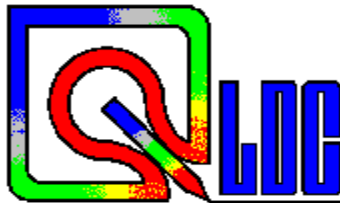


DRAINAGE CALCULATIONS
FOR
ERIE SHORES SUBDIVISION

PAINESVILLE TOWNSHIP, LAKE COUNTY, OHIO



Job # FIRSR1-1101

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LAKE ERIE SHORES SUBDIVISION DRAINAGE CALCULATION SUMMARY

STORM INTENSITIES

Storm frequencies referred to in this summary indicate the time period in which a storm of a certain intensity can be expected to occur. For example, a 1 year frequency storm has an intensity that can be expected to occur once every year. A 100 year storm has an intensity that can be expected to occur once every 100 years. Therefore there is a one percent chance of a 100 year storm occurring in any given year. Following is a table of frequency storms and their related intensities.

Frequency Storm	24 – Hour Rainfall (Inches of Rain)
1 yr (100% chance of occurrence)	2.1
2yr (50% chance of occurrence)	2.2
5yr (20% chance of occurrence)	3.0
10yr (10% chance of occurrence)	3.4
25yr (4% chance of occurrence)	3.9
50yr (2% chance of occurrence)	4.4
100yr (1% chance of occurrence)	4.6 *

* As a matter of comparison, the storm which occurred in the summer of 2006 in Lake County recorded between 5.5 and 7.5 inches of rain in a 24 hour period.

DRAINAGE AREAS

The area draining to the CREEK running through Lake Erie Shores Subdivision enters via a 42" culvert crossing under the railroad tracks at the south end of the subdivision. The total area draining to the existing 48" culvert crossing Lake Road at the north end of Lake Erie Shores Subdivision is 631 acres. The area south of the railroad tracks is 498 acres, and the area between the tracks and the 48" Lake Road culvert is 133 acres.

DRAINAGE AREA SOUTH OF THE RAILROAD TRACKS

The drainage area south of Lake Erie Shores Subdivision which enters the existing 42 inch culvert crossing the tracks is 498 acres. A 159 acre portion of this area drains to the existing 24" culvert crossing Bacon Road north of S.R. 2. The remaining 339 acres

downstream of the Bacon Road culvert drains to the 42" culvert crossing the railroad tracks.

The 24 inch culvert crossing Bacon Road restricts the flow toward Lake Erie Shores Subdivision in larger storms. The pavement over the culvert is higher than the land to the east and thereby causes runoff from larger storms to be diverted to the next easterly ditch. As illustrated in the table below, the Bacon Road culvert diverts a major portion of the stormwater runoff from the higher intensity storms.

Frequency Storm	Peak Flow Through 24" Culvert	Peak Flow To Adjacent Easterly Creek
1 yr	20 cfs	9 cfs
5yr	21 cfs	41 cfs
10yr	21 cfs	66 cfs
25 yr	21 cfs	94 cfs
50 yr	22 cfs	122 cfs
100 yr	22 cfs	140 cfs

The 42 inch culvert crossing the railroad tracks at the southerly end of the Lake Erie Shores Subdivision CREEK restricts additional flow to the CREEK as shown in the table below. As with the Bacon Road culvert, the peak flows in the larger storms do not go over the tracks, but instead flow easterly to the next available creek.

Frequency Storm	Peak Flow Through 42" Culvert	Peak Flow To Adjacent Easterly Creek
1 yr	106 cfs	0 cfs
5yr	132 cfs	40 cfs
10yr	133 cfs	82 cfs
25 yr	134 cfs	123 cfs
50 yr	135 cfs	295 cfs
100 yr	135 cfs	310 cfs

DRAINAGE AREA NORTH OF THE RAILROAD TRACKS

The drainage area north of the tracks which is tributary to the CREEK in Lake Erie Shores Subdivision is 133 acres.

