06

STEPHEN HOVANCSEK & ASSOCIATES

Attachment 7: No. 3C Catch Basin Spacing Form

Calculated by: *SMH* Date: *03/22/07* 2 YEAR 15 MIN. i = 2.95 INCHES/HOUR Project: *Stoney Creek Drive (Existing)*

Checked by: *XXX* Date: *XX/XX/XX* 5 YEAR 15 MIN. i = 3.62 INCHES/HOUR Worksheet 1 of 2

10 YEAR 15 MIN. i = 4.21 INCHES/HOUR

1	2	3	4	5	6	7	8	9	10	11	12
Inlet Location	Station	Drainage Ares "A"	Runoff Coefficient "C"	Qa = ix3x4	Bypass from Upstream Inlet "Qb"	Total Gutter Flow "Qt"	Longitudinal Gutter Slope "S"	Cross-Slope of Pavement	Spread 20 FT. Upstream from Grate	Depth 20 FT. Upstream from Grate	Remarks
					Bypass Chart	Columns 5+6		Section A-A	Section A-A	Columns 9 x 10	
		(Acres)		(CFS)	(CFS)	(CFS)	(FT/FT)	(FT/FT)	(FT)	(FT)	
LT.	6+00	0.75	0.45	0.996	0.00	0.996	0.0329	0.0208	5.48	0.11	2 YR.
					0.037						
LT.	0+75	1.19	0.46	1.615		1.652	0.0275	0.0208	6.86	0.14	2 YR.
					0.280						
RT.	6+00	0.19	0.59	0.331	0.00	0.331	0.0329	0.0208	3.63	0.08	2 YR.
					0.000						
RT.	0+75	1.34	0.46	1.818		1.818	0.0275	0.0208	7.11	0.15	2 YR.
					0.340						
LT.	6+00	0.75	0.45	1.222	0.00	1.222	0.0329	0.0208	5.92	0.12	5 YR.
					0.090						
LT.	0+75	1.19	0.46	1.982		2.072	0.0275	0.0208	7.46	0.16	5 YR.
					0.460						
RT.	6+00	0.19	0.59	0.406	0.00	0.406	0.0329	0.0208	3.92	0.08	5 YR.
					0.000						
RT.	0+75	1.34	0.46	2.231		2.231	0.0275	0.0208	7.67	0.16	5 YR.
					0.530						

STEPHEN HOVANCSEK & ASSOCIATES

Attachment 7: No. 3C Catch Basin Spacing Form

Calculated by: *SMH* Date: *03/22/07* 2 YEAR 15 MIN. i = 2.95 INCHES/HOUR Project: *Stoney Creek Drive (Existing)*

Checked by: *XXX* Date: *XX/XX/XX* 5 YEAR 15 MIN. i = 3.62 INCHES/HOUR Worksheet 2 of 2

10 YEAR 15 MIN. i = 4.21 INCHES/HOUR

1	2	3	4	5	6	7	8	9	10	11	12
Inlet Location	Station	Drainage Ares "A"	Runoff Coefficient "C"	Qa = ix3x4	Bypass from Upstream Inlet "Qb"	Total Gutter Flow "Qt"	Longitudinal Gutter Slope "S"	Cross-Slope of Pavement	Spread 20 FT. Upstream from Grate	Depth 20 FT. Upstream from Grate	Remarks
					Bypass Chart	Columns 5+6		Section A-A	Section A-A	Columns 9 x 10	
		(Acres)		(CFS)	(CFS)	(CFS)	(FT/FT)	(FT/FT)	(FT)	(FT)	
LT.	6+00	0.75	0.45	1.421	0.00	1.421	0.0329	0.0208	6.26	0.13	10 YR.
					0.150						
LT.	0+75	1.19	0.46	2.305		2.455	0.0275	0.0208	7.95	0.17	10 YR.
					0.620						
RT.	6+00	0.19	0.59	0.472	0.00	0.472	0.0329	0.0208	4.14	0.09	10 YR.
					0.000						
RT.	0+75	1.34	0.46	2.595		2.595	0.0275	0.0208	8.12	0.17	10 YR.
					0.700						

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Attachment 8: No. 3C Catch Basin Spacing Form

Calculated by: *SMH* Date: *03/22/07* 2 YEAR 15 MIN. i = 2.95 INCHES/HOUR Project: *Stoney Creek Drive (Proposed)*

Checked by: *XXX* Date: *XX/XX/XX* 5 YEAR 15 MIN. i = 3.62 INCHES/HOUR Worksheet 1 of 2

