CITY OF AUBURN HILLS

ENGINEERING STANDARDS

REVISED DATE: 06.16.2022

AUBURN HILLS

REVISIONS

1. 9-2-2008 – Added Appendix K Auburn Hills Fire Department Ladder Truck Turning Template, updated language on page 25, Section B. Public ROW, Item #7
2. 4-30-2009 – Revised AH-Appendix D Standard Notes & Fire Department Notes to include paint supplier and item numbers required for steamer cap paint
3. 2018 – Revised Appendix K Auburn Hills Fire Department Ladder Truck Turning Template
4. 6-16-2022 Updated per new OCWRC standards and EGLE comments

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GENERAL PLAN SUBMITTAL REQUIREMENTS AND REVIEW PROCEDURES

I. PLAN SUBMITTAL PROCEDURES

A. The plan review and approval process consists of two (2) separate review submittals as required by the Community Development Department (CDD). The City's engineer conducts these reviews, which must be completed before construction can begin.

B. The first review submittal is of the SITE PLAN.

1. The SITE PLAN must show the existing site conditions, as well as all proposed improvements inclusive of paving, grading, storm sewer, detention/retention, sanitary sewer and water main service. A Development Application Packet, which includes an application, a checklist, a contact list, a fee schedule and information regarding Campaign Contribution Disclosure, can be found on the CDD website. (http://www.auburnhills.org/)
    a. Once all applicable City Departments give approval, the SITE PLAN must be presented for approval to the Planning Commission and City Council. A review of the impacts on any existing woodlands or wetlands is conducted prior to being presented to the Planning Commission and City Council as well.
    b. Upon receipt of the Planning Commission and City Council approval of the SITE PLAN, an Engineering Plan Review application, a signed and sealed cost estimate and three (3) sets of signed and sealed engineering plans for site improvement are to be submitted to the CDD.
2. The second review step for a project is the ENGINEERING PLAN review. The ENGINEERING PLAN must address the same concerns as the site plan but shall include the required information in greater detail. The application for this submittal can also be found on the CDD website.

II. PREPARATION OF THE SITE IMPROVEMENT PLAN

A. **ALL SITE IMPROVEMENT SUBMITTALS MUST ORIGINATE AT THE COMMUNITY DEVELOPMENT DEPARTMENT (CDD). Electronic plans shall be submitted in addition to hard copy plans.**

B. Plans are forwarded from CDD to the City Engineer. The engineers will review the total site for the City, concentrating on water, sanitary, storm water detention/retention and soil erosion control. Site grading and paving will be checked as part of the storm design. A cost estimate for all site work including utilities, earthwork, retaining walls, and landscaping as well as all relevant calculations are required, as noted in these Standards. If additional information is needed, the City Engineer will contact the Design Engineer directly.

1. As part of the review process, the City Engineer may contact the CDD, the Department of Public Works (DPW), Fire Department and Police Department for comments and feedback. If other agencies (MDOT, RCOC, etc.) have not completed their reviews, City Engineer may request that their comments be supplied to City Engineer prior to final approvals.
2. When plans are complete and ready for approval the City Engineer will request additional sets of plans be submitted for distribution to regulatory agencies for public improvements. In general, 4 sets of water main plans, 3 sets of sanitary sewer plans and 7 complete construction sets **and a PDF** of the final approved plans (for distribution to other City Departments) are required. The permitting plans shall include a location map, a quantity list with private and public main or sewer indicated, a utility plan sheet, and the current City of Auburn Hills Standard Water Main or Sanitary Sewer Detail Sheets. All plan sets must be signed and sealed by an engineer registered in the State of Michigan.
3. A water main permit is required for the addition of public main in excess of 100'. Water main plans (4 hard copies) along with a completed Michigan Department of Environment, Great Lakes, and Energy (EGLE) Permit Application for Water Supply Systems (Act 399 of 1976, as amended) shall be provided to the City Engineer. The most recent version of the application and the checklist can be obtained on the EGLE website, https://www.michigan.gov/egle/. The applicant must complete the *Project Basis of Design*, including Item F by conducting a flow and pressure test on an existing hydrant in the vicinity of the project. This test can be scheduled by contacting the DPW at (248) 391-3777. The WSSN for the City of Auburn Hills is 5450. The City Engineer will provide the flow rates and units for Items G and H on page five of the application. The City Engineer will have the DPW Director or Utilities Manager execute the permit application and then will forward the application and plans to EGLE (and the Great Lakes Water Authority (GLWA), if necessary) for their approval and permitting. It is recommended that the design engineer complete the Streamlined Water Main Permit Certification Checklist in order to expedite permit issuance.
4. All public sanitary sewer extensions require a construction permit per Part 41 of Act 451 of 1994, as amended. Sanitary sewer plans (3 hard copies and 1 electronic copy) along with a completed EGLE Sanitary Sewer Permit Application (Part 41 of Act 451 of 1994, as amended) shall be provided to the City Engineer. The City Engineer will have the DPW Director or Utilities Manager execute the permit. The Applicant shall provide the City Engineer with a sanitary sewer basis of design for use in the permit application. The City Engineer will submit the permit application to Oakland County Water Resource Commission (OCWRC) through their Self Service Permitting Portal. Upon OCWRC approval, the plans will then be forwarded to GLWA and finally to EGLE for permitting.
5. All public improvement plans submitted for permits must carry the seal and signature of the Design Engineer along with the approval stamp of the City of Auburn Hills. Note that lineal footage and type of sanitary and/or water main pipe must be summarized on the cover sheet and, depending on which permit is

necessary, the City of Auburn Hills Standard Water Main or Sanitary Sewer Details included when EGLE permitting is required.

6. Upon final plan approval and receipt of all permits, but prior to commencing construction, a pre-construction meeting shall be held.
    a. The Developer or Developer's Authorized Representative shall contact the City Engineer to schedule the pre-construction meeting. The following attendees are required, at a minimum, from the developer's team: the Developer or Developer's Authorized Representative, the Design Engineer, the General Contractor and/or the Underground Contractor and the Paving Contractor. Prior to scheduling the Pre-construction Meeting, proof of payment of the required construction escrows and right-of-way (ROW) cash bonds (if required) as specified in the Engineering Plan approval letter shall be submitted to the City Engineer.
    b. The contractor shall provide, at the Pre-construction Meeting, proof of general liability insurance (project name appearing in description area) naming the City of Auburn Hills and its Engineer as additionally insured. Policies are required to provide coverage up to $2,000,000 for each occurrence and $4,000,000 aggregate. Standard language regarding cancellation will be upgraded to "30 days written notice" for cancellation and the language "failure to do so shall impose no obligation or liability of any kind upon the insurer, its agents or representatives" will be removed or crossed off. An additional insured endorsement must be submitted with the certificate of insurance. Blanket additional endorsements will **not** be accepted. The additional insured endorsement shall name the City of Auburn Hills and its Engineer. Additionally, the endorsement policy number shall be referenced back to the general liability insurance certificate. See *Appendix A* for an example of a properly completed insurance form and additional insured endorsement. Language stating "where required by written contract" shall not be used.
    c. The final approval letter from the City Engineer will detail the total amount of fees required for the project, which typically include construction escrow, a ROW cash bond, and Maintenance & Guarantee Bond. The ROW cash bond shall cover any repair to damage within the public ROW that may result from the proposed improvements. Typically the bonds are required for new drive approaches or removal and replacement of roadways or asphalt pathways/concrete sidewalks. A description of the basis for the escrow and bonds can be viewed in *Appendix B*, as well as the approved form for the Maintenance & Guarantee Bond.
    d. Final occupancy permit will require a passing DPW final inspection, approval of reproducible record plans, maintenance and guarantee bond, and signed easements including a legal description and sketch. A grading certificate may also be required if requested by the City of Auburn Hills and a disk in a layered format acceptable for incorporation into the Auburn Hills GIS system (see *Appendix C* for criteria regarding acceptable

format). An ADA Certification Form will also be required, if applicable and can be found in Appendix H.

e. Unused construction escrow funds and ROW cash bond will be eligible for return as described in the final approval letter.

III. PERMITTING AGENCIES

CITY DEPARTMENTS:

Community Development Department
Steve Cohen, Director of Community Development
1827 N. Squirrel Road
Auburn Hills, Michigan 48326
Phone: (248) 364-6900

Community Development Department
Shawn Keenan, City Planner
1827 N. Squirrel Road
Auburn Hills, Michigan 48326
Phone: (248) 364-6900

Department of Public Works
Stephen Baldante, Director
1500 Brown Road
Auburn Hills, Michigan 48326
Phone: (248) 391-3777

CITY ENGINEERS:

Orchard, Hiltz & McCliment, Inc.
Andrew Cousino, P.E.
2365 Pontiac Road
Auburn Hills, Michigan 48326
Phone: (734) 522-6711

OTHER REVIEW AGENCIES:

Great Lakes Water Authority
6425 Huber Street
Detroit, Michigan 48211-1677
Phone: (313) 964-9800
Fax: (313) 964-9810
Phone: (313) 964-9871

Oakland County Water Resource Commission
One Public Works Drive
Waterford, Michigan 48328-1907
Phone: (248) 858-0958

Road Commission for Oakland County
2420 Pontiac Lake Road
Waterford, Michigan 48328
Phone: (248) 858-4804

OTHER REVIEW AGENCIES (cont.):

Michigan Department of Transportation
Lansing Headquarters
State Transportation Building
425 W. Ottawa St.
P.O. Box 30050
Lansing, Michigan 48909
Phone: (517) 373-2090

Metro Region Office
18101 W. Nine Mile Road
Southfield, Michigan 48075
Phone: (248) 483-5100
Fax: (248) 569-3103

Oakland TSC
800 Vanguard Drive
Pontiac, MI 48341
Phone: (248) 451-0001
Fax: (248) 451-0108

Michigan Department of Environment, Great Lakes, and Energy
Lansing Headquarters
Phone: (517) 373-7917

SE Michigan District Office
27700 Donald Court
Warren, Michigan 48092-2793
Phone: (586) 753-3700
Fax: (586) 751-4690

IV. ADDITIONAL PERMITTING INFORMATION

A. A ROW Permit from the Road Commission for Oakland County (RCOC) is necessary for work within ROWs maintained by RCOC. Roads maintained by RCOC within the City limits:

1. Opdyke Road (Lapeer Road to South Boulevard)
2. Walton Boulevard (Pontiac City Limits to Rochester Hills City Limits)
3. South Boulevard (Opdyke Road to Adams Road)
4. Dutton Road (Lapeer Road to Rochester Hills City Limits)
5. Brown Road (Baldwin Road to Lapeer Road)
6. Adams Road (Rochester Hills City Limits to South Boulevard)
7. Rohr Road (Orion Township Limits to Lake Angelus Road)
8. Lake Angelus Road (Rohr Road to Baldwin Road)
9. Baldwin Road (Brown Road to Pontiac City Limits)

B. A ROW Permit from the Michigan Department of Transportation (MDOT) is necessary for work within ROWs maintained by MDOT. Roads maintained by MDOT within the City limits:

1. I-75 (Orion Township limits to Bloomfield Township limits)
2. Lapeer road (M-24) (Orion Township limits to Pontiac City limits)
3. M-59 (Pontiac City limits to Rochester Hills City limits)

C. Roads co-maintained by the City of Pontiac within the City limits:

1. Collier Road (Joslyn Road to Stirling Road)
2. Commonwealth Road (Walton Boulevard to Pontiac City Limits)

D. The Design Engineer shall submit plans to RCOC for review of any work proposed within County rights-of-way. The City will request the developer/engineer to submit the RCOC review comments and Permit prior to final City approval. Note that the City's standards for entrance drive or other improvements may be more stringent than RCOC requirements.

E. On state highways, approach improvements or use of drainage facilities must have approval of the Michigan Dept. of Transportation (MDOT). The Design Engineer shall submit plans to MDOT for review of any work proposed in state rights-of-way. The City will request the Developer/Design Engineer to submit the review comments and Permit prior to final approval.

F. OCWRC is the Soil Erosion Control Agent for all work performed in the City, and also reviews all work associated with County drains, i.e. tapping an existing drain, work within a County drain easement, etc. Plans should be submitted to OCWRC for all sites greater than one acre or within 500' of a lake or stream. The City will require a Soil

Erosion and Sediment Control (Part 91 of Act 451 of 1994) Permit prior to final approval. Upon receipt of the Part 91 permit, all sites with construction activity that disturbs more than one (1) acre of land must submit a Notice of Coverage to EGLE Surface Water Quality in Lansing. Forms are available at the EGLE website, https://www.michigan.gov/egle/. Notice of Termination is also required upon completion.

G. Capital, lateral and tapping fees are assessed by the DPW for sanitary sewer and water main taps, respectively and must be paid prior to the request for a pre-construction meeting. Contact the Auburn Hills DPW for more information, (248) 391-3777 or view the fee listing on their website, http://www.auburnhills.org/.

APPLICABILITY

1. These standards shall apply to development and redevelopment projects within the City's municipal boundary, with the exception of the following, where it does not conflict with State or Federal requirements:
    a. City road projects that involve reconstruction or rehabilitation of existing road sections, or projects that reduce the overall impervious area.
    b. Resurfacing of an asphalt, concrete, or similar surface (i.e. 'mill and fill') that does not result in replacement of the onsite drainage system or exposure of aggregate.
    c. The practices of clearing, plowing and tilling soil and harvesting for the purpose of crop production.
    d. The project does not meet the development or redevelopment criteria in these standards.
    e. The development or redevelopment project is for one single family detached dwelling that is not part of a common plan of development.
    f. The development or redevelopment project is for emergency maintenance and work performed to protect public health and safety.
    g. Planned developments (if existing storm water infrastructure is in place but outdated per the current standards, credit can be given for existing storm water infrastructure but the overall site will need to be brought up to current treatment standards)
    h. The development or redevelopment project discharges solely to a RCOC stormwater system or right-of-way. Contact RCOC permit staff for specific storm water requirements.
    i. Other exemptions listed herein or approved by the City of Auburn Hills.

ENGINEERING PLAN REQUIREMENTS

I. PLAN REQUIREMENTS

A. GENERAL

1. It is recommended that plans be submitted on 24" x 36" paper.
    a. Minimum horizontal scale: 1" = 50'
    b. Minimum vertical scale: 1" = 5'
2. A general plan at 1" = 100' or 1" = 200' needs to be included when the size of site prohibits a single plan sheet at 1" = 50'. Provide street names, units, utilities, pavement, site dimensions, and phase lines on the general plan. Setbacks and building separations shall be noted in accordance with the zoning requirements and the approved site plan.
3. A cover sheet including project name, location map showing major thoroughfares & section number, proprietor, engineer & architect contact information (necessary

for forwarding review comments), and Professional Engineer (State of Michigan) stamp and original signature shall be submitted with the plan set.

4. A title block shall be used for each sheet.
5. Appropriate sidwell numbers, lot number (if multiple lots), parcel dimensions, property zoning, building use and adjoining rights-of-way shall be shown. Additionally, the property owners and zoning shall be shown for all adjacent properties.
6. The City of Auburn Hills Standard Notes and City of Auburn Hills Fire Department Notes shall be included in the plan set. See *Appendix D* for a copy of these notes. The City of Auburn Hills Standard Details (available for download on the CDD website) are required with the permitting and final plan submittals.
7. A minimum of two benchmarks must be shown on the general plan. See *Section II Topographical Survey* for additional requirements.
8. A legal description of property shall be included. The description must have an error of closure no less than 1': 5000'.
9. A striping and traffic control plan for parking lot that indicates the proposed loading area must be included in the submittal.
10. A plan sheet that shows landscaping in accordance with zoning requirements and the approved Site Plan shall be provided. All utilities shall be shown on the landscaping plan.
11. The project's tree survey information shall also be provided (it should not differ from information submitted to the CDD for site plan review). The developer's engineer shall be responsible for coordinating tree removal plans with construction plans. Grading limits shall be shown on the tree removal plan.
12. Wetland limits and size shall be clearly shown, regardless of size/regulation status.
13. Easements for off-site work (grading, sewer, tap, etc.) must be submitted prior to construction. Appropriate notes shall be provided on the site plan.