A 70 acre portion of this area is collected by a 36 inch storm sewer which enters the CREEK through an easement across from the most southerly pond in Lake Erie Shores Subdivision. The 70 acre drainage area consists of the southerly end of Outrigger Cove, Sea Ray Cove, and a large area of open space containing wetland and pond areas which reduce the runoff. There is a by-pass swale at the entrance of the 36 inch storm sewer which diverts flow to the north and enters the Outrigger Cove storm sewer system crossing Lake Road to the west of the 48" culvert at the north end of the Lake Erie Shores Subdivision CREEK. The diverted flow is illustrated in the table below.

Frequency Storm	Peak Flow Through 36" Culvert To the CREEK	Peak Flow Through Overflow Swale To Outrigger Cove Storm Sewer System
1 yr	12 cfs	0 cfs
5yr	28 cfs	0 cfs
10yr	40 cfs	0 cfs
25 yr	52 cfs	0 cfs
50 yr	59 cfs	0 cfs
100 yr	62 cfs	9 cfs

The remaining 63 acres draining to the CREEK between the tracks and the existing 48 inch culvert enters the Lake Erie Shores storm water drainage system consisting of various storm sewer and detention pond systems.

SUMMARY

Flow Entering Lake Erie Shores Subdivision

The storm water peak flow rate entering the southerly end of the Lake Erie Shores Subdivision CREEK is greatly reduced by upstream culvert restrictions. The two significant restrictions are the 24 inch culvert crossing Bacon Road, north of S.R. 2, and the 42 inch culvert crossing the railroad tracks at the southerly end of the CREEK.

48" Pebble Beach Cove Culvert

The 48 inch culvert crossing Pebble Beach Cove has an upstream invert of 617.43. The water at the upstream end of this culvert rises to an elevation of 624.0 in a 100 year frequency storm. This 100 year elevation at the low point elevation of the pavement. Any storms exceeding the intensity of a 100 year storm (approximately 5 inches of rain in a 24 hour period) will overtop the roadway pavement to the east of the culvert.

South Pond

The South Pond is located on the east side of the CREEK, just north of Hideaway Cove. The overflow elevation of the South Pond is at elevation 620.0. The CREEK at this pond location reaches an elevation of 620.0 in a 10 year frequency storm. Therefore, the CREEK elevation controls the water level of the South Pond in all storms beyond a 10 year frequency storm.

Middle Pond

The Middle Pond is located on the east side of the CREEK, just south of Clipper Cove. The overflow elevation of the Middle Pond is 618.3. The CREEK at this pond location reaches an elevation of 618.3 in a 2 year frequency storm. Therefore, the water elevation in the CREEK controls the pond level in all storms beyond a 2 year frequency storm.

North Pond

The North Pond is located on the east side of the CREEK between Clipper Cove and Commodore Cove. The overflow elevation of the North Pond is 616.3. The CREEK at this pond location reaches an elevation of 616.3 in a 1 year frequency storm. Therefore, the water elevation in the CREEK controls the pond level in all storms beyond a 1 year frequency storm.

48" Culvert Crossing Lake Road

The 48" culvert crossing Lake Road at the north end of Lake Erie Shores Subdivision has an upstream invert elevation of 611.71. The peak flow to this culvert from a 2 year frequency storm (approximately 2-1/2 inches of rainfall in a 24 hour period) causes the water to reach the of the low point in Lake Road which is at elevation 617.92. This is near or above the elevation of the two walk out basements located at the west end of Commodore Cove, and the two walk out basements located at the west end of Clipper Cove. The two walkout basement elevations of the Commodore Cove houses are 616 and 617. The two houses with walk out basements along the ditch at the end of Clipper Cove are at elevations 617.7 and 618.

CONCLUSIONS

Any alterations or improvements to the detention ponds or stormwater piping within Lake Erie Shores Subdivision will have minimal effect on the flood levels being experienced by the homeowners on Clipper Cove and Commodore Cove. The flooding is due to the storm water runoff from upstream areas entering the CREEK through the 42 inch culvert crossing the tracks and the 36 inch storm sewer entering the CREEK from the primarily undeveloped area at the southwestern portion of the Lake Erie Shores Subdivision.