10 YEAR 15 MIN. i = 4.21 INCHES/HOUR

1	2	3	4	5	6	7	8	9	10	11	12
Inlet Location	Station	Drainage Ares "A"	Runoff Coefficient "C"	Qa = ix3x4	Bypass from Upstream Inlet "Qb"	Total Gutter Flow "Qt"	Longitudinal Gutter Slope "S"	Cross-Slope of Pavement	Spread 20 FT. Upstream from Grate	Depth 20 FT. Upstream from Grate	Remarks
					Bypass Chart	Columns 5+6		Section A-A	Section A-A	Columns 9 x 10	
		(Acres)		(CFS)	(CFS)	(CFS)	(FT/FT)	(FT/FT)	(FT)	(FT)	
LT.	6+00	0.75	0.45	0.996	0.00	0.996	0.0329	0.0208	5.48	0.11	2 YR.
					0.036						
* LT.	2+30	0.45	0.56	0.743		0.779	0.0515	0.0208	4.60	0.10	2 YR.
					0.000						
LT.	0+75	0.73	0.40	0.861		0.861	0.0275	0.0208	5.37	0.11	2 YR.
					0.020						
RT.	6+00	0.19	0.59	0.331	0.00	0.331	0.0329	0.0208	3.63	0.08	2 YR.
					0.000						
* RT.	2+30	0.99	0.46	1.343		1.343	0.0515	0.0208	5.64	0.12	2 YR.
					0.070						
RT.	0+75	0.35	0.46	0.475		0.545	0.0275	0.0208	4.52	0.09	2 YR.
					0.000						
LT.	6+00	0.75	0.45	1.222	0.00	1.222	0.0329	0.0208	5.92	0.12	5 YR.
					0.090						
* LT.	2+30	0.45	0.56	0.912		1.002	0.0515	0.0208	5.05	0.11	5 YR.
					0.000						
LT.	0+75	0.73	0.40	1.057		1.057	0.0275	0.0208	5.80	0.12	5 YR.
					0.065						

* Proposed Catch Basin

STEPHEN HOVANCSEK & ASSOCIATES

Attachment 8: No. 3C Catch Basin Spacing Form

Calculated by: *SMH* Date: *03/22/07* 2 YEAR 15 MIN. i = 2.95 INCHES/HOUR Project: *Stoney Creek Drive (Proposed)*

Checked by: *XXX* Date: *XX/XX/XX* 5 YEAR 15 MIN. i = 3.62 INCHES/HOUR Worksheet 2 of 2

10 YEAR 15 MIN. i = 4.21 INCHES/HOUR

1	2	3	4	5	6	7	8	9	10	11	12
Inlet Location	Station	Drainage Ares "A"	Runoff Coefficient "C"	Qa = ix3x4	Bypass from Upstream Inlet "Qb"	Total Gutter Flow "Qt"	Longitudinal Gutter Slope "S"	Cross-Slope of Pavement	Spread 20 FT. Upstream from Grate	Depth 20 FT. Upstream from Grate	Remarks
					Bypass Chart	Columns 5+6		Section A-A	Section A-A	Columns 9 x 10	
		(Acres)		(CFS)	(CFS)	(CFS)	(FT/FT)	(FT/FT)	(FT)	(FT)	
RT.	6+00	0.19	0.59	0.406	0.00	0.406	0.0329	0.0208	3.92	0.08	5 YR.
					0.000						
* RT.	2+30	0.99	0.46	1.649		1.649	0.0515	0.0208	6.09	0.13	5 YR.
					0.150						
RT.	0+75	0.35	0.46	0.583		0.733	0.0275	0.0208	5.05	0.11	5 YR.
					0.000						
LT.	6+00	0.75	0.45	1.421	0.00	1.421	0.0329	0.0208	6.26	0.13	10 YR.
					0.150						
* LT.	2+30	0.45	0.56	1.061		1.211	0.0515	0.0208	5.42	0.11	10 YR.
					0.035						
LT.	0+75	0.73	0.40	1.229		1.264	0.0275	0.0208	6.20	0.13	10 YR.
					0.120						
RT.	6+00	0.19	0.59	0.472	0.00	0.472	0.0329	0.0208	4.14	0.09	10 YR.
					0.000						
* RT.	2+30	0.99	0.46	1.917		1.917	0.0515	0.0208	6.44	0.13	10 YR.
					0.250						
RT.	0+75	0.35	0.46	0.678		0.928	0.0275	0.0208	5.52	0.11	10 YR.
					0.030						

* Proposed Catch Basin

City of North Royalton
2007 Addendum
Attachment 9
Stoney Creek Catch Basin Improvement
Preliminary Engineer's Estimate

PRELIMINARY COST ESTIMATE					STEPHEN HOVANCSEK & ASSOCIATES Engineer's Estimate	
#	DESCRIPTION		QUANTITY	UNIT	UNIT PRICE	TOTAL
1	ITEM 207:	EROSION AND SEDIMENT CONTROL	LUMP	LUMP	$200.00	$200.00
2	ITEM 255:	FULL DEPTH PAVEMENT REMOVAL AND RIGID REPLACEMENT	25	SY	$60.00	$1,500.00
3	ITEM 603:	12" RCP STORM SEWER	37	LF	$75.00	$2,775.00
4	ITEM 604:	CATCH BASIN CB-3C	2	EA	$1,600.00	$3,200.00
5	ITEM 614:	MAINTAINING TRAFFIC	LUMP	LUMP	$1,000.00	$1,000.00
6	ITEM 624:	MOBILIZATION	LUMP	LUMP	$1,000.00	$1,000.00
7	ITEM 659:	SEEDING AND MULCHING	20	SY	$8.00	$160.00
8	ITEM SPECIAL:	DISCRETIONARY ALLOWANCE TO BE UTILIZED AS DIRECTED BY THE ENGINEER FOR UNSCHEDULED WORK ITEMS NOT INCLUDED IN THIS PROPOSAL OR SHOWN ON THE PLANS	LUMP	LUMP	$1,000.00	$1,000.00
		TOTAL				$10,835.00
		Engineering & Surveying				$2,280.00
		Construction Inspection				$2,200.00
						$15,315.00