II. TOPOGRAPHICAL SURVEY

A. GENERAL

1. Topographical survey shall be no older than 3 years.
2. Indicate a minimum of 2 Benchmarks based on NAVD88 or NGVD29 (USGS).
3. Show property lines indicated by bearing and distance.
4. The existing elevations shall be provided so that the drainage pattern can be established. A minimum distance of 100' beyond the property lines must be shown. Use contours at the following spacing:
    a. Scale of plan is less than or equal to 1"=50' 1' contours
    b. Scale of plan is greater than or equal to 1"=50' 2' contours
4. Proposed elevations shall be shown at property corners and along property lines with sufficient on-site elevations or contours to establish site drainage.
5. Show all existing conditions, including but not limited to: ditches, culverts, utilities (invert and casting elevation), sidewalks, power poles, easements, building footprint and finish grade, finish grade of adjacent buildings, wetlands and woodlands, flood plains etc.
6. Show existing adjacent roads with ROW. Grades must be shown at ditch centerline, top of bank, edge of shoulder, edge of pavement or top of curb and pavement centerline. Grades must be shown on both sides of the road.
7. Show the locations of all existing gas, electric, cable and phone lines.

III. UTILITIES (GENERAL)

A. GENERAL

1. No new utilities to be placed underneath building footprint. For existing utilities to be abandoned within the influence of the foundation, the following criteria shall apply:
    a. Abandoned utility less than 5' below footing---Remove existing utility.
    b. Abandoned utility more than 5' below footing ---Grout existing utility full as directed, using standpipe to prevent air voids. Provide calculations showing the volume (in cubic feet) of grout required on plans.
    c. Abandoned utility not within influence (assume 1:1 trench) of footing---bulkhead as required by City, unless utility is determined by the City to be a hazard, nuisance, or potential maintenance problem. Existing utilities proposed to be abandoned below footings must be approved by the building department.
2. Water Main, Sanitary Sewer, and Storm Sewer must be extended across property frontage(s) or to a property line as directed by the City.
3. Provide a sleeve (casing pipe) when utilities must cross retaining walls.
4. No water main or sanitary sewer will be allowed within five (5) feet, measured horizontally, of the high water elevation of basins.
5. All utilities shall be shown on the site, engineering, and as-built plans, including those that will not be City maintained. All utility crossings shall specify top and bottom of pipe elevations.

6. No trees shall be planted in the sanitary sewer, storm sewer or water main easements.
7. Proposed franchise utilities (including but not limited to gas, electric, fiber optic) shall be shown on the engineering plans.
8. Utilities shall be placed in the greenbelt where practicable. A minimum 25-foot greenbelt shall be provided abutting public right-of-way and private road easements and shall be kept free of parking.

IV. WATER MAIN

A. GENERAL

1. Quantity list on the cover sheet or utility sheet of the plans. (This location is required for permitting purposes.)
2. Looped water main may be required based on City review.
3. 10' horizontal separation required between water main and either sanitary or storm sewer. All other utilities shall be located outside the limits of the water main easement. (See item 7 below.)
4. 18" minimum vertical clearance between water main and all utilities, i.e. storm, sanitary sewer, electric, gas, phone, etc. Top and bottom of pipe elevations shall be indicated on the profile with crossing noted on plan view.
5. All fittings, valves, hydrants shall be dimensioned from property corners or located by State Plane Coordinates.
6. Cut in tees shall be used to connect to existing mains unless connection cannot be made without interrupting service. All tapping sleeve valve and well (TSV&W) connections shall be approved by the City Engineer prior to use. A like sized tap (i.e. the proposed main is the same size as the main to which it will connect) can only be constructed when the existing main is ductile iron. Additionally, a mechanical tapping sleeve must be utilized, not the typical stainless steel tapping sleeve. A gate valve and well is also required at all extensions of municipal water main.
7. No live taps shall be made to existing asbestos cement water main.
8. Minimum 12' wide exclusive easement must be shown on the plans and must extend to the property lines where future connections are anticipated.
9. Water main cover shall be 5.5' to top of pipe, with 4' minimum allowed at ditch/utility crossings, in conformance with City of Auburn Hills Standard Water Main Details.
10. Taps for domestic water service from the fire service lead are not permitted, per Fire Department requirements.
11. Testing:
    a. Bacteria samples shall be obtained by a licensed testing agency with a City Inspector and the Contractor witnessing. The Contractor shall contact the City Engineer for scheduling.
    b. Prior to bacteria testing, the City Engineer will conduct pressure testing on behalf of the City. The Contractor shall contact the City Engineer for scheduling.
12. Tracing wire shall be provided for all water main and appurtenances (including service leads, hydrants and gate wells), regardless of pipe material. When PVC is

installed for a service line, tracing wire shall be run from the meter setup to the curb box. Wire shall be solid copper, 12-gauge stranded and blue. Tracing wire and installation of tracing wire for water main shall conform to the City of Auburn Hills Standard Water Main Details and AWWA Standards.

B. MAINS

1. Minimum size water main (exclusive of hydrant leads) is 8", with the following maximum dead-end main lengths:
    a. 75' for 6" fire hydrant lead
    b. 450' for 8" main
    c. 1000' for 12" main

   All dead-end mains must end with a gate valve, well, and hydrant. Maximum lengths are subject to modification based on City review, and may require submittal of calculations showing adequate fire flow and daily turnover.
2. Profiles are required on all water main.
3. Pipe size, length and type shown in plan view for each run of pipe. Material requirements are as indicated on the current Standard Details.
4. Use of 90° bends shall be eliminated, and may be placed only if specifically approved in writing by the City. Minimum length between bends shall be two (2) pipe diameters. Maximum preferred bend size is 45°.
5. Domestic and fire protection services shall be allowed on 8" to 16" water mains only. All water services must be connected directly to the water main. All valves shall be located in a public ROW or easement, and in the greenbelt where practicable.
6. Length, size, and invert of casing and pipe shall be shown at all bore locations. Casing pipe is required in the event a water main must pass under a structural retaining wall, and must extend beyond the angle of repose of the retaining wall. Every attempt must be made to direct the water main around any structural retaining wall.
7. Joints shall be restrained per manufacturer or as approved by City Engineer, tied or harnessed at all deflections of 11¼° or greater, behind tee outlets, at hydrant shoes, at plugs or caps and at any crosses to prevent lateral movement of the pipe. Concrete thrust blocks will not be permitted, unless specifically allowed by the City Engineer. Where allowed, concrete thrust blocks shall bear against undisturbed earth in all instances and shall have sufficient bearing area to develop the full resultant axial thrust of the pipe at test pressure. The concrete thrust block shall not cover fastener nuts and/or threaded connections that would hinder future maintenance or repairs of fittings or valve assemblies.
    a. Ductile Iron Joints, where required, shall be restrained by an approved mechanical restraining gland or instant push-on restraining device.
    b. Push-on Joints shall be restrained with approved instant joint-retaining device such as Field Lok Gasket manufactured by U.S. Pipe Company or approved equal. A restraining schedule must be submitted and approved by the City Engineer prior to installation and can be obtained from the pipe manufacturer.
    c. Mechanical Joint-Retaining Glands where allowed shall be the “Megalug Series” as manufactured by EBAA Iron or approved equal.

d. Thrust blocks, where allowed, shall be made of 3,000 psi concrete and of adequate size and shape to resist all design working and surge pressures to which the main will be subjected.
e. All joint materials and lubricants shall be furnished with the pipe, including all material required for connection to existing water mains and appurtenances.
f. Harnessed joints and steel reinforced concrete anchorage will be required on pipes larger than 16" diameter.

C. VALVES

1. Valve spacing: 800' maximum inline, or less, based on requirements of item #2.
2. The following requirements need to be met in the event of a breakage:
    a. A maximum of three valves shall be used to isolate break.
    b. No more than 2 hydrants can be out of service.
    c. No more than 24 single family units or 30 multiple units out of service.
    d. Subject to modification based on Fire Department review.
3. Valves shall generally be located outside of sidewalk/pathway.
4. Gate wells are required for all valves that are 6" diameter and larger. Valves that are 2" and smaller only require a box. Valves between 2" and 6" that require a tapping sleeve for installation shall be placed in a well, otherwise a box is acceptable.

D. HYDRANTS

1. Hydrant spacing:
    a. Residential: 300' maximum
    b. Commercial, industrial or multiple: Spacing of hydrants shall be considered as individual cases, and shall be determined by consultation with the Fire Department and Manager of Water and Sewer.
2. Hydrants must be protected by 6" curb in parking areas. The City can at its discretion approve standard hydrant posts.
3. No parking within 10' of a hydrant.
4. Hydrants to be placed between 3' and 10' of the back of curb.
5. Hydrants and leads shall be restrained joint only, per Standard Detail Sheet. Thrust blocks are not permitted at hydrants.
6. Gate wells should not be used for hydrants; all hydrants shall be installed in boxes.
7. Any hydrant proposed for relocation shall be the current required model per the Water Main Standard Details; if not, a new hydrant shall be used. A note shall be placed on the plans stating this requirement.

E. METERS

1. Approved meters shall be installed in all pump houses.
2. All users (homes, businesses, commercial buildings, etc.) shall have approved type meters installed. Contact Auburn Hills DPW at (248) 391-3777.

F. WELLS

1. All wells, pumps and pump housings shall be permitted and constructed as required by current Oakland County and Michigan Department of Public Health requirements, standards, and specifications.
2. Private wells must be separate and independent of the City water system.
3. Where a well is to be abandoned, it shall be capped as required by Oakland County and Michigan Department of Public Health requirements, standards, and specifications.

G. METERS AND SERVICE LINES

1. The City of Auburn Hills Water Department will make the tap only on all water services 2 or fewer inches in diameter. The contractor will be responsible for installing the lead.
2. All water service connections shall include corporation stops, service pipe, and either curb stops and boxes (for 2" and smaller), valve and box (for 2" to 6"), or gate valve and well (for larger than 6"). Where possible, the curb stops and box shall be set in the road ROW, 6" from the property line. Otherwise, all curb stops and boxes shall be located within a dedicated water main easement.
3. Stops and boxes shall not be placed within existing or proposed pavement, unless there is no alternative, or if otherwise required by the City. Stops placed within existing or proposed pavement will be required to be housed in a valve box and cover. Stops and boxes shall be placed within the water main easement unless otherwise authorized by the DPW or OHM.
4. Water service size shall be 1" minimum.
5. All water service pipe up to 2" diameter shall be either Type K soft copper or PVC with a pressure class of 200 psi to the meter. If PVC is used, a tracing wire shall be run from the meter setup to the curb box.
6. All water services greater than 2" diameter shall be Class 54 ductile iron pipe.
7. Meters shall be purchased from the City of Auburn Hills Water Department.
    a. 3/4" and 1" meters shall be installed by the City.
    b. 1-1/2" (or larger) meters shall be installed by a licensed plumber.

H. MATERIALS AND CONSTRUCTION METHODS

1. All proposed water systems shall be constructed in compliance with these standards and the City of Auburn Hills Water Main Standard Details. The current allowable water main material types are as follows unless otherwise approved in writing by the City of Auburn Hills:
    a. Ductile Iron Class 54 (for sizes 6” - 16”)

V. SEWERS (SANITARY/STORM)

A. GENERAL

1. Storm and sanitary sewer size, grade and manhole spacing table:

Size	Std. Grade (%)	Min. Grade (%)	Max. Grade (%)	Std. Run (Ft)	Max. Run (Ft)
10"*	0.60	0.30	6.2	300	350
12"**	0.40	0.22	6.0	300	350
15"	0.24	0.16	3.6	300	350
18"	0.18	0.12	2.8	300	400
21"& greater	0.14	0.10	2.2	300	400

* The minimum allowable public sanitary sewer size is 10" diameter.

** The minimum allowable public storm sewer size is 12" diameter.

2. The following must be shown on plan view for storm and sanitary sewer plans:
    a. Size of pipe
    b. Length between structures
    c. Easement (where required)
    d. Progressive numbering system for all structures.
3. Profiles must be shown with the following information for storm and sanitary sewer plans:
    a. Length, type, class, size and slope of pipe between structures
    b. Top of casting and all sewer inverts at all structures
    c. Existing and proposed ground elevations
    d. All utility crossings
    e. Special backfill areas, i.e., compacted sand
    f. Provisions for infiltration testing (sanitary sewer only)
    g. Progressive numbering system
4. All structures shall be dimensioned from property corners or located by State Plane Coordinates.
5. A structure will be required at all changes in alignment, size or grade and at all junction points.
6. No "blind" taps of mainline sewer shall be allowed into the existing system. All such taps will require the installation of a standard structure (i.e. manhole or catch basin). Taps for sewer leads do not require a structure.
7. Where Manning's equation is required to compute flow, minimum value for "n" shall be 0.013 for sewers (even if a smoother pipe is accepted), 0.025 for culverts, and 0.035 for open channels.
8. All sewer construction is required to maintain a minimum 10' horizontal separation between the sewer and water main. Additionally, an 18" minimum vertical clearance is required between the sewer and water main.

VI. SANITARY SEWER

A. GENERAL

1. Indicate building lead size, locations and invert elevation at building or finish grade of building. (Minimum 6" diameter at 1% slope.) Verify and indicate elevations at crossings with all other utilities.
2. Testing:
    a. City Engineer and Oakland County WRC will inspect sanitary taps into existing structures. The Contractor shall contact City Engineer and County. See sewer inspection permit from Oakland County for their contact information.
    b. Sanitary air test will be conducted by Oakland County DPW with City Engineer witnessing. The Contractor shall contact City Engineer for scheduling. The Contractor shall perform and pass a preliminary air test with City Engineer witnessing prior to final test being scheduled.
3. Added depth may be required for sewer extensions to provide future service to the sewer district.
4. In sanitary sewers where construction of building sewers (leads) to the property line is not required, a wye branch (tees not allowed) shall be installed for each lot or potential building site.
5. Minimum 20' wide exclusive easement. Increase may be required due to depth of sewer.
6. Leads shall not be connected to manholes unless specifically approved by the City for a connection to the last manhole.
7. Lift stations will not be allowed unless there is no other alternative for sewer service. If a lift station is required, the Design Engineer shall provide the City with all design details and calculations.
8. Prior to acceptance of the sewer, the developer or contractor shall provide a videotape or approved digital image file of the sewer (with flows) to the City. The video shall be taken no less than 30 days after installation.
9. Casing pipe is required in the event a sanitary sewer must pass under a structural retaining wall, and must extend beyond the angle of repose of the retaining wall. Every attempt must be made to direct the sanitary sewer around any structural retaining wall.
10. Tracing wire shall be provided for all sanitary sewer and appurtenances (including service leads and manholes), regardless of pipe material. Wire shall be solid copper, 12-gauge stranded and green. Tracing wire and installation of tracing wire for sanitary sewer shall conform to the City of Auburn Hills Standard Sanitary Sewer Details.
11. All sanitary manholes shall be a minimum 5’ diameter.

B. MATERIALS AND CONSTRUCTION METHODS

1. All proposed sewer systems shall be constructed in compliance with these standards and the City of Auburn Hills Sanitary Sewer Standard Details. The current allowable sewer material types are as follows:
    a. Building Leads – S.D.R. 23.5 ABS pipe or Schedule 40 PVC

b. Sanitary Sewer: PVC Truss Pipe (ASTM D2680) (Diameter - 15" or less)
c. Reinforced Concrete Pipe (Sanitary Sewer: Diameter – 18" or larger)
    i. RCP CL. IV for a depth up to 14 feet
    ii. CL. V for a depth 14 feet to 24 feet
    iii. Special design for depth greater than 24 feet
    iv. RCP CL. III may be allowed in some cases if engineer provides calculations to show CL. III pipe can withstand the loading.

B. DESIGN CRITERIA

1. Quantity list and design data (on the cover sheet or utility sheet of the plans) in conformance with current 10 States Standards shall be included. See *Appendix E* for a copy of the OCWRC Schedule of Unit Assignment Factors and an example of a typical basis of design.
2. Velocity: Minimum = 2.0 fps; Maximum = 12.0 fps.
3. The maximum depth to invert of any sanitary sewer pipe shall not exceed 80% of the manufacturer's recommendation.
4. Whenever there is a change in direction in a sewer at a manhole, an allowance of 0.10 feet in grade shall be made for loss of head through the manhole.
5. Whenever there is a change in pipe size, the inverts of both sewers shall be set at a grade so that both sewers maintain the same energy gradient.
6. Minimum size for sewer shall be 10" diameter.
7. Materials, bedding, joints, manholes, and other appurtenances shall be as specified or shown on the Standard Details.
8. Siphons shall only be allowed when specifically approved by the City of Auburn Hills DPW and City Engineer.
9. 4' minimum cover required over mains and leads.

