

MEMO header with fields for TO, FROM, SUBJECT, DATE, and PROJECT. Includes a routing slip with names like M.E. Lindback, P.E., and Charles S. Brown, P.E.

This memorandum is a report of an investigation of major storm overflows from the intersection of Bekemeyer and Pine Grove in Golden Hills Fifth Addition in the City of Michigan.

1. Purpose of Study

The Developer and the Contractor have both raised a question as to the necessity of the flume shown on the plans. Although not yet constructed, conditions in the field are such that it will not function as an overflow device until the crest just south of the intersection of Cindy and Pine Grove is overtopped.

II. History

Drainage in the vicinity of 119th St. West and Central has been studied in several separate reports by Professional Engineering Consultants from 1985 to present. The natural terrain is very flat, and prior to development the only drainage channels were the roadside ditches of Central and 119th St. West.

- 1. Drainage Plan and Supporting Calculations for Golden Hills Addition, June 7, 1985.
2. Design Computations and Drainage Plan for Bay Country, April 27, 1987 (2 volumes).

- 3. Drainage Plan and Supporting Calculations for Golden Hills Fourth Addition, May 22, 1987.
4. Design Computations, Golden Hills Fifth Addition Phase I Streets and Storm Water Sewer, PEC Project No. 32-07555-1 & 2-1310, February 1988.
5. Drainage Documentation Submittal for 119th Street West: Maple to Central and Central: 119th Street West to M156, April 1988.

III. Investigation

As stated previously, the 119th/Central improvement did not consider the 19 acre area concentrating at Bekemeyer and Pine Grove. An investigation was made to determine: a) the feasibility of directing major storm flows south and west via Pine Grove and Pine Street rights-of-way to 119th Street; b) once routed to 119th, the feasibility of routing this flow from 119th and Pine, via the inlet at Pond No. 6 in Bay Country.

To this end, 100-year major storm flows were determined for the affected areas with the following assumptions:

- 1. The times of concentration of major and minor storms are the same. This assumption introduces some conservatism into the analysis since gutter flow velocities are in the range of 1 to 2 feet per second while pipe flow velocities range up to 5 feet per second or more.
2. Under major storm conditions, flows carried in the pipe will not exceed the minor storm design capacity. This assumption also introduces conservatism since under the higher head conditions due to the ponding normally associated with major storms, additional flows can be carried in storm sewers.

Runoff coefficients in the Rational Formula are constant under major and minor storm conditions. For each basin, the major storm was computed from the previously calculated minor storms using the ratio of rainfall intensities for the time of concentration. Once flow rates were determined, the flows were routed through the street system. Due to the flat terrain, the drainage pattern in the area is a series of several sumps or ponding areas interconnected by storm water sewers.

Capacity of the street right-of-way was computed by the modified Manning's formula for triangular channels: Q = (0.562 d 8/3 S 1/2) / n. As each crest is overtopped, weir flow occurs initially. Eventually, sufficient head must be built up to convey the water down the street. Thus, the depth required to convey a given flow based on the grade and typical section was determined at the point just downstream of the overtopped crest.

The residential streets are 35' back to back constructed with 3/8 in./ft. cross-slope and standard 6 5/8-inch curb. It is assumed that 119th north of Central and Central west of 119th Street will be constructed as 49' back to back arterial streets with 3/8 in./ft. cross-slope and 400T Std. Type 1 (6-inch) curb.

IV. Findings and Recommendations:

On the basis of this hydrological analysis, it was determined that the nineteen acres contributing to the Bekemeyer/Pine Grove intersection add an additional 40 cfs during the 100-year event which was not previously considered in the analysis and design of Bay Country or 119th and Central.

It is feasible to eliminate the flume at Bekemeyer and Pine Grove and to route major storm flows via Pine Grove south, Pine west, 119th St. West south, and Central west to Pond #6 in Bay Country. To do so walk grades should desirably be as follows: Pine Grove from Pine to Cindy: 0.55 ft. above top of curb Cindy from 119th St. W. to a point 300 ft. east: 0.7 ft. above top of curb 119th St. W. from Central to a point 900 ft. north: 1.0 ft. above top of curb Central from Bay Country pond to 119th St. W.: 1.0 ft. above top of curb

In summary, we recommend elimination of the flume at Bekemeyer and Pine Grove. We also recommend provision for walk grades of 1.0 ft. above top of curb along 119th St. West and Central Avenue as noted above.