STEPHEN HOVANCSEK & ASSOCIATES

Attachment 10: Storm Sewer Computation Sheet

Calculated by: *SMH* Date: *03/06/07* Mannings "n" = *0.015 for < 27", 0.013 for > 30"* Project: *04-207 N.R. Stoney Creek*

Checked by: *XXX* Date: *01/00/00* Design Storm = *10* Year

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Station		**Drainage Area**		**Time of Concentration**					**"Area " * "C"**												
From	**To**	**Incremental Area (acres)**	**Total Area (acres)**	**Inlet To Time (min.)**	**Incremental Time (min.)**	**Total Time (min.)**	**Rain intensity (inches/hour)**	**Runoff coefficient**	**Incremental**	**Total**	**Discharge (cfs)**	**Pipe Diameter (inches)**	**Length of pipe (ft)**	**Roughness Coefficient**	**Pipe Slope (ft/ft)**	**Full Capacity (cfs)**	**Percent of Full Section (Flow)**	**Percent Full (Velocity)**	**Full Velocity (ft/s)**	**Mean Velocity (ft./sec)**	**Time in Pipe (min.)**
		ΔA	ΣA	t_i	Δt	Σt	i	C	ΔCA	ΣCA	Q	ϕ	L	n	s_o	Q_{full}	Q/Q_{full}	V/V_{full}	V_{full}	V	t_p
D1	D2	1.15	1.15	10.00		10.00	4.95	0.59	0.68	0.68	3.37	12	174	0.015	0.0157	3.87	0.87	1.12	4.93	5.52	0.53
D2	D3	0.33						0.90	0.29	0.29											
		1.15								0.68											
			1.47	10.00	0.53	10.53	4.86			0.97	4.71	12	358	0.015	0.0392	6.11	0.77	1.11	7.78	8.64	0.69
D3	D4	0.00						0.00	0.00	0.00											
		1.47								0.97											
			1.47	15.00	0.00	15.00	4.21			0.97	4.08	12	215	0.015	0.0252	4.90	0.83	1.12	6.24	6.99	0.51
D4A	D4	2.53	2.53	15.00		15.00	4.21	0.47	1.20	1.20	5.05	12	44	0.015	***0.0218***	4.56	1.11	***Q/Q?***	5.81	######	######
D5	D6	1.80	1.80	15.00		15.00	4.21	0.35	0.63	0.63	2.65	12	178	0.015	0.0085	2.85	0.93	1.14	3.63	4.14	0.72
D6	D4	0.76						0.47	0.36	0.36											
		1.80								0.63											
			2.56	15.00	0.72	15.72	4.12			0.99	4.08	12	104	0.015	0.0199	4.36	0.94	1.14	5.55	6.33	0.27
D4	D7	0.25						0.56	0.14	0.14											
		2.56								0.99											
		2.53								1.20											
			5.34	15.72	0.27	15.99	4.09			2.33	9.53	18	12	0.015	0.0125	10.18	0.94	1.14	5.76	6.57	0.03

STEPHEN HOVANCSEK & ASSOCIATES

Attachment 10: Storm Sewer Computation Sheet

Calculated by: *SMH* Date: *03/06/07* Mannings "n" = *0.015 for < 27", 0.013 for > 30"* Project: *04-207 N.R. Stoney Creek*

Checked by: *XXX* Date: *01/00/00* Design Storm = *10* Year

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Station		Drainage Area		Time of Concentration					"Area " * "C"												
From	To	Incremental Area (acres)	Total Area (acres)	Inlet To Time (min.)	Incremental Time (min.)	Total Time (min.)	Rain intensity (inches/hour)	Runoff coefficient	Incremental	Total	Discharge (cfs)	Pipe Diameter (inches)	Length of pipe (ft)	Roughness Coefficient	Pipe Slope (ft/ft)	Full Capacity (cfs)	Percent of Full Section (Flow)	Percent Full (Velocity)	Full Velocity (ft/s)	Mean Velocity (ft./sec)	Time in Pipe (min.)
		ΔA	ΣA	t_i	Δt	Σt	i	C	ΔCA	ΣCA	Q	ϕ	L	n	s_o	Q_{full}	Q/Q_{full}	V/V_{full}	V_{full}	V	t_p
D7	D8	0.74						0.41	0.30	0.30											
		5.34								2.33											
			6.08	15.99	0.03	16.02	4.09			2.63	10.76	18	105	0.015	0.0159	11.48	0.94	1.14	6.50	7.41	0.24
D8	A	0.25						0.55	0.14	0.14											
		6.08								2.63											
			6.33	16.02	0.24	16.26	4.06			2.77	11.25	18	100	0.015	0.0159	11.48	0.98	1.15	6.50	7.48	0.22
A	B	1.84						0.35	0.65	0.65											
		6.33								2.77											
			8.17	16.26	0.22	16.48	4.04			3.42	13.82	21	157	0.015	0.0159	17.32	0.80	1.12	7.20	8.06	0.32
B	C	1.04						0.38	0.40	0.40											
		8.17								3.42											
			9.21	16.48	0.32	16.80	4.00			3.82	15.28	21	95	0.015	0.0159	17.32	0.88	1.13	7.20	8.14	0.19
C	D	0.65						0.41	0.26	0.26											
		9.21								3.82											
			9.86	16.80	0.19	16.99	3.98			4.08	16.24	21	100	0.015	0.0159	17.32	0.94	1.14	7.20	8.21	0.20
D	E	0.91						0.37	0.34	0.34											
		9.86								4.08											
			10.77	16.99	0.20	17.19	3.96			4.42	17.50	24	74	0.015	0.0159	24.72	0.71	1.08	7.87	8.50	0.15