C. DROP CONNECTIONS

1. Drop connections shall be constructed according to the Standard Sanitary Sewer Details. A drop connection is required when there is an 18" vertical difference between inverts on outlet and inlet pipes. Drop connections are to meet the following requirements:
    a. If the drop manhole is to be part of the new construction, then a pre-cast base with integral drop connection shall be used.
    b. If the existing manhole is deemed large enough to accommodate an interior drop by the system owner (i.e. OCWRC or Auburn Hills DPW), then an interior drop that utilizes a drop bowl can be constructed. A minimum 5' diameter manhole will be required to construct an interior drop connection. No external drop connections will be permitted unless approved by the system owner.

D. INFILTRATION

1. The infiltration rate for all sanitary sewers shall comply with current Oakland County Standards.

E. PUMP STATIONS

1. Any proposed pump station shall be considered on a case-by-case basis by the DPW and City Engineer, according to existing and proposed site conditions and according to all current local, County and State requirements.

VII. STORM SEWER

B. GENERAL

1. It shall be unlawful for any person to interfere with or obstruct flow of surface water over easements for public utilities or to impede the flow of surface water across private property in a manner different from the approved grading plan and drainage pattern.
2. A storm district drainage map shall be provided for all plan submittals, showing the storm system, sub-areas contributing to each structure and/or system, along with the overall drainage district limits. Areas and structures should be labeled and correspond with the calculations.
3. Upstream (pass through) drainage shall also be accommodated. Smaller sites may only need to indicate the quantity of flow, contributing acreage, and point of entry (with an arrow, etc.). Larger sites will be required to provide a contour map, at no more than 1"=200'.
4. Where retention is required, storage volume must be provided for all acreage contributing to the basin, including that acreage off-site.
5. Where detention or retention is required, a sediment forebay designed to capture a volume equal to 15% of the Water Quality Volume and capture heavy sediment at inlet pipe locations shall be utilized.
6. Storage may be allowed by either an in-line or off-line basin. See the appropriate section of these Standards for basin requirements.
7. Discharge cannot be diverted onto adjoining properties.
8. Outlet shall be in accordance with the Master Storm Drain Plan.
9. Connections at storm structures: roof drains may flow overland or be connected at a structure; no direct tap connections are allowed. If sump discharge is connected to storm sewer, 4" is the minimum diameter pipe to be utilized.
10. Square structure covers can only be used as required for collection in conjunction with curb and gutter. Round grates shall be according to the Auburn Hills Standard Details. This criterion is required in public ROW, and recommended on all sites, due to the possibility that a square cover may fall into the structure when being removed.
11. Size the pipe downstream of outlet to carry the flow from all on-site and off-site contributing area for a 10-year storm event.
12. All storm drainage from truck wells and parking lots shall pass through an approved oil/gas separator structure. Capacity of the structure shall be based on the contributing area.
13. A note shall be added to the plans stating that the owner will regularly clean and maintain all storm sewer and detention basins.

14. Casing pipe is required in the event a storm sewer must pass under a structural retaining wall, and must extend beyond the angle of repose of the retaining wall. Every attempt must be made to direct the storm sewer around any structural retaining wall.
15. Side slopes of all open channels and/or ditches shall be no steeper than 1 vertical to 4 horizontal.
16. Tracing wire shall be provided for all sanitary sewer and appurtenances (including service leads and manholes), regardless of pipe material. Wire shall be solid copper, 12-gauge stranded and green. Tracing wire and installation of tracing wire for storm sewer shall conform to the City of Auburn Hills Standard Storm Sewer Details.
17. Property owner is responsible for tracking and completing all stormwater Operations and Maintenance (O&M) tasks for their stormwater systems. Property owners shall keep a stormwater O&M summary on file.

C. MAINTENANCE REQUIREMENTS

1. An executed Stormwater Management Operations and Maintenance Agreement for the proposed stormwater system shall be submitted prior to receiving final approval of the development. The City of Auburn Hills will not accept the responsibility for the maintenance of any stormwater system.
2. The maintenance plan must include the following:
    a. The locations of all the stormwater system components, structures and BMPs.
    b. Specific maintenance requirements for the stormwater components including the required inspection cycle, personnel, training, inspection activities, and preventative maintenance required to ensure that the stormwater system functions properly.
    c. The owner shall retain the services of a qualified individual, which may include a Licensed Professional Engineer, Certified Professional in Storm Water Quality (CPSWQ) NICET Certified Engineering Technologist in Stormwater and Wastewater System Inspection, or EGLE Certified Stormwater Operator (NPDES construction sites) to provide inspection and maintenance services.
    d. A log of all inspections, maintenance activities and repairs are required. The log must provide, the date of activity, name of person performing activity and the description of activity performed.
    e. Provisions for establishing and maintaining vegetation that is integral to the proper functioning of the stormwater system.
    f. Identify the entity responsible for the maintenance and/or repair of the stormwater system, including modifying or reconstructing the system, if the system does not function as designed.
    g. A schedule for implementing the activities necessary for proper functioning of the system.
    h. A maintenance agreement (template included in the Appendix) must allow the local government the right to access, inspect, and maintain the

stormwater system. The maintenance agreement shall allow the local community to complete the following:

i. Inspect the structural or vegetative BMPs;
ii. Perform necessary maintenance or corrective actions neglected by the BMP owner and charge the property owner the cost of the work plust 15%
iii. Track the transfer of the operation and maintenance responsibility of the BMP in the event of ownership of the property changes

i. A copy of the Stormwater Management Operations and Maintenance Agreement or Memorandum of Stormwater Management Operations and Maintenance Agreement shall be recorded at the Register of Deeds.
j. A copy of the executed agreement must be submitted for review and approval prior to the City's final approval of the project.

D. MATERIALS AND CONSTRUCTION METHODS

2. All proposed sewer systems shall be constructed in compliance with these standards and the City of Auburn Hills Storm Sewer Standard Details. The current allowable sewer material types are as follows:
    a. Building Leads – S.D.R. 23.5 ABS pipe or Schedule 40 PVC
    b. Storm Sewer: PVC (meeting requirements of ASTM F949, D3212 and F477) or HDPE (meeting requirements of ASTM M294, D3350, D3212 and F477) (Diameter – 12" or less, unless approved by City due to site conditions)
    c. Reinforced Concrete Pipe (Storm Sewer: All sizes)
        v. RCP CL. IV for a depth up to 14 feet
        vi. CL. V for a depth 14 feet to 24 feet
        vii. Special design for depth greater than 24 feet
        viii. RCP CL. III may be allowed in some cases if engineer provides calculations to show CL. III pipe can withstand the loading.
    d. Allowable H20/HS20 load rated smooth walled plastic pipe.

E. DESIGN CRITERIA

1. Design calculations shall be submitted with hydraulic grade line computed.
2. Attempt to keep hydraulic grade line (HGL) within pipe. At no time shall HGL be within two feet of the top of casting elevation. Where edge drain is used, HGL shall also be kept below invert of the edge drain. When starting HGL from an existing pond or other water area, the 100-year elevation shall be used.
3. Design shall minimize standing water in all storm sewers, existing and proposed.
4. Design: Q = CIA, Rational Method.
    a. 10-year storm, $I = 83.3/(T_c+9.17)^{0.81}$ with an initial $T_c = 15$ minimum for residential development; shall be less for non-residential development, based on the actual time of flow from the most distant point of flow measurement.
    b. Larger sites should use a more appropriate method of determining flow. For watersheds up to 20 square miles, the suggested method for determining surface runoff is the Soil Conservation Service (SCS)

Methodology. The computations should be based on the Type II rainfall distribution, 10-year, 24-hr storm. It is the responsibility of the design engineer to determine the best method to use for the site.

c. Typical composite runoff coefficient, C:

	C
Agricultural/Undeveloped	0.20
Single Family Residential	0.35
Multiple Family	0.55
Commercial & Industrial	0.70
Completely Paved/Open Water	0.95

i. These coefficients are recommended minimums and may not be sufficient based on City review - use surface runoff coefficients for each sub-area.

ii. A composite runoff coefficient of 0.74 will typically meet the 20% landscape requirement as set forth by the City (contact the Community Development Department for landscaping requirements.)

d. Typical surface runoff coefficients, C:

Surface	**C**
Open Water	0.95
Pavement	
Asphalt and Concrete	0.90
Brick	0.90
Aggregate	0.65
Roofs	0.90
Lawns	0.20

NOTE: Surface area of detention/retention ponds shall be considered to be open water. Calculations shall consider the pond area at the peak (100-year) storage elevation.

e. Velocity: Minimum = 2.5 fps; Maximum = 10.0 fps. Velocities exceeding 5 fps (or less depending on soils) will require erosion protection at outfall.

f. Use the “Manning” equation to calculate the flow capacity.

g. The runoff coefficient calculation must be included with plan submittal.

5. Sewer requirements:

a. All storm sewer shall be sized for the flow generated from a 10-year storm event. Calculations shall take into account both on-site and off-site contributing area.

b. All storm sewer shall be shown in profile.

c. 12" diameter minimum pipe size

d. 4’ diameter minimum for manholes and catch basins.

e. 2’ diameter minimum for inlets – allowable for use when only one 12” pipe is connected to the structure (discharge pipe) and when preceding a structure with a sump.

f. Minimum cover of 2'-6". MDOT "low head" required instead of cone/corbel if less than 4 feet of cover over pipe at structure, unless structure is 2' diameter. Plan & profile shall specify "low head" where necessary, and shall be constructed according to the Standard Details

g. Drainage inlets and catch basins shall be located as follows:
    i. To assure complete positive drainage of all areas of the development.
    ii. At all low points of streets and rear yards.
    iii. Such that there is no flow across a street intersection.
    iv. Such that there is a maximum of 500 feet of drainage from any particular point in the development to an inlet or catch basin.

h. All pipe connections at manholes shall be separated a minimum 1' between pipe walls with 40% of the manhole circumference intact. The design engineer shall provide details for all manholes with multiple pipe connections not meeting the requirements below:

MANHOLE INSIDE DIAMETER	MAX. PIPE SIZE FOR STRAIGHT-THROUGH INSTALLATION	MAX. PIPE SIZE FOR RIGHT-ANGLE INSTALLATION
48”	24”	18”
60”	36”	24”
72”	42”	36”
96”	60”	42”

i. If public, a minimum 12' wide exclusive easement granted to the City will be required unless within R.O.W. If storm sewer will be maintained by a subdivision Home Owners Association (HOA), a 12’ minimum easement granted to the HOA will be required.

j. A two (2) foot sump is required for any structure receiving surface runoff, except inlet structures.

k. All storm sewer shall be “premium joint” (rubber gasket).

l. Trench drains shall not be permitted.

6. Inlet headwater control or outlet tailwater control nomographs with proper “K” factors shall be used to determine culvert sizes.

VIII. DETENTION/RETENTION BASIN/BMPs

A. GENERAL

1. Water Quality Control (WQC) shall be implemented on site to achieve either of the following water quality standards: 80 mg/L, or 80% TSS reduction for the 1-inch event.
2. Infiltration (i.e., runoff volume-reducing) or water reuse Best Management Practices (BMPs) that achieve the required Channel Protection Volume meet the TSS requirements for only areas tributary to an infiltration BMP. If any areas on the site plan bypass infiltration BMPs, those areas must receive alternative TSS treatment.
3. In the event that an area on the site plan will bypass infiltration BMPs, it will be required to provide a sediment forebay or an equivalent mechanical treatment unit structure within the storm system, at each inlet point to the basin. They shall be designed with a volume equal to 15% of the Water Quality Volume and capture heavy sediment at inlet pipe locations. Sediment forebays and mechanical treatment units shall conform to the OCWRC Stormwater Engineering Design Standards and the formulas provided therein.

a. A mechanical treatment system (pre-treatment device) may be used in lieu of a sediment forebay. Treatment systems shall conform to the standards set forth by the New Jersey Department of Environmental Protection (NJDEP) for manufactured treatment systems, as defined at https://www.njstormwater.org/treatment.html, including inline and/or offline use, manhole diameter, size, and custom or multiple lines. Sizing calculations shall be provided. The NJDEP Certified Treatment Flowrate (cfs) for a manufacturer and model shall be greater than or equal to the calculated peak discharge for the site.
b. The forebay should be a separate cell from the main detention/retention basin and designed such that it will dewater within 48 hours. The outlet device must be designed to filter sediment, heavy pollutants and oil from the water flow.
c. The volume of detention/retention within the forebay, above any proposed permanent pool of water, can be considered when calculating total detention/retention volume required for a site.
d. The forebay must have a minimum depth of 2 feet to capture and prevent resuspension of sediment.
e. The separation between the main basin and the forebay shall be designed to allow overtopping of flows in a controlled and non-erosive manner.
f. An access route shall be provided for forebay/treatment unit maintenance. The access road shall be stabilized to accommodate heavy equipment for maintenance purposes and provide direct access to the inlet and outlet facilities. The road surface shall consist of a non-erosive, non-pollutant, and dust free material wherever possible.

4. Detention volume on a gravity outflow detention basin is defined as the volume of detention provided above the invert of the outflow pipe. Any volume provided below the invert of the outflow pipe will not be considered detention.
5. Detention basin must "pass thru" off-site drainage. Drainage area map shall include all off-site areas per storm sewer requirements.
6. All basins must drain entirely unless basin is part of overall landscaping plan. All basins shall have a positive dewatering method, such as by gravity flow or pump outlet. The average depth of permanent standing water shall greater than 10 feet.
7. Bottom must be sodded. 1.0% is the minimum bottom slope allowed.
8. Minimum 12" freeboard provided (at overflow) above 100-year storm elevation.
9. A proposed non-erodible overflow route must be shown on the plans and must be able to contain a 100-year storm event. Acceptable methods would include a control structure, overflow weir and swale, etc. Downstream drainage easements may be required for the overflow route.
10. The receiving watercourses shall be identified on the plan for the 100-year event by stating the route to the Clinton River or other outlet from Auburn Hills.
11. The developer shall make provisions for maintenance of the basin by the property owner(s). The City will not accept the responsibility for the maintenance of any basin or other site drainage feature. All platted subdivision developers must submit a maintenance plan, budget, and bond as part of the approval process.

12. Basins shall be fenced if side slopes exceed 1 on 6 (may be waived if Bldg. Dept. feels location and depth do not present a hazard and/or design is integral part of landscaping). Also applies to sediment basins.
    a. Fence minimum 6' high chain link with 8' access gate.
    b. Maximum side slope 1 on 3. Properly designed retaining walls may be utilized on any or all sides of a proposed basin. See Section XI "Retaining Walls" for wall requirements.

B. DESIGN CRITERIA

1. Oversize storm pipes or underground basin (with restricted outlet) may be allowed, subject to City review.
2. No rooftop or parking lot detention/retention is allowed.
3. Restricted outflow shall be 0.2 cfs/acre unless otherwise allowed/required by design of receiving drain. Note: Many areas of Auburn Hills require a more restrictive runoff rate. See *Appendix F* for a listing of allowable discharge rates for drainage districts within the City or contact OCWRC.
4. Provide calculations showing the required restrictor size to control the rate of outflow. The minimum restrictor size is three (3) inches in diameter.
5. Channel Protection Volume shall be implemented to the maximum extent practicable via BMPs. Soil infiltration rate testing shall occur by a licensed geotechnical engineer prior to construction of any BMPs to show adequate infiltration will occur. The required Channel Protection Volume is the post-development site runoff volume from a 1.3 inch rainfall event. BMPs shall be implemented to limit the increase of runoff volume. The following list is a partial list of Best Management Practices (BMPs):

    a. Green Roofs
    b. Bioswales
    c. Cisterns
    d. Rain Gardens
    e. Porous Pavement
    f. Native Landscaping
    g. Filter Strips
    h. French Drains
    i. Level Spreaders
    j. Dry wells

6. Channel Protection Volume shall be calculated based on the Oakland County Channel Protection Volume Control section of the Stormwater Engineering Design Standards as shown in Appendix F. Channel Protection Rate Control (CPRC) per the Oakland County Stormwater Engineering Design Standards is based on a 2-year/24-hour storm. Extended Detention is required. See *Appendix F* for a sample calculation.
7. As an incentive, all sites that implement BMPs may subtract the Channel Protection Volume from the required 100-year detention volume. The resulting volume cannot be less than the Extended Detention Volume.
8. Infiltration BMPs are prohibited in areas containing contaminated soils/groundwater, wellhead protection areas, high seasonal groundwater as defined in the Oakland County Stormwater Engineering Design Standards, and in areas with hotspot activities or setback restrictions (foundations, property lines, drinking wells, septic fields, pavements etc.).
9. Sediment forebays shall be sized to handle the runoff generated by all improved site area during a 1-year storm event, based on the Oakland CountyWater Quality Control section of the Stormwater Engineering Design

Standards. Volume calculations must be provided for each contributing area. See *Appendix F* for a sample calculation.