MBC:cas

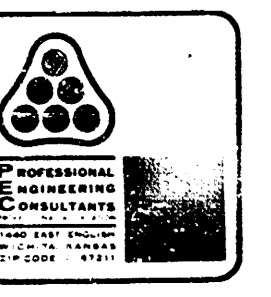


MEMO header with routing slip for Golden Hills Fifth Addition project, dated 8/16/88.

Transmitted herewith are two copies of the revised Drainage Plan for Golf Park West Addition.

This plan has been revised by adding a temporary drainage easement for the south 400' of the subject property. This will allow surface drainage from the west to continue to flow across this property. When the property to the west develops, their internal drainage would be diverted to the existing storm sewer in 19th Street via storm sewer hook-up. Mr. Carson has granted storm sewer easement on Lot 14, Block 1, WestLink Village 16th to accommodate this future storm sewer hook-up.

CSB/elm



MEMO header for page 1 of 13, project Golden Hills 5th Addition, Revised Drainage Calc's.

I. HYDROLOGY Use Rational Method Q = CIA

Table with columns: Node, Hyd. Soil Cp., Land Use, C1, C100. Lists nodes 120 through 100 with corresponding values for runoff coefficients.



MEMO header for page 2 of 13, project Golden Hills 5th Addition, Revised Drainage Calc's.

Determine "I"

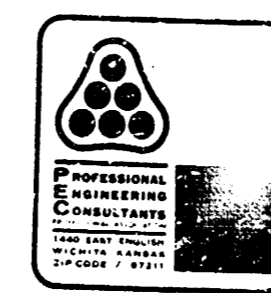
Table with columns: Node, Lc, I2, I100. Lists nodes 120 through 100 with corresponding values for travel times.



MEMO header for page 3 of 13, project Golden Hills 5th Addition, Revised Drainage Calc's.

Determine "A"

Table with columns: Node, Planimeter, Area SF, Area Ac. Lists nodes 120 through 100 with corresponding values for drainage areas.



MEMO header for page 4 of 13, project Golden Hills 5th Addition, Revised Drainage Calc's.

Determine "Q2"

Table with columns: Node, C2, I2, A, Q2. Lists nodes 120 through 100 with corresponding values for 2-year return period discharge.



MEMO header for page 5 of 13, project Golden Hills 5th Addition, Revised Drainage Calc's.

Determine "Q100"

Table with columns: Node, C100, I100, A, Q100. Lists nodes 120 through 100 with corresponding values for 100-year return period discharge.



MEMO header for page 6 of 13, project Golden Hills 5th Addition, Revised Drainage Calc's.

II. INLET SIZING

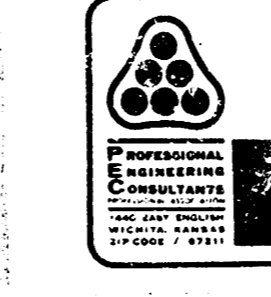
Table with columns: Node, Q2, Inlet Condition, Gmax 5' Inlet, Gmax 10' Inlet, Use Inlet. Lists nodes 120 through 100 with inlet sizing details.



MEMO header for page 7 of 13, project Golden Hills 5th Addition, Revised Drainage Calc's.

III. STREET FLOW - 2 YR

Table with columns: Node, Q2, Distribution, Street Slope, d, dmax, Comment. Lists nodes 120 through 100 with street flow details.



MEMO header for page 7A of 13, project Golden Hills 5th Addition, Revised Drainage Calc's.

Street Flow - 2 Yr (continued)

Table with columns: Node, Q2, Distribution, Street Slope, d, dmax, Comment. Lists nodes 107 through 100 with street flow details.



MEMO header for page 8 of 13, project Golden Hills 5th Addition, Revised Drainage Calc's.

Street Flow - 100 Yr

Table with columns: Location, Contributing Areas, Q100, Qpipe, Qstreet, Street Slope, Gmax, Comment. Lists nodes 120 through 100 with 100-year return period flow details.



MEMO header for page 8A of 13, project Golden Hills 5th Addition, Revised Drainage Calc's.

Street Flow - 100 Yr (continued)

Table with columns: Location, Contrib. Areas, Q100, Qpipe, Qstreet, Street Slope, Gmax, Comment. Lists nodes 120 through 100 with 100-year return period flow details.