STEPHEN HOVANCSEK & ASSOCIATES

Attachment 10: Storm Sewer Computation Sheet

Calculated by: *SMH* Date: *03/06/07* Mannings "n" = *0.015 for < 27", 0.013 for > 30"* Project: *04-207 N.R. Stoney Creek*

Checked by: *XXX* Date: *01/00/00* Design Storm = *10* Year

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Station		Drainage Area		Time of Concentration					"Area " * "C"												
From	To	Incremental Area (acres)	Total Area (acres)	Inlet To Time (min.)	Incremental Time (min.)	Total Time (min.)	Rain intensity (inches/hour)	Runoff coefficient	Incremental	Total	Discharge (cfs)	Pipe Diameter (inches)	Length of pipe (ft)	Roughness Coefficient	Pipe Slope (ft/ft)	Full Capacity (cfs)	Percent of Full Section (Flow)	Percent Full (Velocity)	Full Velocity (ft/s)	Mean Velocity (ft./sec)	Time in Pipe (min.)
		ΔA	ΣA	t_i	Δt	Σt	i	C	ΔCA	ΣCA	Q	ϕ	L	n	s_o	Q_{full}	Q/Q_{full}	V/V_{full}	V_{full}	V	t_p
E	F	0.27						0.56	0.15	0.15											
		10.77								4.42											
			11.04	17.19	0.15	17.34	3.94			4.57	18.01	24	86	0.015	0.0159	24.72	0.73	1.08	7.87	8.50	0.17
F	G	0.70						0.41	0.29	0.29											
		11.04								4.57											
			11.74	17.34	0.17	17.51	3.92			4.86	19.05	24	97	0.015	0.0159	24.72	0.77	1.11	7.87	8.74	0.18
L	G	2.96	2.96	15.00		15.00	4.21	0.30	0.89	0.89	3.75	12	140	0.015	0.0167	3.99	0.94	1.14	5.08	5.79	0.40
G	H	0.66						0.40	0.27	0.27											
		2.96								0.89											
		11.74								4.86											
			15.36	17.51	0.18	17.69	3.90			6.02	23.48	24	123	0.015	0.0159	24.72	0.95	1.14	7.87	8.97	0.23
H	I	1.26						0.36	0.45	0.45											
		15.36								6.02											
			16.62	17.69	0.23	17.92	3.88			6.47	25.10	27	107	0.015	0.0159	33.85	0.74	1.09	8.51	9.28	0.19
I	J	0.73						0.43	0.31	0.31											
		16.62								6.47											
			17.35	17.92	0.19	18.11	3.86			6.78	26.17	27	92	0.015	0.0159	33.85	0.77	1.11	8.51	9.45	0.16

STEPHEN HOVANCSEK & ASSOCIATES

Attachment 10: Storm Sewer Computation Sheet

Calculated by: *SMH* Date: *03/06/07* Mannings "n" = *0.015 for < 27", 0.013 for > 30"* Project: *04-207 N.R. Stoney Creek*

Checked by: *XXX* Date: *01/00/00* Design Storm = *10* Year

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Station		**Drainage Area**		**Time of Concentration**					**"Area " * "C"**												
From	**To**	**Incremental Area (acres)**	**Total Area (acres)**	**Inlet To Time (min.)**	**Incremental Time (min.)**	**Total Time (min.)**	**Rain intensity (inches/hour)**	**Runoff coefficient**	**Incremental**	**Total**	**Discharge (cfs)**	**Pipe Diameter (inches)**	**Length of pipe (ft)**	**Roughness Coefficient**	**Pipe Slope (ft/ft)**	**Full Capacity (cfs)**	**Percent of Full Section (Flow)**	**Percent Full (Velocity)**	**Full Velocity (ft/s)**	**Mean Velocity (ft./sec)**	**Time in Pipe (min.)**
		ΔA	ΣA	t_i	Δt	Σt	i	C	ΔCA	ΣCA	Q	ϕ	L	n	s_o	Q_{full}	Q/Q_{full}	V/V_{full}	V_{full}	V	t_p
J	K	1.54						0.34	0.53	0.53											
		17.35								6.78											
			18.89	18.11	0.16	18.27	3.84			7.31	28.07	27	78	0.015	0.0159	33.85	0.83	1.12	8.51	9.53	0.14
CULVERT		18.89	18.89	18.27	0.14	18.41	3.82			7.31	27.92	27	260	0.015	0.0230	40.71	0.69	1.07	10.24	10.96	0.40
												proposed									

City of North Royalton
Royalton Road Storm Sewer Improvement
2007 Addendum
Attachment 11
Preliminary Engineer's Estimate