10. Detention basins shall be sized to handle the runoff generated by all improved site area during a 100-year storm event, based on the Oakland County Detention and Flood Control section of the Stormwater Engineering Design Standards. Calculations for storage (both required and provided) and orifice sizing must be shown on the plans. See *Appendix F* for a sample calculation.

11. Retention basins shall be sized to handle the runoff generated by all improved site area for two (2) consecutive 100-year storm events, using Oakland County Simplified Method. See *Appendix F* for a sample calculation. If retention is proposed, infiltration tests must be performed by a licensed geotechnical engineer to ensure the reservoir will drain sufficiently.

12. Both in-line and off-line detention will be considered. An in-line detention outlet must control the runoff from the 100-year storm event, including upstream drainage.

13. Underground storage facilities will be considered where traditional storm water management measures are not feasible. The use of underground storage will require the installation of one of two recommended control structure. The first is a standard manhole with weir plate (top of plate at 100-year storm elevation) and orifice provided for 1-year allowable discharge; this configuration can only be used in a pre-cast manhole. The second is a corrugated metal standpipe strapped inside in a minimum 5' diameter manhole (top of standpipe at 100-year storm elevation) and an orifice drilled into the standpipe to allow the discharge of the 1-year storm event. See the Auburn Hills Storm Sewer Standard Details for more information.

14. Detention in wetlands may be allowed, subject to City/EGLE review, with a sediment forebay (canister type basin is allowed) sized for a 1-year storm upstream of wetlands if wetland detention is approved. The permitted use of the wetlands for storm water discharge and/or detention shall not exempt the wetlands from future regulation or consideration as a wetland with respect to Ordinance No. 482, or the Goemaere-Anderson Wetland Act. (Part 303 of Act 451 of P.A. 1994)

15. Overflow outlet design and protection shall be per OCWRC standards and details. See *Appendix F* for a copy of the OCWRC detail.

16. Outlet pipe from 100-year overflow to receiving system shall be sized for 10-year storm.

17. A sediment basin shall be required prior to discharge for any site where detention is not required. A mechanical treatment unit may be provided in lieu of a sediment basin per the requirements above.

18. A land use summary shall be included on the site plan showing existing and proposed conditions in a table similar to the table provided in the Oakland County Stormwater Engineering Design Standards (showing development area, impervious/pervious area, CPVC/CPRC volume, etc.).

IX. FLOOD PLAIN DEVELOPMENT

A. GENERAL

1. EGLE permit required.
2. Review per principles of compensating excavation (i.e., all fill within floodplain must be compensated for by an equivalent volume of excavation to maintain water storage volume).
3. 100-year flood plain (per FEMA) must be shown on all plans. If no flood plain exists, so note.

X. SITE GRADING

A. GENERAL

1. Sufficient proposed grades indicated to ensure that:
    a. Drainage is adequately discharged offsite with proper detention or retention.
    b. No upstream drainage is restricted.
    c. Paving slopes are adequate.
    d. The site generally drains without standing water.
    e. Sight lines are not obstructed (especially at driveways).
2. Elevations representing the finished grade and the first floor grade must be indicated for both proposed buildings and existing buildings on adjacent property.
3. No disturbance shall be permitted to vegetation and no activity shall be permitted within twenty-five (25) feet of a regulated wetland or watercourse in all zoning districts, with the exception of walking trails approved by the City Council, after recommendation from the Planning Commission. This provision is not intended to prohibit wetland crossings for infrastructure or wetland fill approved by either the City of Auburn Hills or Michigan Department of Environmental Quality.
4. Proposed grading shall meet abutting property line elevations. Easements from adjacent property owners will be required for any offsite grading.
5. Differentials in grade must incorporate a 4 on 1 maximum slope to the abutting property line.
6. The steepest permissible slope is 4 on 1. Slopes of 4 on 1 can be constructed interior to the site and shall be restored using an approved "erosion blanket". This shall be identified on the plans. Non-vegetative restoration may also be considered for these slopes, if permitted. In no case shall slopes steeper than 4 on 1 be permitted.
7. A minimum 2% slope is required for all residential swales greater than 50 feet unless otherwise approved in writing by the City of Auburn Hills or the City Engineer.

8. Walls or berms, as required by Zoning, must be shown in cross-section and included in the bound engineering plan set. Walls separating a grade differential of more than 2.5' are considered retaining walls and require a structural engineering design and review. Design Engineer must supply calculations and include all retaining walls in the Engineer's estimate. Walls shall be inspected.

XI. RETAINING WALLS

A. GENERAL

1. Design details and computations (sealed by a registered engineer) shall be submitted and approved for all walls not attached to a building, which are greater than one (1) foot in height. Cost of wall shall be included in engineer's estimate submitted with Engineering Plan Review application.
2. Any face of a retaining wall shall be a minimum of two (2) feet from the nearest property line.
3. Easement from abutting parcels will be required for any retaining wall footing that encroaches on said parcel, or where it appears that "normal" (1 on 1 side slope) excavation to the bottom of the footing would require encroachment.
4. Typically, utilities shall not be proposed under a retaining wall. If it is unavoidable, than all proposed utilities shall be installed in a proper casing pipe.
5. Wall details shall be included in the overall plan set.
6. Additional surface drainage shall not be placed directly behind the wall upon completion of construction for this may compromise the structural integrity of the wall. In addition, surface drainage shall not be directed over top of a wall.
7. Design engineer shall execute and submit certification form. (See *Appendix G* for example form.) Additionally, if the design engineer for the site did not complete the design of the retaining wall, then the retaining wall design engineer shall sign and seal their plans.
8. The following wall types are acceptable in the City:
    a. Concrete Wall
    b. Pre-Cast Wall
    c. Block Wall
    d. Boulder Wall (Maximum height: 4 feet)
9. The following items shall be included in all retaining wall submittals for review:
    a. Plan View
        i. Clearly identify location of the structure in plan view.
        ii. Indicate the top of wall and bottom of wall elevation at a minimum interval of 25' along the wall.
        iii. Provide finished grades adjacent to the structure at a maximum interval of 25'.
        iv. Show location of protective guardrail and/or fencing. The necessity for guardrail will be reviewed on a case-by-case basis. Typically a guard, fence or guardrail is required on structures greater than 30" in height. The typical guard, fence or guardrail is 42" high with openings less than 4" in diameter.

v. The proposed drainage system shall be shown on the plans as well as its ultimate discharge point, i.e. storm structure, ditch or swale, etc.

b. Cross-section View
   i. Provide minimum and maximum heights of the wall.
   ii. Identify the material type and all manufacturers' specifications.
   iii. State the proposed structural dimensions, including wall thickness, and the depth and thickness of the footing.
   iv. Geo-grid length shall be provided, dimensioned and labeled, as well as the embedment depth. Any changes in layout shall be shown on the plans.
   v. Fence, guard, or guardrail post footings or connections to walls shall be detailed. Installation of the post or post footing shall be specified so as not to damage any geo-grid, if applicable. Prior to final approval and when a fence is required, a fence design shall be completed.
   vi. The location of utility crossings shall be noted. Additionally, the manner in which these crossings will be constructed so as not to diminish the integrity of the wall shall be noted.

c. Calculations
   i. Design loads including vehicular impact and surcharge loadings where applicable. Loads due to attached structures (fences, guardrails, guards, etc) shall be considered in the design of the wall.
   ii. Note the grade of reinforcing steel, as well as the cover depth and the horizontal spacing.
   iii. Provide the bearing pressures (noted or referenced) and the soil bearing capacities.
   iv. Provide soil boring information and geotechnical analysis, if required.

XII. SOIL EROSION CONTROL

A. GENERAL

1. All sites with more than an acre of disturbed ground (total) must apply for a permit from Oakland County. All sites shall conform to the minimum criteria listed herein.
2. All proposed erosion control measures shall be shown on the plans submitted to the City. A Soil Erosion Control (and/or construction) Sequence shall also be shown on the plans.
3. The smallest practical area of land should be exposed at any one time during development. "Practical area" shall be defined as the area in which temporary or permanent restoration can and will be performed within a reasonable period of time, as defined by the City.
4. When land is exposed during development, the exposure should be kept to the shortest possible period of time, as deemed by the City.
5. Temporary vegetation or mulching may be required to protect areas exposed during development, particularly if an unexpected erosion problem becomes evident. The developer will be required to assign this activity top priority upon

notification by the City. Failure to act after a second notification will be grounds for the City to take necessary action to address the problem and charge the owner/developer accordingly.

6. Sediment basins (debris basins or silt traps) shall be installed and maintained during construction, to remove sediment from runoff from land undergoing development.
7. Sediment basins (debris basins or silt traps) prior to discharge into any wetland, stream, pond, etc., require 1 x 3 stone outlet filter at all low points/discharge points properly toed into silt fence.
8. The permanent vegetation and structures/basins should be installed as soon as practical during development. This would be included in the Soil Erosion Control Sequence noted above.
9. Wherever feasible, natural vegetation should be retained and protected.
10. The development plan should be best fitted to the topography and soil so as to create the least erosion potential. The best earth balance may not be the best fit with respect to topography and natural vegetation.
11. All new or existing (disrupted) ditches shall be sodded.
12. Seed and mulch is not permitted on slopes greater than 4:1. "Excelsior" Mulch blanket, sod pegged per City specifications, or approved equal will be required on such slopes.
13. Erosion control shall conform to Oakland County SESC standard details, with a detail of each measure used required to be shown on the plans.
14. Erosion protection shall be provided in the public roadway for all drainage structures receiving road runoff to the low point.
15. The developer shall clean all structures impacted during construction along with any other erosion control items prior to occupancy.

XIII. PAVING AND RIGHT-OF-WAY IMPROVEMENTS

A. GENERAL

1. All paving shall be per the City of Auburn Hills Standard Paving Detail Sheet.
2. On-site Paving Requirements:
    a. Pavement cross-section must be shown on the site plan as well as the site improvement plan. All driveway cross-sections shall meet or exceed the cross-section of the roadway it enters onto. On-site minimums are:
        i. Residential & Multiple (R1A-C, R1-R4, RM1-RM3): 4" asphalt on 8" aggregate base or 7" concrete on approved base.
        ii. Commercial/Light Industrial (MHP, O, B1, B2, I1, T&R): 4" asphalt (6” asphalt for drive aisles and truck routes) on 8" aggregate base or 8" concrete on approved base.
        iii. Industrial (I2, I3, LF5, LF11): 9" asphalt or 9" concrete on approved base.
        iv. Loading zones and dumpster pads: 8” non-reinforced concrete on approved base.

NOTE: Requirements are typical for areas zoned industrial, technology and research, or office, and may be modified based on City review. Requirements for areas zoned SP, P, PL and D will be based on City review.

b. The entire pavement cross section must be paved in a continuous process without delay between separate courses.
c. MDOT "E" mixes shall be used unless otherwise approved in writing by the City or City Engineer.
d. Minimum slope:
    i. Asphalt: 1.0%
    ii. Concrete: 0.4%
e. Maximum Slope
    i. Roads: 6.0%
    ii. Parking: 4.0%
    iii. Sidewalks and Pathways: 5.0%,
    iv. Accessible parking spaces (per ADA requirements and MDOT, where applicable) and access aisles shall be level with surface slopes not exceeding 2.0% in all directions.
f. Minimum drive & greenbelt widths and parking lot dimensions to be in accordance with City of Auburn Hills Zoning Ordinance No. 372. The ordinance text can be viewed on the Ordinance Website.
g. Concrete curb and gutter is required at edge of drive or parking unless otherwise approved by the City.
h. Concrete curb and gutter sections shall meet requirements M.D.O.T. Specifications Section 802.

2. All public roads shall have 6" edge drain with pea stone and filter fabric provided on both sides of the road for its entire length. It is strongly recommended that edge drain be installed for private roads if it is the intent of the developer to turn the road over to the City in the future. The City will not accept any road lacking edge drain.

B. PUBLIC RIGHT-OF-WAY (City controlled):

1. All roads that are to be turned over to the City are required to be constructed to public road standards (See *Appendix H* for a public road acceptance list).
2. Sufficient proposed grades, as noted in the first item of site grading requirements.
3. Pavement cross-sections must be shown, minimums are:
    a. Concrete major/collector road: 9" non-reinforced concrete on 8" MDOT 21AA aggregate with a proof rolled subbase.
    b. Asphalt major/collector road (only if allowed by the City): 9" asphalt on 6" MDOT 21AA aggregate base.
    c. Concrete local road: 8" non-reinforced concrete on 6" MDOT 21AA aggregate with a proof rolled subbase.
    d. Asphalt local road: 4" asphalt on 8" MDOT 21AA aggregate base.
    e. Unpaved road: 8" MDOT 22A or approved equal.

4. Where curb and gutter is proposed it shall be concrete with a cross-section as required by the City.
5. Road width shall be based on proposed use, and shall be determined during the site plan review process.
6. 6" edge drain with pea stone and filter fabric shall be required on all City maintained roads unless otherwise approved by the City. The approved detail is located on the Auburn Hills Storm Sewer Details. Filter fabric shall be wrapped around trench. Filter fabric socks will not be accepted.
7. All approach radii must have concrete curb & gutter. The minimum radius is 35'; a 45' radius is required if zoning allows truck traffic. Exceptions to the minimum requirement may be made by the City in the area-zoned Village Center. See *Appendix K* for AHFD Ladder Truck Turning Template.
8. The City may require a passing lane, acceleration lane and taper, and/or deceleration lane and taper as recommended by the City's Traffic Consultant. Design standards are as follows:
    a. Concrete curb & gutter on curbed streets.
    b. Dimension shall be per RCOC standard details. See *Appendix I* for the relevant excerpt from *RCOC Permit Rules, Specifications and Guidelines, January 2001*. The RCOC publication can be viewed in its entirety at https://www.rcocweb.org/101/Permits.
    c. When connecting to or extending an existing taper, some or all of the existing taper may be required to be replaced as directed by the City.
9. Shoulder requirements (uncurbed roads):
    a. Major/collector road: 3' to 8' wide asphalt shoulder with cross-section to match road pavement, and 3' to 8' wide, 12" MDOT 23A aggregate.
    b. Local road: MDOT 22A aggregate to match pavement and road base depth, 3' width, 8" minimum depth
10. The minimum dedication of ROW along frontage shall be to the ultimate ROW shown on the City Major Thoroughfare Plan. Thoroughfare plan shall take precedence over these requirements if there is any discrepancy.
    a. Major road: 100' to 204' (Contact City Engineer for requirement.)
    b. Collector road:
        i. Residential: 86'
        ii. Industrial: 70'
    c. Local road: 60'
11. Drainage Ditches:
    a. Adequate culvert capacity for a 10-year storm event
    b. Enclosure of ditch permitted only with written City approval
    c. Side slopes: 4 to 1 maximum
    d. 2' wide ditch bottom
12. Road design to be based on most recent AASHTO criteria, including, but not limited to the following:
    a. Vertical curves where algebraic difference of slopes is >1%.
    b. Horizontal curves with adequate superelevation and transitions.
    c. Sight distance shown where not intrinsic to vertical curves, i.e. sight triangles at intersections, or curves where sight obstructions exist.

d. Signing and striping plans and construction required per the Michigan Manual of Uniform Traffic Control Devices (MUTCD). The City's requirements for signage may exceed the size specified in the MMUTCD; where this occurs, the City's requirements shall govern. See *Appendix H* for further details. All public signs shall be installed on 3-pound **square** posts.