PRELIMINARY COST ESTIMATE					STEPHEN HOVANCSEK & ASSOCIATES Engineer's Estimate	
#	DESCRIPTION		QUANTITY	UNIT	UNIT PRICE	TOTAL
		ROYALTON ROAD SEWER				
1	ITEM 201:	CLEARING AND GRUBBING	LUMP	LUMP	$3,000.00	$3,000.00
	ITEM 203:	EXCAVATION	450	CY	$15.00	$6,750.00
2	ITEM 207:	TEMPORARY SOIL AND EROSION CONTROL	LUMP	LUMP	$3,000.00	$3,000.00
1	ITEM 253:	CONCRETE PAVEMENT REPAIR (DRIVES)	150	SY	$45.00	$6,750.00
2	ITEM 603:	18"RCP STORM SEWER	217	LF	$100.00	$21,700.00
3	ITEM 603:	21" RCP STORM SEWER	352	LF	$125.00	$44,000.00
4	ITEM 603:	24" RCP STORM SEWER	380	LF	$135.00	$51,300.00
5	ITEM 603:	27" RCP STORM SEWER	170	LF	$150.00	$25,500.00
6	ITEM 604:	CB 2-3 INLET BASIN	12	EACH	$1,700.00	$20,400.00
7	ITEM 614:	MAINTAINING TRAFFIC	LUMP	LUMP	$12,000.00	$20,000.00
8	ITEM 623:	CONSTRUCTION LAYOUT STAKING, AS PER PLAN	LUMP	LUMP	$2,000.00	$2,000.00
9	ITEM 624:	MOBILIZATION	LUMP	LUMP	$7,500.00	$15,000.00
10	ITEM SPECIAL:	SITE RESTORATION	LUMP	LUMP	$8,000.00	$15,000.00
11	ITEM SPECIAL:	DISCRETIONARY ALLOWANCE TO BE UTILIZED AS DIRECTED BY THE ENGINEER FOR UNSCHEDULED WORK ITEMS NOT INCLUDED IN THIS PROPOSAL OR SHOWN ON THE PLANS	LUMP	LUMP	$23,400.00	$23,400.00
		TOTAL				$257,800.00
		Engineering & Surveying				$28,235.00
		Construction Inspection				$13,680.00
		Sub Total				**$299,715.00**

		SEWER EXTENSION & OUTLET REPLACEMENT				
1	ITEM 202:	STRUCTURE REMOVED	LUMP	LUMP	$2,000.00	$2,000.00
2	ITEM 209I	LINEAR GRADING (CHANNEL)	LUMP	LUMP	$2,500.00	$2,500.00
3	ITEM 253:	PAVEMENT REPAIR	60	SY	$50.00	$3,000.00
4	ITEM 253:	PAVEMENT REPAIR (DRIVE)	450	SY	$45.00	$20,250.00
5	ITEM 601:	DUMPED ROCK FILL, TYPE C (10' X'18"X4'-6")	1.2	CY	$200.00	$240.00
6	ITEM 602:	CONCRETE MASONRY, HW-4B	LUMP	LUMP	$1,000.00	$1,000.00
7	ITEM 603:	18" PIPE GROUTED WITH LSM	210	LF	$8.00	$1,680.00
8	ITEM 603:	27" RCP STORM SEWER	550	LF	$150.00	$82,500.00
9	ITEM 604:	MANHOLE, MH3	2	EA	$2,500.00	$5,000.00
10	ITEM 614:	MAINTAINING TRAFFIC	LUMP	LUMP	$2,000.00	$2,000.00
11	ITEM SPECIAL:	SITE RESTORATION	LUMP	LUMP	$3,000.00	$3,000.00
12	ITEM SPECIAL:	DISCRETIONARY ALLOWANCE TO BE UTILIZED AS DIRECTED BY THE ENGINEER FOR UNSCHEDULED WORK ITEMS NOT INCLUDED IN THIS PROPOSAL OR SHOWN ON THE PLANS	LUMP	LUMP	$12,300.00	$12,300.00
		TOTAL				$130,970.00
		Engineering & Surveying				$9,822.75
		Construction Inspection				$4,560.00
						$145,352.75
		TOTAL				**$445,067.75**