13. MDOT Detail "L" or "M" required at all drive entrances. Radius returns shall not butt into existing curb. See *Appendix J* for the appropriate details.
14. Public road extensions shall have horizontal and vertical alignments submitted for review.

C. RECREATIONAL PATHWAYS AND SIDEWALKS

1. Sidewalk or recreational pathway required along the frontage of all major roads. Reference City Master Non-Motorized Pathway Plan.
2. Located 1' from ultimate ROW line unless otherwise approved. Path can be constructed on private property if easement is dedicated to the City.
3. Concrete sidewalk: minimum 5' wide, 4" minimum thickness with 8" thickness at driveways for major/collector roads and 6" thickness at driveways for local roads. Base to be 4" as noted below in item 8.
4. Recreational Pathway: minimum 8' wide, 3" minimum thickness, with 9" thickness at driveways for major/collector roads and 6" thickness at driveways for local roads.
5. Proposed grades shall be given at property corners, driveways and intermittent locations between approximately every 50 feet.
6. Handicapped ramps shall be noted and an acceptable detail provided for a detectable warning (per ADA requirements). All areas where the pathway/sidewalk intersects the curb will require a handicapped ramp. The MDOT Sidewalk Ramp Detail can be found on the MDOT website. The detectable warning shall be specified as Vitrified Polymer Composite cast-in-place tile, whose color shall be "Safety Yellow" (Federal Color No. 33538). All sidewalk construction shall be in accordance with the most current version of the Americans with Disabilities Act.
7. All structures, hydrants, poles, etc., shall be noted and moved or adjusted as necessary.
8. A minimum 4" aggregate base (MDOT 21AA) or suitable Class II base (approved by the City) shall be required for all recreational pathways and sidewalks. Pramitol "25E" or approved equal soil sterilant shall be placed on the subbase prior to paving. (Note: crystalline form placed immediately prior to paving is recommended, to minimize sterilant migration from the path)
9. 3' minimum clearance required from the edge of path to fixed objects, ditch banks, drop-offs, water, etc. 5' minimum clearance required from back of curb and 12' minimum clearance required from edge of pavement (no curb).
10. The cross slope gradient for drainage shall not exceed 2%. It is recommended to design cross slope gradient for drainage channel at 1.5%.
11. The longitudinal grade of the path shall not exceed 5%.

12. All sidewalk or recreational pathways shall attempt to perpendicularly intersect drives, railroads, roadways, etc. At no time shall the crossing angle be less than 75°.

D. PRIVATE ROADS

1. Private roads shall be constructed in accordance with the following: Minimum cross section shall be 4" asphalt over 8" aggregate base, or 6" concrete over approved base. Pavement shall be 22' wide with a minimum 3' wide aggregate shoulder (8" thick) and an 8' clear zone. The entire pavement cross section must be paved in a continuous process without delay between separate courses.
2. Conversion from designation as a private road to a public road requires construction to public road standards, with inspection. (See *Appendix H* for a public road acceptance list)
3. All private roads shall have a minimum ROW of 60 feet in width, with any additional width as required by the City. Minimum ROW for business and industrial private roads (all non-residential zoning) shall be a minimum of 70 foot ROW, with any residential collectors to be a minimum of 86 feet of ROW.
4. Sufficient space for acceleration, deceleration and passing lanes shall be required unless waived by the City Council during site plan approval.
5. Developers of private roads shall provide easements and maintenance agreements as deemed necessary by the City.
6. Where City maintained utilities are placed in private roads, exclusive easement(s) rights shall be granted to the City. Recorded documents shall be provided prior to acceptance, use, or occupancy.

E. PAVEMENT CONSTRUCTION REQUIREMENTS

1. All pavement shall be constructed to the most current version of MDOT Standard Specifications unless otherwise directed by the Engineer.
2. All compaction tests of subgrade and subbase shall be conducted by an independent testing laboratory and signed and sealed results shall be furnished to the City upon request. Testing will also be required for road and curb pavement.

APPENDIX A

GENERAL LIABILITY INSURANCE FORM

ADDITIONAL INSURED ENDORSEMENT SAMPLE

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YY)

PRODUCER

YOUR INSURANCE COMPANY

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURERS AFFORDING COVERAGE	NAIC #
INSURER A:	
INSURER B:	
INSURER C:	
INSURER D:	

INSURED

CONTRACTOR

COVERAGES

THIS IS TO CERTIFY THAT THE POLICIES OF THE INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAME ABOVE FOR THE POLICY PERIOD INDICATED, NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

R LTR	D'L INS	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
A		**GENERAL LIABILITY**				EACH OCCURRENCE	$ 2,000,000
		[X] COMMERCIAL GENERAL LIABILITY				DAMAGE TO RENTED PREMISES (Ea occurrence)	$
		[ ] CLAIMS MADE [X] OCCUR				MED EXP (Any one person)	$
		[ ] _____				PERSONAL & ADV INJURY	$
		[ ] _____				GENERAL AGGREGATE	$ 4,000,000
		GEN'L AGGREGATE LIMIT APPLIES PER:				PRODUCTS - COMP/OP AGG	$
		[ ] POLICY [ ] PROJECT					
A		**AUTOMOBILE LIABILITY**				COMBINED SINGLE LIMIT (Ea accident)	$ 2,000,000
		[X] ANY AUTO					
		[ ] ALL OWNED AUTOS				BODILY INJURY (Per person)	$ 500,000
		[ ] SCHEDULED AUTOS					
		[ ] HIRED AUTOS				BODILY INJURY (Per accident)	$ 500,000
		[ ] NON-OWNED AUTOS					
		[ ] _____				PROPERTY DAMAGE (Per accident)	$ 500,000
		GARAGE LIABILITY				AUTO ONLY - EA ACCIDENT	$
		[ ] ANY AUTO				OTHER THAN EA ACC	$
						AUTO ONLY AGG	$
A		**EXCESS/UMBRELLA LIABILITY**				EACH OCCURRENCE	$
		[ ] OCCUR [ ] CLAIMS MADE				AGGREGATE	$
							$
		[ ] DEDUCTIBLE					$
		[ ] RETENTION					$
A		**WORKERS COMPENSATION AND EMPLOYERS' LIABILITY**				WC SATUTORY LIMITS	
						OTHER	
		ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED?				E.L. EACH ACCIDENT	$
		If yes, describe under				E.L. DISEASE - EA EMPLOYEE	$
		SPECIAL PROVISIONS below				E.L. DISEASE - POLICY LIMIT	$
B		**OTHER**					

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/EXCLUSIONS ADDED BY ENDORSEMENT/SPECIAL PROVISIONS

LIST PROJECT NAME, ADDITIONALLY INSURED: ORCHARD, HILTZ & McCLIMENT, INC., CITY OF AUBURN HILLS, REFERENCE ADDITIONAL INSURED ENDORSEMENT POLICY NUMBER

CERTIFICATE HOLDER

OWNER/DEVELOPER

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, ~~BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OF LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES.~~

AUTHORIZED REPRESENTATIVE

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

ADDITIONAL INSURED - DESIGNATED PERSON OR ORGANIZATION

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

SCHEDULE

Name of Person or Organization:

City of Auburn Hills
OHM Advisors

A. **SECTION II - WHO IS AN INSURED** is amended to include as an insured the person or organization shown in the Schedule but only with respect to liability arising out of your operations or premises owned by or rented to you.

B. The following exclusion is added to **SECTION I - COVERAGES, COVERAGE A. BODILY INJURY AND PROPERTY DAMAGE LIABILITY, 2. Exclusions** and **SECTION I - COVERAGES, COVERAGE B. PERSONAL AND ADVERTISING INJURY LIABILITY, 2. Exclusions:**

The insurance provided to the additional insured does not apply to "bodily injury", "property damage" or "personal and advertising injury" arising out of the sole negligence or willful misconduct of, or for defects in design furnished by, the additional insured or its "employees".

C. **SECTION IV - COMMERCIAL GENERAL LIABILITY CONDITIONS, 5. Other Insurance** is amended to include:

Any insurance provided by this endorsement shall be primary to other insurance available to the additional insured except:

a. As otherwise provided in **SECTION IV - COMMERCIAL GENERAL LIABILITY CONDITIONS, 5. Other Insurance**; or

b. For any other valid and collectible insurance available to the additional insured as an additional insured by attachment of an endorsement to another insurance policy that is written on an excess basis. In such case, the coverage provided under this endorsement shall also be excess.

APPENDIX B

INSPECTION ESCROW/
MAINTENANCE & GUARANTEE BOND

BASIS FOR CALCULATING INSPECTION ESCROW AND MAINTENANCE & GUARANTEE BOND

Escrow charges will cover costs associated with the pre-construction meeting, full-time inspection, field engineering due to change requests from approved plans, witnessing of water main pressure test and sanitary sewer air test (if applicable), final site inspection, reviewing of "Record Drawings" and any public sewer or water main easements, inspection administration and Auburn Hills Department of Public Works administrative costs. This money will be placed in an escrow account and any unused funds will be refunded. If the estimated amount is not sufficient to cover the project inspection costs, an additional fee shall be required prior to acceptance by the City.

A Maintenance & Guarantee Bond for 50% of the engineer's estimate of all public improvements will be required prior to acceptance by the City.

The following is a summary of the items that will be included when calculating the Inspection Escrow and the Maintenance & Guarantee Bond. Please note that some sites may step out of the boundaries herein and will need to be treated uniquely.

A. <u>INSPECTION ESCROW</u>

1. Private Sites
   - Water Main
   - Sanitary Sewer
   - Storm Sewer
   - Public Paving

2. Oakland Community College (OCC), Oakland University (OU), Chrysler Campus, Avondale & Pontiac Schools, Mobile Home Parks (MHP)
   - Sanitary Sewer
   - Storm Sewer (depending on its impacts on neighboring private properties and public ROW)
   - Public Water Main
   - Private Water Main when requested by the private entity

B. <u>MAINTENANCE & GUARANTEE BOND</u>

- Public Water Main (i.e. no service leads, no private water main on site such as OU, OCC, Chrysler Campus, MHP, or Public School sites where meter pit is installed)
- Public Sanitary (i.e. no service leads, no private sanitary sewer on sites such as OU, OCC, Chrysler Campus, MHP, Landfills, or certain Public Schools)
- Public Paving

Prior to construction, a pre-construction meeting will be held. The developer will be required to post the estimated inspection escrow prior to scheduling this meeting.

MAINTENANCE AND GUARANTEE BOND

Obligee Review or Project No._____ Bond No._____
(if applicable)

KNOW ALL MEN BY THESE PRESENTS:

That we, the developer, _____ (hereinafter called Principal), and _____ (hereinafter called Surety), a corporation organized under the laws of the State of _____ and authorized to do a surety business in the State of Michigan, are held and firmly bound unto the municipal agency known as the City of Auburn Hills (hereinafter called Obligee) in the full and just sum of _____ Dollars and _____ Cents ($_____), lawful money of the United States of America, for the payment of which sum, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Principal has constructed or caused to have constructed the following described public improvements in a public easement and/or right-of-way:

(Check all applicable items)

_____Storm Sewer System	_____Roadway
_____Sanitary Sewer System	_____Sidewalk or Pathway
_____Water Main System	_____Other: _____

which have been or are about to be accepted by the Obligee for the project known as _____ _____ and located in Section _____, T_____, and R_____; more specifically at _____.

AND WHEREAS, it is required that the Principal should guarantee the project from defects caused by faulty materials or workmanship for a period of 2 year(s) from and after the date of acceptance of same by the Obligee.

The Obligee shall notify the Principal in writing of any defect for which the Principal is responsible and shall specify in said notice a reasonable period of time within which the Principal shall have to correct said defect. If the Principal fails to correct such defect within the time specified in said notice, then the Surety shall have sixty (60) days thereafter within which to take such action as it deems necessary to insure performance of the Principal's obligation. If such defect is not corrected after the expiration of such sixty-day period, then the Obligee shall have the right to correct such defect and the Principal and Surety, jointly and severally, shall pay all costs and expenses incurred by Obligee in correcting such defect; including but not limited to, the engineering, legal, administration and other costs, together with any damages either direct or consequential, which the Obligee may sustain on account of the Principal's failure to correct such defect. In addition, the Obligee shall have the right to contract for the correction of such defect and, upon acceptance of the lowest responsible bid, the Principal and Surety shall become immediately liable for the amount of the said bid.

If any repair is necessary to be made at once to protect life and property, then and in that case, the Obligee may take immediate steps to repair or barricade such defects without notice to the Principal or Surety. In such accounting, the Obligee shall not be held to obtain the lowest figures for the doing of the work, or any part thereof, but all sums actually paid therefore shall be charged to the Principal or Surety. In this instance, the judgment of the Obligee is final and conclusive.

The Principal shall fully indemnify, defend and save harmless the Obligee, and its agents, consultants, employees and officers from all suits and actions for damages of every name and description brought or claimed against them for, or on account of, any injury or damage to person or property received or sustained by any party or parties, by or from any of the acts or omissions or through the negligence of said Principal, and its servants, agents or employees, in the prosecution of the work, and from any and all claims arising under the Workman's Compensation Act, so-called, of the State of Michigan.

NOW, THEREFORE, if the said Principal shall for a period of 2 year(s) from and after the date of acceptance of the completed project by the Obligee replace any and all defects arising in said work whether resulting from defective materials or defective workmanship, then the above obligation shall be null and void; otherwise to remain in full force and effect for 2 year(s) from the date of acceptance by the Obligee.

IN WITNESS WHEREOF, the parties have caused this instrument to be signed and sealed by their respective authorized officers this_____day of_____,20___.

WITNESS

_____

Name:_____

PRINCIPAL

_____
(seal)

By:_____

Name:_____

Title:_____

Address:_____

_____

Phone:_____

Fax:_____

SURETY

_____
(seal)

_____

By:_____

Name:_____

Name:_____

Title:_____

Address:_____

_____

Phone:_____

Fax:_____

APPENDIX C

GIS FORMAT FOR RECORD PLANS

APPENDIX D

THE CITY OF AUBURN HILLS STANDARD NOTES & FIRE DEPARTMENT NOTES

CITY OF AUBURN HILLS STANDARD NOTES

CONSTRUCTION SHALL CONFORM TO CURRENT CITY OF AUBURN HILLS' STANDARDS.

NO WORK SHALL BE PERFORMED WITHOUT INSPECTION.

A PERMIT FROM THE DPW IS REQUIRED FOR ALL CONSTRUCTION WITHIN CITY ROW. NO EQUIPMENT OR MATERIAL STORAGE WILL BE PERMITTED IN THE ROW.

ALL CITY STREETS MUST BE MAINTAINED DURING CONSTRUCTION. STREETS SHALL BE KEPT FREE OF MUD, DIRT, CONSTRUCTION DEBRIS, DUST AND THE LIKE. IF CLEAN-UP IS NOT PERFORMED WITHIN 24 HOURS OF NOTIFICATION, THE CITY RESERVES THE RIGHT TO PERFORM THE WORK AND CHARGE THE DEVELOPER ACCORDINGLY.

WORKING HOURS (INCLUDING RUNNING OF ANY MACHINERY) SHALL BE RESTRICTED TO MONDAY THROUGH SATURDAY, 7:00 AM TO 7:00 PM; SUNUP TO SUNDOWN; WHICHEVER IS LESS. CONSTRUCTION OPERATIONS BEYOND THE PERIODS MENTIONED ABOVE SHALL BE PERMITTED ONLY AFTER WRITTEN APPROVAL OF THE CITY MANAGER OR HIS DESIGNEE.

ALL MATERIALS AND MANUFACTURERS SHALL CONFORM TO THE STANDARD DETAILS.

UTILITY STRUCTURES SHALL NOT BE LOCATED IN DRIVEWAYS, AND WHERE POSSIBLE, SHALL NOT BE LOCATED IN PAVED AREAS.

THE CONTRACTOR SHALL NOTIFY ALL UTILITY COMPANIES IN ACCORDANCE WITH ACT 53 OF P.A. OF 1974 AND ALSO CONTACT OAKLAND COUNTY UTILITY AND PROTECTION SERVICE (MISS DIG 1-800-482-7171) THREE (3) WORKING DAYS BEFORE THE START OF ANY CONSTRUCTION.

THE CONTRACTOR SHALL PROVIDE NECESSARY SIGNS, BARRICADES AND LIGHTS TO PROTECT TRAFFIC AND THE WORK AS DIRECTED BY THE ENGINEER. SUCH DEVICES SHALL BE PLACED PRIOR TO STARTING WORK IN AFFECTED AREAS.

ALL SOIL EROSION AND SEDIMENTATION CONTROLS SHALL BE IN ACCORDANCE WITH THE OAKLAND COUNTY STANDARDS AND DETAILS. THE CONTRACTOR SHALL FOLLOW LOCAL RULES AND REGULATIONS FOR SOIL EROSION AND SEDIMENTATION CONTROL FOR ALL MATERIALS THAT ARE DISPOSED OF OFF OF THE PROJECT SITE.

ALL SOIL EROSION MEASURES MUST BE PROPERLY PLACED PRIOR TO GRADING OR OTHER CONSTRUCTION ACTIVITIES.

FIELD CHANGES TO THE APPROVED PLAN SHALL BE BROUGHT TO THE ATTENTION OF THE INSPECTOR ON SITE, WHO WILL DETERMINE WHETHER THE CHANGE IS CONSIDERED "SIGNIFICANT". "SIGNIFICANT" FIELD CHANGES SHALL BE SUBMITTED TO THE CITY BY THE DESIGN ENGINEER. THE CITY SHALL NOT BE HELD RESPONSIBLE FOR DELAYS IN APPROVAL OF CHANGES TO THE APPROVED SITE IMPROVEMENT (ENGINEERING) PLAN.

WHERE POSSIBLE, PUBLIC UTILITIES SHALL NOT BE PLACED UNDER PAVEMENT. THE CITY OF AUBURN HILLS SHALL NOT BE RESPONSIBLE FOR PAVEMENT, CURB, OR OTHER RESTORATION OF PERMANENT FACILITIES LOCATED WITHIN THE MUNICIPAL EASEMENT.

3 WORKING DAYS PRIOR TO STARTING CONSTRUCTION, CONTACT THE CONSTRUCTION DEPARTMENT OF ORCHARD, HILTZ & McCLIMENT, INC. AT (734) 466-4539 TO SCHEDULE INSPECTION. OHM SHALL INSPECT ALL SITE IMPROVEMENTS INCLUDING UNDERGROUND UTILITY INSTALLATION, EARTHWORK OPERATIONS, RETAINING WALLS, PAVEMENT IN CITY R.O.W., ALL SIDEWALKS OR SAFETY PATHS IN ANY PUBLIC R.O.W., AND ANY ADDITIONAL ITEMS NOTED DURING REVIEW OR AT THE PRE-CONSTRUCTION MEETING. FINAL OCCUPANCY MAY BE AFFECTED IF PROCEDURES ARE NOT FOLLOWED FOR PROPER INSPECTION.

PERMANENT STRUCTURES OF ANY TYPE, INCLUDING BUT NOT LIMITED TO, TREES, LIGHT POLES, DRAINAGE STRUCTURES, SANITARY STRUCTURES, BENCHES, TRASH RECEPTACLES, ETC., WILL NOT BE ALLOWED WITHIN THE INFLUENCE OF THE PUBLIC WATER MAIN OR SANITARY SEWER EASEMENTS.

CITY OF AUBURN HILLS FIRE DEPARTMENT NOTES

(Contact John Burmeister – (248) 370-9461)

1. THE FOUR (4) INCH STEAMER CAPS ON ALL HYDRANTS WILL BE PAINTED ACCORDING TO THE FOLLOWING (PAINT CAN BE OBTAINED FROM TRACTOR SUPPLY COMPANY BY USING THE ASSOCIATED PAINT NUMBERS):

WHITE	4-INCH MAINS
RED	6-INCH MAINS (PAINT #4431-01)
ORANGE	8-INCH MAINS (PAINT #4431-24)
GREEN	12-INCH MAINS (PAINT #4431-10)
BLUE	16-INCH OR LARGER MAINS (PAINT #4431-12)

2. NO PARKING SHALL BE PERMITTED AND/OR NO OBSTRUCTIONS SHALL BE PLACED OR CONSTRUCTED WITHIN FIFTEEN (15) FEET OF ANY FIRE HYDRANT OR FIRE DEPARTMENT CONNECTION, PUBLIC OR PRIVATE.

3. THE FIRE DEPARTMENT CONNECTION MUST BE LOCATED WITHIN ONE HUNDRED (100) FEET OF A FIRE HYDRANT AND WITHIN FIFTY (50) FEET OF A MINIMUM EIGHTEEN (18) FOOT WIDE PAVED DRIVEWAY OR STREET.

4. GAS METERS, PROPANE TANKS, OVERHEAD ELECTRICAL SERVICE, AND TRANSFORMERS MUST NOT BE LOCATED ON THE SAME SIDE OF THE BUILDING OR STRUCTURE AS THE FIRE DEPARTMENT CONNECTION UNLESS A CLEAR DISTANCE OF ONE HUNDRED FIFTY (150) FEET CAN BE MAINTAINED BETWEEN UTILITIES AND THE FIRE DEPARTMENT CONNECTION.

5. ALL DRIVE AREAS MUST BE POSTED AS FIRE LANES WITH UNIFORM SIGNS IN KEEPING WITH THE STANDARD ESTABLISHED IN THE MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES. SIGNS MUST BE ERECTED ON BOTH SIDES OF THE FIRE LANES WITH SPACING BETWEEN SIGNS NOT TO EXCEED ONE HUNDRED (100) FEET.

6. DESIGNATED EXIT DOORS ONTO DRIVES OR PARKING AREAS MUST BE PROTECTED WITH GUARD POSTS OR PARKING BLOCKS.

A WHITE HIGH VISIBILITY STRIP SHALL BE PAINTED ON THE UPPER FLANGE OF ALL FIRE HYDRANTS.

Sanitary Sewer Basis of Design

DEFINITIONS

U	Equivalent Units, calculated using the Oakland County Water Resources Commissioner Schedule of Unit Assignment Factors (January, 2018).
P	Equivalent People, 2.44 people/unit.
Q	Daily Flow Rate, 100 (gallons/day)/person
P_f	Peaking Factor
Q_{cfs}	Peak Flow Rate, cfs

CALCULATIONS

P = $U * (2.44 \text{ people/unit})$

Q = $P * (100 \text{ gallons/day})/\text{person}$

$P_f = \dfrac{18 + (P) \wedge (0.5)}{4 + (P) \wedge (0.5)}$ (P = population in thousands)

$Q_{cfs} = P_f * Q * (1 \text{ cfs} / 7.48 \text{ gallons}) * (1 \text{ day} / 86{,}400 \text{ sec})$

Calculate receiving sewer capacity to compare to peak flow

WRC
WATER RESOURCES COMMISSIONER
Jim Nash

Oakland County Water Resources Commissioner
Schedule of Unit Assignment Factors
Effective July 1, 2018

Business/Category Use	Unit Factors	
Single Family Residential	1.00	per dwelling
Auto		
Auto Showroom/Dealership	0.37	per 1,000 sq. ft.
Auto Service/Repair	0.29	per employee
Auto Service/Convenience Stations	0.21	per pump
Self-Serve Car Washes	2.89	per stall
Fully & Semi-Automatic Car Washes	6.95	per 1,000 sq. ft.
Food, Beverage & Retail		
Banquet Halls	0.23	per fixture
Country Clubs	0.04	per member
Convenience Store w/ Pharmacy	1.00	per facility
Full Service Grocery Store (w/ florist, eye care, etc.)	0.26	per 1,000 sq. ft.
Grocery Store w/o Full Service	0.19	per 1,000 sq. ft.
Fraternal Organizations	0.04	per 1,000 sq. ft.
Restaurants w/ Liquor	0.35	per fixture
Restaurants w/o Liquor	0.08	per seat
Quick Service Restaurants w/ dining & restrooms	0.49	per fixture
Quick Service Restaurants w/o dining & restrooms	1.00	per restaurant
Stores (other than specifically listed)	0.04	per 1,000 sq. ft.
Personal Care		
Nail Salons	0.18	per employee
Barber Shops	0.14	per fixture
Beauty Salons	0.71	per 1,000 sq. ft.
Entertainment/Health & Fitness		
Bowling Alleys	0.36	per 1,000 sq. ft.
Theatres	0.27	per 1,000 sq. ft.
Kids Indoor Play Centers	0.12	per 1,000 sq. ft.
Health Club/Fitness Center w/ Showers &/or Pool	1.29	per fixture
Health Club/Fitness Center w/o Showers &/or Pool	0.29	per 1,000 sq. ft.
Swimming Pools	3.00	per 1,000 sq. ft.
Service Providers		
Funeral Homes	0.15	per 1,000 sq. ft.
Dry Cleaners	1.18	per 1,000 sq. ft.
Self Service Laundry Facilities	0.71	per washer
Pet Care Kennels	0.63	per fixture
Pet Care Grooming	1.33	per 1,000 sq. ft.
Hotels	0.38	per room
Motels	0.90	per 1,000 sq. ft.

WRC
WATER RESOURCES COMMISSIONER
Jim Nash

Oakland County Water Resources Commissioner
Schedule of Unit Assignment Factors
Effective July 1, 2018

Medical/Wellness		
Medical Clinics	0.19	per 1,000 sq. ft.
Dental Clinics	0.83	per dentist
Hospitals	1.22	per bed
Retirement Homes/Assisted Living	0.39	per bed
Office/General Use/Assembly		
Churches	0.11	per 1,000 sq. ft.
Warehouses & Storage	0.12	per fixture
Offices – General	0.40	per 1,000 sq. ft.
Public Institutions (other than hospitals, schools)	0.12	per fixture
Government		
Fire Stations	0.40	per employee
Police Stations	0.09	per employee
Daycare/Early Learning	4.28	per facility
Elementary Schools	0.02	per student
Junior or Middle Schools	0.12	per 1,000 sq. ft.
Senior High Schools	0.09	per 1,000 sq. ft.
Manufacturing		
Dry Process	1.38	per facility
Wet Process	0.29	per fixture
Housing		
Convents & Seminaries	0.29	per employee
Multiple Family Residences	0.60	per residence
Mobile Home Parks	0.41	per mobile home

APPENDIX E

OCWRC SCHEDULE OF UNIT ASSIGNMENT FACTORS & EXAMPLE BASIS OF DESIGN

WRC
WATER RESOURCES COMMISSIONER
Jim Nash

Oakland County Water Resources Commissioner
Schedule of Unit Assignment Factors
Effective July 1, 2018

Business/Category Use	Unit Factors	
Single Family Residential	1.00	per dwelling
Auto		
Auto Showroom/Dealership	0.37	per 1,000 sq. ft.
Auto Service/Repair	0.29	per employee
Auto Service/Convenience Stations	0.21	per pump
Self-Serve Car Washes	2.89	per stall
Fully & Semi-Automatic Car Washes	6.95	per 1,000 sq. ft.
Food, Beverage & Retail		
Banquet Halls	0.23	per fixture
Country Clubs	0.04	per member
Convenience Store w/ Pharmacy	1.00	per facility
Full Service Grocery Store (w/ florist, eye care, etc.)	0.26	per 1,000 sq. ft.
Grocery Store w/o Full Service	0.19	per 1,000 sq. ft.
Fraternal Organizations	0.04	per 1,000 sq. ft.
Restaurants w/ Liquor	0.35	per fixture
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Quick Service Restaurants w/ dining & restrooms	0.49	per fixture
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Stores (other than specifically listed)	0.04	per 1,000 sq. ft.
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Barber Shops	0.14	per fixture
Beauty Salons	0.71	per 1,000 sq. ft.
Entertainment/Health & Fitness		
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WRC
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Schedule of Unit Assignment Factors
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Churches	0.11	per 1,000 sq. ft.
Warehouses & Storage	0.12	per fixture
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Public Institutions (other than hospitals, schools)	0.12	per fixture
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Fire Stations	0.40	per employee
Police Stations	0.09	per employee
Daycare/Early Learning	4.28	per facility
Elementary Schools	0.02	per student
Junior or Middle Schools	0.12	per 1,000 sq. ft.
Senior High Schools	0.09	per 1,000 sq. ft.
Manufacturing		
Dry Process	1.38	per facility
Wet Process	0.29	per fixture
Housing		
Convents & Seminaries	0.29	per employee
Multiple Family Residences	0.60	per residence
Mobile Home Parks	0.41	per mobile home

Sanitary Sewer Basis of Design

DEFINITIONS

U	Equivalent Units, calculated using the Oakland County Water Resources Commissioner Schedule of Unit Assignment Factors (January, 2018).
P	Equivalent People, 2.44 people/unit.
Q	Daily Flow Rate, 100 (gallons/day)/person
P_f	Peaking Factor
Q_{cfs}	Peak Flow Rate, cfs

CALCULATIONS

P = $U * (2.44 \text{ people/unit})$

Q = $P * (100 \text{ gallons/day})/\text{person}$

$P_f = \dfrac{18 + (P) \wedge (0.5)}{4 + (P) \wedge (0.5)}$ (P = population in thousands)

$Q_{cfs} = P_f * Q * (1 \text{ cfs} / 7.48 \text{ gallons}) * (1 \text{ day} / 86{,}400 \text{ sec})$