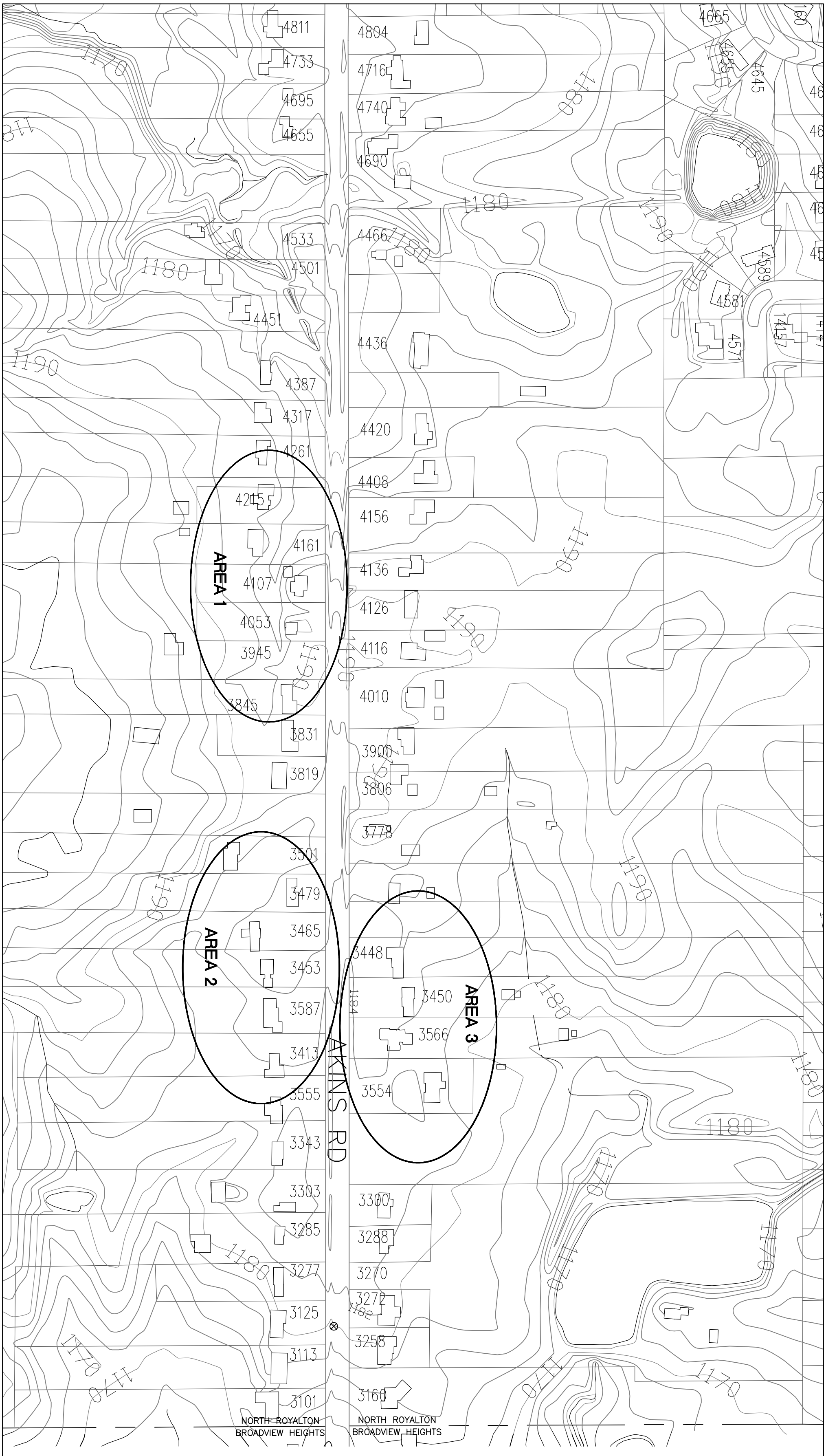

FIG. 12: AKINS ROAD SCHEMATIC

FIGURE 12

06-28-07
04-207

STEPHEN HOVANCSEK & ASSOCIATES, INC.
CONSULTING ENGINEERS AND PLANNERS
TWO MERIT DRIVE
RICHMOND HEIGHTS, OHIO 44143
PH: (216) 731-6255 FAX: (216) 731-4483

REVISIONS

No.	DESCRIPTION	DATE	BY
6.)			
5.)			
4.)			
3.)			
2.)			
1.)			

0 200
SCALE IN FEET (HORIZONTAL)

NORTH

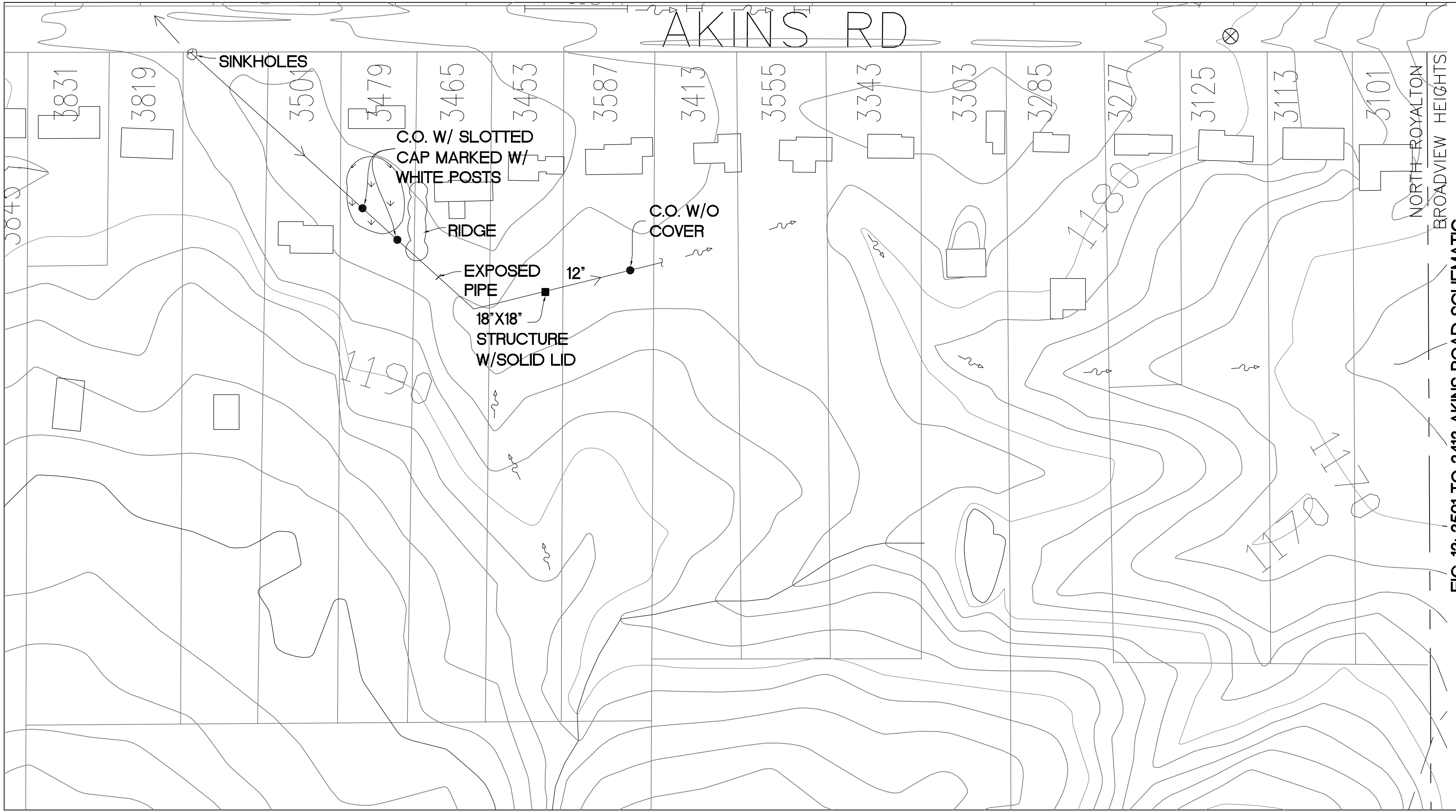

FIG. 13: 3501 TO 3413 AKINS ROAD SCHEMATIC

No.	DESCRIPTION	DATE	BY
1.)			
2.)			
3.)			
4.)			
5.)			
6.)			

REVISIONS

STEPHEN HOVANCSEK & ASSOCIATES, INC.
CONSULTING ENGINEERS AND PLANNERS
TWO MERIT DRIVE
RICHMOND HEIGHTS, OHIO 44143
PH: (216) 731-6255 FAX: (216) 731-4483

04-17-07

04-207

FIGURE 13

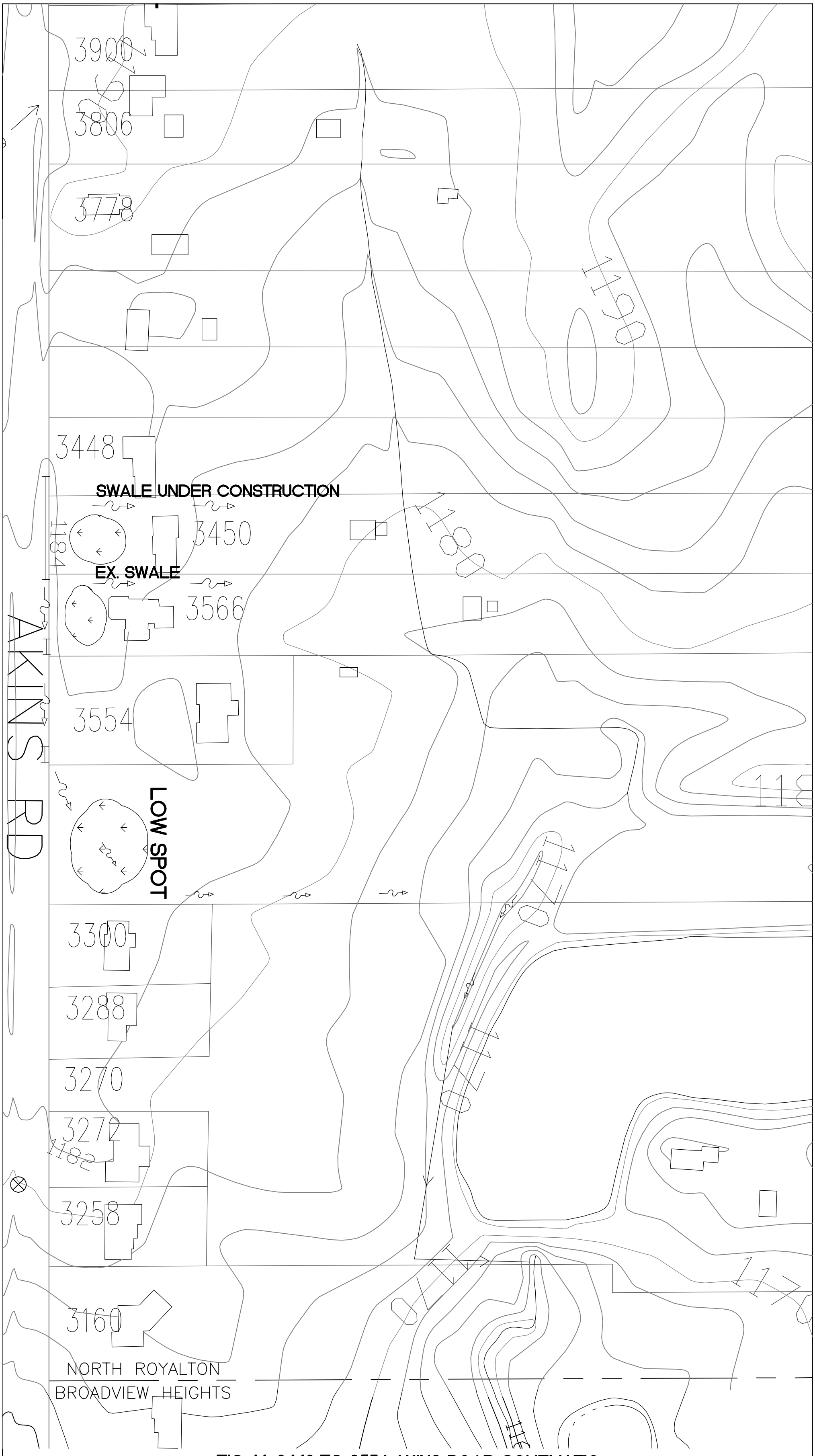

FIG. 14: 3448 TO 3554 AKINS ROAD SCHEMATIC

FIGURE 14

04-17-07
04-207

STEPHEN HOVANCSEK & ASSOCIATES, INC.
CONSULTING ENGINEERS AND PLANNERS
TWO MERIT DRIVE
RICHMOND HEIGHTS, OHIO 44143
PH: (216) 731-6255 FAX: (216) 731-4483