Calculate receiving sewer capacity to compare to peak flow

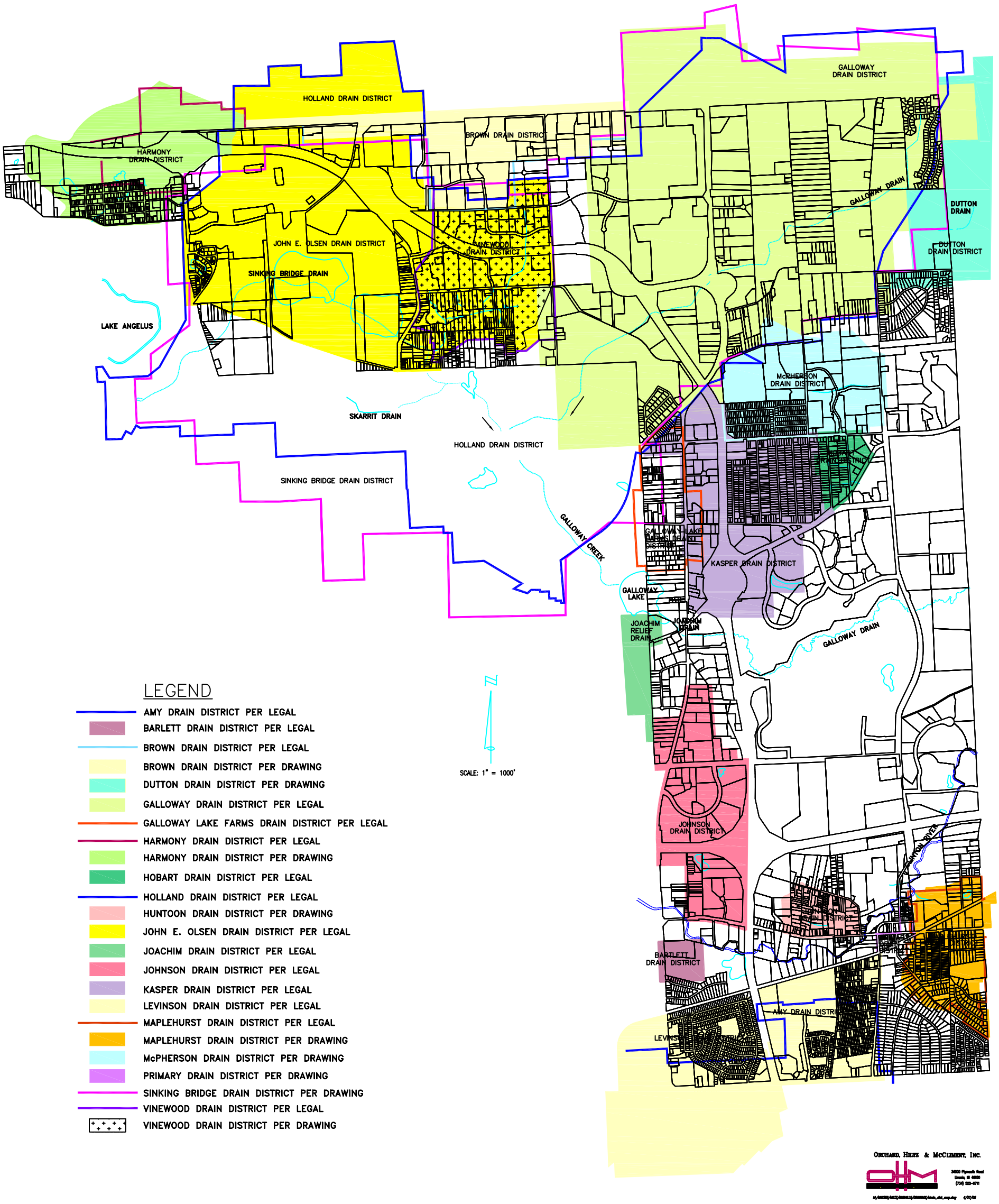
APPENDIX F

ALLOWABLE DISCHARGE RATES FOR DRAINAGE DISTRICTS IN AUBURN HILLS

OCWRC STORMWATER CALCULATION FORMULAS

TYPICAL OCWRC DETENTION BASIN DETAILS

AUBURN HILLS
DRAINAGE DISTRICT MAP



LEGEND

- AMY DRAIN DISTRICT PER LEGAL
- BARLETT DRAIN DISTRICT PER LEGAL
- BROWN DRAIN DISTRICT PER LEGAL
- BROWN DRAIN DISTRICT PER DRAWING
- DUTTON DRAIN DISTRICT PER DRAWING
- GALLOWAY DRAIN DISTRICT PER LEGAL
- GALLOWAY LAKE FARMS DRAIN DISTRICT PER LEGAL
- HARMONY DRAIN DISTRICT PER LEGAL
- HARMONY DRAIN DISTRICT PER DRAWING
- HOBART DRAIN DISTRICT PER LEGAL
- HOLLAND DRAIN DISTRICT PER LEGAL
- HUNTOON DRAIN DISTRICT PER DRAWING
- JOHN E. OLSEN DRAIN DISTRICT PER LEGAL
- JOACHIM DRAIN DISTRICT PER LEGAL
- JOHNSON DRAIN DISTRICT PER LEGAL
- KASPER DRAIN DISTRICT PER LEGAL
- LEVINSON DRAIN DISTRICT PER LEGAL
- MAPLEHURST DRAIN DISTRICT PER LEGAL
- MAPLEHURST DRAIN DISTRICT PER DRAWING
- McPHERSON DRAIN DISTRICT PER DRAWING
- PRIMARY DRAIN DISTRICT PER DRAWING
- SINKING BRIDGE DRAIN DISTRICT PER DRAWING
- VINEWOOD DRAIN DISTRICT PER LEGAL
- VINEWOOD DRAIN DISTRICT PER DRAWING

ORCHARD, HILTZ & McCLIMENT, INC.
34000 Plymouth Road
Livonia, MI 48150
(734) 522-6711

County Drainage District Restrictions

Drain	Discharge Rate
Bartlett	0.20 cfs/acre
Brown	0.10 cfs/acre
Dutton	*Call County*
Galloway	0.097 cfs/acre
Galloway Lake Farms	0.20 cfs/acre
Harmony	0.20 cfs/acre
Hobart	0.09 cfs/acre
Holland	0.0776 cfs/acre
Huntoon	0.20 cfs/acre
Joachim	See Joachim Drain Plans for Subarea Requirements
Johnson	See Johnson Drain Plans for Subarea Requirements
Kasper	See Kasper Drain Plans for Subarea Requirements
Levinson	*Call County*
Maplehurst	0.20 cfs/acre
McPherson	0.20 cfs/acre
Olsen	0.0776 cfs/acre
Primary	0.20 cfs/acre
Sinking Bridge	0.0776 cfs/acre
Vinewood	0.0776 cfs/acre


ABRAMS
AERIAL SURVEY CORPORATION
SCALE 1" = 200'
CONTOUR INTERVAL 2'
(2) CONTOURS PHOTOGRAMMETRICALLY INTERPOLATED. STANDARD VERTICAL ACCURACIES REDUCED BY THE USE OF HIGHER ALTITUDE PHOTOGRAPHY.
DATE OF PHOTOGRAPHY NOVEMBER 1979
DATE OF MAPPING JULY 1982
N
TOPOGRAPHIC MAP
PART OF
SEC. 14, 15, 22 & 23, PONTIAC TWP.,
OAKLAND COUNTY, MICHIGAN
PREPARED FOR
OAKLAND COUNTY DRAIN COMMISSIONER
PONTIAC, MICHIGAN
GALLOWAY LAKE WEIR
SEE SHEET 1B FOR
DESIGN CALCULATIONS
GALLOWAY LAKE
ELEV. 904.3
(APRIL 1982)
M.H. 1
7.60 AC.@ C=.35
M.H. 2
9.28 AC.@ C=.35
M.H. 3
11.56 AC.@ C=.35
BAY
ST.
PALMER
DR.
GRAND
TRUNK
WESTERN
M.H. 27
6.25 AC.@ C=.35 Tc=23 min.
M.H. 26
3.35 AC.@ C=.35
M.H. 23
2.63 AC.@ C=.40
M.H. 22
26.29 AC.@ C=.40, Tc=30 min.
M.H. 42
11.41 AC.@ C=.40 Tc=26 min.
M.H. 38
13.9 AC.@ C=.40 Tc=25 min.
M.H. 37
10.90 AC.@ C=.50, Tc=25 min.
193 AC.@ C=.40, Tc=61 min.

GEORGE W. KUHN
OAKLAND COUNTY DRAIN COMMISSIONER
NO. 1 PUBLIC WORKS DRIVE, PONTIAC, MICHIGAN 48054

JOACHIM RELIEF DRAINS
CITY OF PONTIAC, OAKLAND COUNTY, MICHIGAN

DRAINAGE BREAK-UP

DESIGNED BY: G.Y.	REV.	SHEET NO.
DRAWN BY: J.B.	REV.	1A OF 20
DATE: 6-22-83	REV.	

DESIGN CALCULATIONS

$Q = CIA$ $\qquad Q = \frac{1.486A}{n} R^{2/3} S^{1/2}$

STREET	FROM M.H.	TO M.H.	INCREMENT ACRES A	C	EQUIV. AREA 100% ACRES CA	TOTAL AREA 100% ACRES ECA	T. TIMES MIN.	I. IN. PER HOUR	Q=CIA C.F.S. FLOW	CAPACITY OF SEWER C.F.S.	DIAM. OF PIPE IN.	LENGTH OF LINE FT.	SLOPE OF PIPE %	SLOPE OF HG %	VEL. FLOW FULL FT/SEC	TIME OF FLOW MIN.	H.G. ELEV. UPPER END	INVERT ELEV. UPPER END RIM ELEV.	INVERT ELEV. Δ H.G.	INVERT ELEV. UPPER END	INVERT ELEV. LOWER END
	42	41	11.41	.40	4.56	4.56	25	3.50	15.96	11.31	24	32	.25	.50	3.60	.15	921.97	922.50	.16	918.66	918.50
	41	40	2.09	.40	.84	5.40	25.15	3.49	18.85	11.31	24	200	.25	.69	3.60	.93	921.81	922.50	1.39	918.50	918.00
	40	39	1.33	.40	.53	5.93	26.08	3.43	20.34	19.66	24	360	.42	.81	4.67	1.29	920.92	922.50	2.91	918.00	916.50
ASPHALT COATED CMP, n=.024	39	10	—	—	—	5.93	27.37	3.34	19.81	29.76	24	260	1.73	.77	9.47	.46	917.51	924.60	1.99	916.50	912.00
	10	5	.36	.40	.14	6.07	27.83	3.31	20.09	13.53	24	82	1.22	2.69	4.31	.32	916.52	916.90	2.20	909.00	908.00
	38	30	13.90	.40	5.56	5.56	25	3.50	19.46	16.47	24	284	.53	.74	6.24	.90	928.70	929.00	2.10	926.50	925.00
	37	36	10.90	.50	5.45	5.45	25	3.50	19.08	24.61	30	145	.36	.22	5.01	.98	931.28	948.50	.31	929.99	928.97
	36	35	1.83	.50	.92	6.37	25.98	3.47	22.10	24.61	30	87	.36	.29	5.01	.29	930.91	944.75	.25	928.97	928.66
	35	34	—	—	—	6.37	25.77	3.45	21.98	24.61	30	302	.36	.29	5.01	1.00	930.44	945.00	.87	928.66	927.67
	34	33	8.18	.50	4.09	10.96	26.77	3.38	35.35	40.02	36	340	.36	.28	5.66	1.00	929.21	941.50	.96	927.07	925.85
	33	32	1.39	.50	.70	11.16	27.77	3.32	37.05	40.02	36	90	.36	.30	5.66	.26	928.24	943.00	.28	925.85	925.53
	32	31	—	—	—	11.16	28.03	3.30	36.83	40.02	36	222	.36	.30	5.66	.65	927.81	939.50	.68	925.53	924.73
	31	30	—	—	—	11.16	28.68	3.26	36.38	40.02	36	202	.36	.30	5.66	.59	927.00	936.75	.60	924.73	924.00
	30	29	1.34	.50	.67	17.39	29.27	3.22	56.00	58.67	42	200	.34	.31	6.10	.55	924.74	930.00	.62	922.00	921.32
	29	28	1.99	.40	.60	17.99	29.82	3.19	57.39	58.67	42	290	.34	.33	6.10	.79	924.05	927.25	.94	921.32	920.33
	28	14	—	—	—	17.99	30.61	3.15	56.67	58.67	42	80	.34	.32	6.10	.22	923.11	925.00	.25	920.33	920.06
	27	26	6.25	.35	2.19	2.19	23	3.64	7.97	6.03	18	305	.33	.58	3.41	1.49	926.03	926.30	1.76	920.50	919.50
	26	25	3.35	.35	1.17	3.36	24.49	3.54	11.89	6.03	18	230	.33	1.28	3.41	1.12	924.27	926.40	2.95	919.50	918.75
	25	24	1.04	.35	.36	3.72	25.61	3.46	12.87	9.85	18	105	.88	1.50	5.58	.31	921.32	925.00	1.58	918.75	917.83
	24	13	.48	.35	.17	3.89	25.92	3.44	13.38	9.85	18	95	.88	1.62	5.58	.28	919.74	920.47	1.54	917.83	917.00
	23	22	2.63	.35	.93	.93	20	3.89	3.62	4.70	18	324	.20	.12	2.66	2.03	929.08	926.75	.38	922.67	922.02
	22	21	26.29	.35	9.20	10.13	30	3.18	32.21	36.53	36	156	.30	.23	5.17	.50	923.70	930.75	.36	921.02	920.55
	21	20	.71	.35	.25	10.38	30.50	3.15	32.70	37.73	36	308	.32	.24	5.34	.96	923.34	928.75	.74	920.55	919.56
	20	15	5.04	.35	1.76	12.14	31.46	3.10	37.63	40.02	36	156	.36	.32	5.66	.46	922.60	927.00	.50	919.56	919.70
	19	18	9.14	.40	1.66	1.66	20	3.89	6.46	8.52	15	172	1.74	1.00	6.94	.41	934.72	944.40	1.72	932.00	934.00
	18	17	1.25	.40	.50	2.16	20.41	3.85	8.32	16.34	18	244	2.42	.63	9.25	.44	928.83	940.15	1.53	932.00	926.10
	17	16	3.43	.40	1.37	3.53	20.86	3.82	13.48	19.59	24	284	.75	.36	6.24	.76	927.81	931.50	1.00	925.60	923.47
	16	15	7.62	.40	3.05	6.58	21.61	3.75	24.68	19.59	24	396	.75	1.19	6.24	1.06	926.81	922.50	4.71	923.47	920.50
ENTIRE TO 54"Ø CONCRETE PIPE	15	14	3.43	.40	1.37	20.09	31.92	3.07	61.68	60.57	42	392	.36	.38	6.27	1.04	921.10	928.15	1.99	918.91	917.50
	14	13	8.88	.40	3.55	41.63	32.96	3.02	125.72	94.31	57 x 68	107	.23	.41	5.93	.30	919.63	928.50	.44	917.50	916.50
	13	12	.93	.40	.37	45.89	33.26	3.00	137.67	90.12	54	362	.21	.99	5.67	1.06	914.77	923.50	1.77	913.75	912.00
	12	11	3.59	.35	1.26	47.15	34.32	2.95	139.09	219.86	54	352	1.25	.50	13.82	.42	913.00	923.50	1.76	912.00	908.10
	11	3	4.74	.35	1.66	48.81	34.74	2.93	143.01	171.43	54	360	.76	.53	10.78	.56	911.24	915.00	1.90	908.10	905.35
	EX.	9	193	.40	77.20	77.20	61	2.03	156.72	192.75	60	88	2.89	.36	12.55	.07		—	.32	932.04	929.50
	9	8	—	—	—	77.20	61.07	2.03	156.72	175.89	54	328	.80	.64	11.06	.49	929.68	932.25	2.08	926.62	924.00
	8	7	—	—	—	77.20	61.56	2.02	155.94	175.89	54	83	.80	.63	11.06	.13	923.62	926.70	.52	920.16	919.50
	7	6	8.70	.50	9.35	81.55	61.69	2.02	164.73	175.89	54	260	.80	.70	11.06	.39	918.92	935.50	1.82	915.58	913.50
ASPHALT COATED, PIPE ARCH CMP, n=.019	6	5	5.71	.40	2.28	83.83	62.08	2.02	168.50	175.89	54	258	.80	.73	11.06	.39	915.21	927.75	1.89	909.66	907.60
n=.019	5	4	9.57	.40	3.83	93.73	62.47	2.00	187.96	97.98	52 x 77	353	.18	.67	9.10	1.83	913.82	917.25	2.35	907.10	906.36
WITHOUT COATED PIPE ARCH CMP, n=.023	4	3	1.97	.40	.79	94.52	63.90	1.97	186.20	97.98	52 x 77	248	.18	.66	9.10	1.01	910.97	912.50	1.63	906.36	905.92
n=.023	3	2	11.56	.35	9.05	147.38	64.91	1.95	287.39	252.56	75 x 112	345	.24	.31	5.02	1.15	909.34	912.00	1.07	904.00	903.07
n=.023	2	1	9.28	.35	3.25	150.63	66.06	1.92	289.21	252.56	75 x 112	330	.24	.31	5.02	1.10	908.27	911.50	1.04	903.07	902.28
n=.023	1	OUTLET	7.60	.35	2.66	153.29	67.16	1.90	291.25	252.56	75 x 112	325	.24	.32	5.02	1.08	907.23	911.00	1.04	902.28	901.50

DESIGN DATA FOR GALLOWAY LAKE WEIR

BASED UPON FLOOD ROUTING METHOD DEVELOPED BY PROFESSOR CHESTER J. ORDON, WAYNE STATE UNIVERSITY.

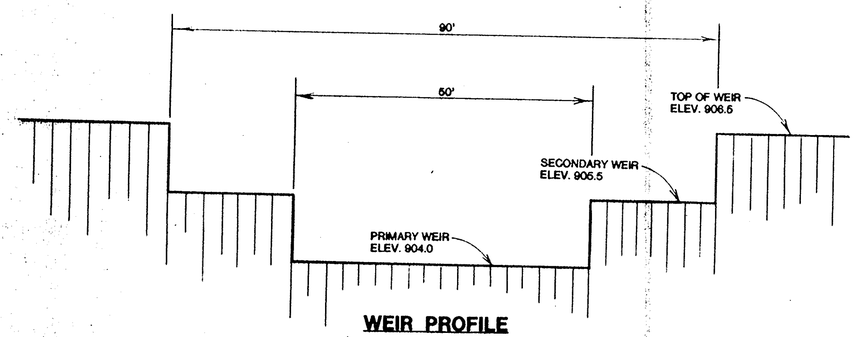
FOR 100 YEAR STORM, 24 HOUR DURATION, Tc = 6.5 HOURS

CONTRIBUTING WATERSHED = 6951 ACRES
Q OVER WEIR = 470 CFS
STAGE RISE = 1.9 FEET, TO ELEVATION 906.4'
STORAGE IN GALLOWAY LAKE = 3,596,400 C.F.