REVISIONS			
6.)			
5.)			
4.)			
3.)			
2.)			
1.)			
No.	DESCRIPTION	DATE	BY

0 100
SCALE IN FEET (HORIZONTAL)

NORTH

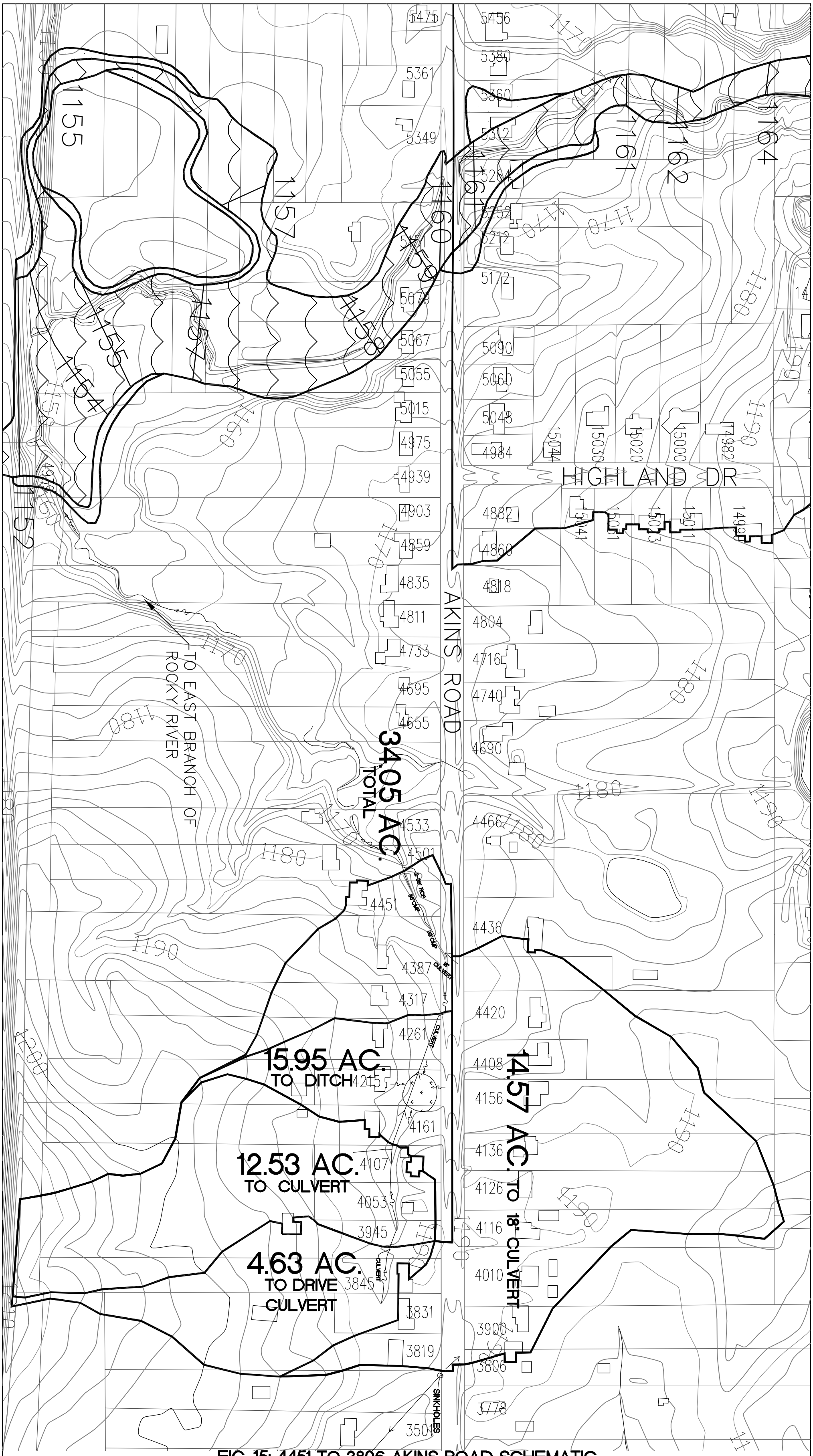

FIG. 15: 4451 TO 3806 AKINS ROAD SCHEMATIC

STEPHEN HOVANCSEK & ASSOCIATES, INC.
CONSULTING ENGINEERS AND PLANNERS
TWO MERIT DRIVE
RICHMOND HEIGHTS, OHIO 44143
PH: (216) 731-6255 FAX: (216) 731-4483

REVISIONS

No.	DESCRIPTION	DATE	BY
6.)			
5.)			
4.)			
3.)			
2.)			
1.)			

0 200
SCALE IN FEET (HORIZONTAL)

NORTH

04-17-07
04-207

FIGURE 15