WEIR CALCULATIONS

THE FLOW CAPABILITY OF THE GALLOWAY LAKE WEIR, AS DETERMINED BY THE WEIR EQUATION, $Q = CLH^{3/2}$, IS AS FOLLOWS:

	ELEVATION	STAGE RISE, FT.	Q, IN CFS
PRIMARY WEIR CREST	904.0	0	0
	904.5	0.5	66.6
	905.0	1.0	188.4
SECONDARY WEIR CREST	905.5	1.5	309.3
	906.0	2.0	524.1
TOP OF WEIR	906.5	2.5	799.7



WEIR PROFILE

ALSO, SEE SHEET NO. 13 FOR GALLOWAY LAKE WEIR CONSTRUCTION DETAILS.

GEORGE W. KUHN
OAKLAND COUNTY DRAIN COMMISSIONER
ONE PUBLIC WORKS DRIVE, WATERFORD, MICHIGAN 48328-1907

JOACHIM RELIEF DRAINS
CITY OF PONTIAC, OAKLAND COUNTY, MICHIGAN

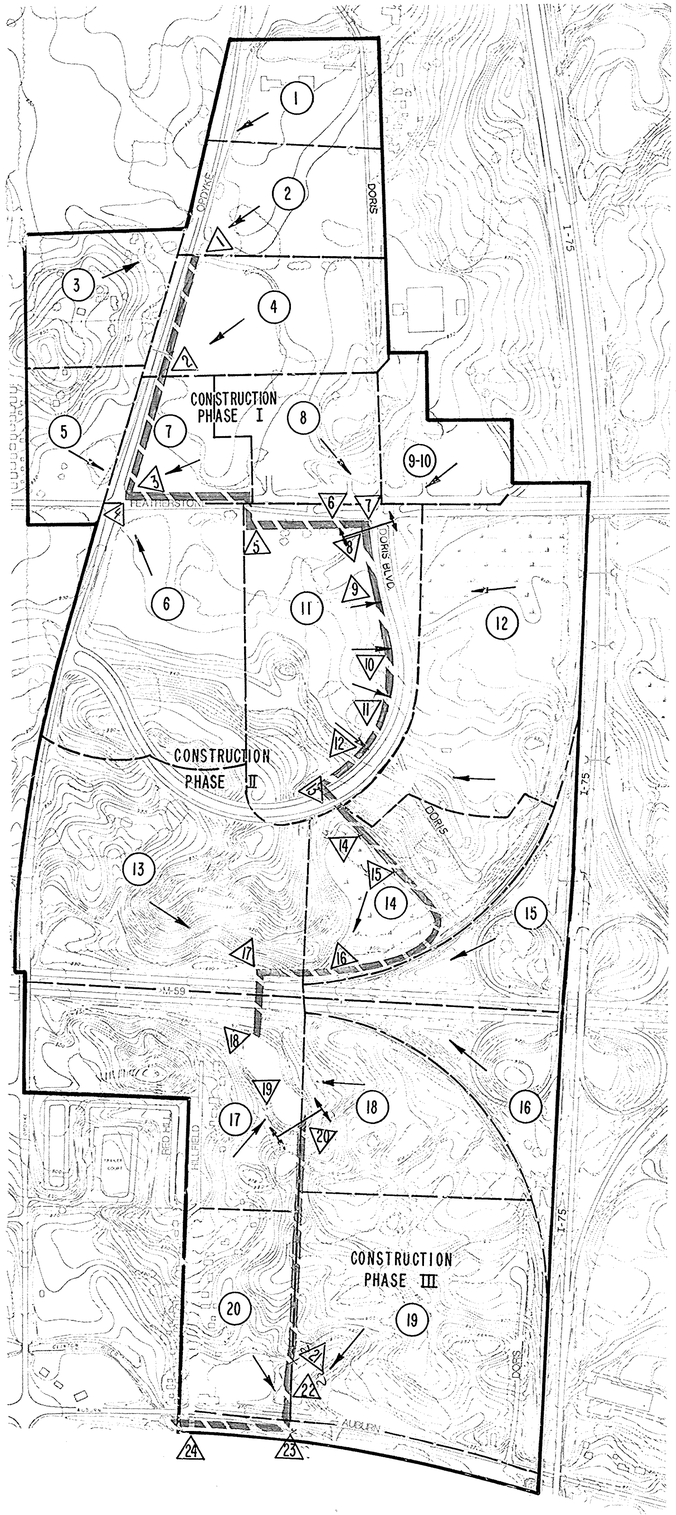
DESIGN CALCULATIONS

DESIGNED BY: G.Y.	REV.
DRAWN BY: J.B.	REV.
DATE: 6 - 22 - 83	REV.

SHEET NO. 18 of 20

JOHNSON DRAIN

DRAINAGE DISTRICT MAP AND DESIGN CALCULATIONS



DRAINAGE AREA CHART		
AREA NUMBER	AREA IN ACRES	RUNNOFF COEFFICIENT
1	12.47	0.67
2	16.44	0.67
3	8.08	0.67
4	9.00	0.67
5	6.00	0.67
6	28.19	0.67
7	5.94	0.67
8	11.94	0.67
9	4.00	0.67
10	5.55	0.67
11	30.81	0.67
12	41.05	0.67
13	50.51	0.67
14	30.58	0.56
15	14.42	0.30
16	12.95	0.30
17	32.23	0.67
18	22.96	0.67
19	50.51	0.67
20	14.05	0.67
	TOTAL= 408 ACRES	

STORM SEWER DESIGN

JOHNSON DRAIN OAKLAND COUNTY - CITY OF AUBURN HILLS
JOB # 105-85-010
15-Jan-92 17:27:43

I=125/(t+25) 10 YEAR STORM

a RUNOFF FROM DES. PT.	b RUNOFF TO DES. PT.	c CONTRIB. AREA	d INCRE. AREA (ACRES)	e IMPERVIOUS FACTOR "C"	f EQUIV. AREA (d x e)	g CUMULATIVE EQUIV. AREA	h TIME OF CONCENT. (minutes)	i RAINFALL RATE (in/hr)	j QUANTITY OF RUNOFF (c.f./s)	k LENGTH OF PIPE (feet)	l DIAMETER OF PIPE (inches)	m PIPE ROUGHNESS	n SLOPE OF H.G. (I)	o DISCHARGE Q (FULL) (c.f./s)	p VELOCITY V (FULL) (ft./sec)	q TIME TO NEXT M.H. (minutes)	r SLOPE (I)
1	2	1,2,3	36.99	0.67	24.78	24.78	35.0	2.92	72.28	578.00	54.00	0.013	0.142	72.58	4.63	2.4	0.142
2	3	4	9.00	0.67	6.03	30.81	37.4	2.88	88.61	558.00	60.00	0.013	0.111	93.98	4.78	1.9	0.111
3	4	5,7	11.94	0.67	8.00	38.81	39.3	2.72	105.63	154.00	66.00	0.013	0.101	158.18	6.32	0.4	0.201
4	5	--	0.00	0.00	0.00	38.81	39.7	2.70	104.97	201.00	66.00	0.013	0.101	158.18	6.32	1.0	0.201
5	6	6	28.19	0.67	18.89	57.70	41.5	2.63	151.84	548.00	66.00	0.013	0.201	212.38	8.54	1.8	0.401
6	8	--	0.00	0.00	0.00	57.70	42.5	2.59	149.59	158.00	66.00	0.013	0.201	212.38	*8.54	0.3	0.401
7	8	8,9,10	21.43	0.67	11.93 *	11.93	42.4	2.60	30.98	125.00	36.00	0.013	0.222	31.28	6.43	0.5	0.222
8	9	--	0.00	0.00	0.00	69.63	42.8	2.58	179.72	520.00	72.00	0.013	0.122	287.16	8.65	1.0	0.241
9	10	11,12	47.51	0.67	32.10	101.73	43.8	2.54	258.76	314.00	84.00	0.013	0.163	325.74	8.46	0.6	0.262
10	11	11,12	0.00	0.67	0.00	101.73	44.4	2.52	256.52	238.00	90.00	0.013	0.122	351.68	7.97	0.5	0.211
11	12	11,12	0.00	0.67	0.00	101.73	44.9	2.50	254.49	282.00	96.00	0.013	0.082	341.27	6.79	0.8	0.142
12	13	11,12	0.00	0.67	0.00	101.73	45.7	2.48	251.81	155.00	96.00	0.013	0.082	341.27	6.79	0.4	0.142
13	14	11,12	23.95	0.67	16.05	117.78	46.1	2.46	289.80	378.00	96.00	0.013	0.102	341.27	6.79	0.9	0.142
14	15	--	0.00	0.00	0.00	117.78	47.0	2.43	286.27	308.00	96.00	0.013	0.102	459.57	9.54	0.6	0.282
15	16	--	0.00	0.00	0.00	117.78	47.6	2.41	283.90	209.00	96.00	0.013	0.102	388.96	7.78	0.6	0.182
16	17	14	38.58	0.56	17.12	134.90	48.2	2.39	322.51	241.00	96.00	0.013	0.133	397.57	7.91	0.5	0.152
17	18	13,15	64.93	0.58	37.66	172.56	48.7	2.37	409.74	413.00	96.00	0.013	0.201	397.57	7.91	0.9	0.152
20	21	16,17,18	68.14	0.68	48.69	213.44	127.8	1.15	245.74	1,144.00	66.00	0.013	0.542	257.94	10.86	1.8	0.592
21	22	--	0.00	0.67	0.00	213.44	128.8	1.14	242.86	386.00	OPEN CH.	0.040	0.101	247.81	3.62	1.4	0.212
22	23	--	64.55	0.67	43.25	256.69	130.2	1.13	289.44	185.00	12x4 BOI	0.013	0.163	295.86	6.15	0.3	0.892
23	24	--	0.00	0.67	0.00	256.69	128.5	1.13	288.80	336.00	12x4 BOI	0.013	0.163	295.86	6.15	0.9	0.892
			408		256.69				8,833.80								

* = EQUIV. AREA MODIFIED TO ACCOUNT FOR FLOW TO WETLAND

LEGEND (This Sheet):

- PROPOSED ROUTE OF JOHNSON DRAIN
- (1) AREA LOCATION NUMBER
- 4 DESIGN FLOW LOADING POINT
- DRAINAGE DISTRICT BOUNDARY
- DRAINAGE DISTRICT SUBDIVISION
- DRAINAGE DIRECTION TO DESIGN POINT

LEGEND (Plans):

- PROPOSED STORM MANHOLE (MH 3)
- PROPOSED STORM CATCH BASIN (CB 4)
- EXISTING STORM MANHOLE
- EXISTING SANITARY MANHOLE
- EXISTING WATER GATE VALVE
- EXISTING HYDRANT
- EXISTING TELEPHONE POLE
- EXISTING POWER POLE
- EXISTING MONUMENT
- SIGN
- TREE (8"DIAMETER TRUNK)
- EXISTING UTILITY MANHOLE
- OVERHEAD TELEPHONE LINE OR GAS MAIN
- EXISTING SANITARY SEWER OR STORM SEWER
- EXISTING WATER MAIN
- (2) SOIL BORING REFERENCE LOCATION
- SILT FENCE / SILT FENCE W/ CHECK DAM
- EASEMENT ACQUISITION NUMBER

48 HOURS BEFORE YOU DIG CALL MISS DIG 800-482-7171 (TOLL FREE)

ISSUE NO.	BID DATE
B.C. DRN. J E	DATE
TOPO DRN. J E	DESIGN D J H
PROFILE DRN.	CHD. DRN. M M B
APPRO. EC	SCA E
AS-BUILT	H 400
REVISIONS	2-12-92

JOHNSON DRAIN
DRAINAGE DISTRICT MAP

ORCHARD, HILTZ & McCLIMENT, INC.
ENGINEERING SURVEYING
CONSULTING ENGINEERS
34935 SCHOOLCRAFT ROAD
LIVONIA, MICHIGAN 48150
(313) 522-7111

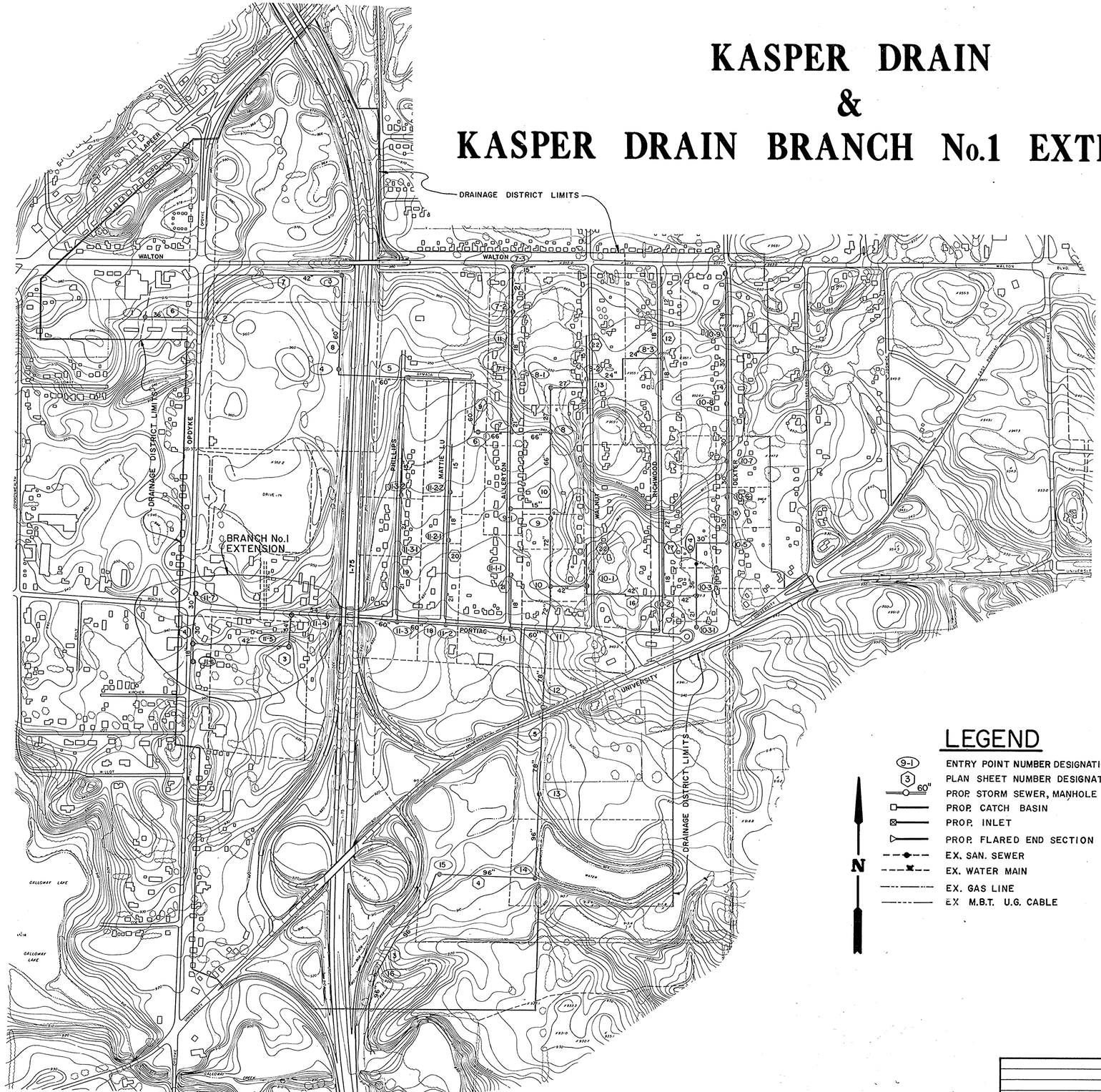
CLIENT: OAKLAND COUNTY DRAIN COMMISSION

F. B.	SHEET	JOB NO.
TOPO. M M B LEVELS:	2 OF 27	105-85-010

BRUNING 44-132 59541

BRUNING 5014+

KASPER DRAIN
&
KASPER DRAIN BRANCH No.1 EXTENSION



LEGEND

- 9-1 — ENTRY POINT NUMBER DESIGNATION ON PLANS
- 3 — PLAN SHEET NUMBER DESIGNATION
- 60" — PROP. STORM SEWER, MANHOLE & SIZE
- PROP. CATCH BASIN
- PROP. INLET
- PROP. FLARED END SECTION
- EX. SAN. SEWER
- EX. WATER MAIN
- EX. GAS LINE
- EX M.B.T. U.G. CABLE

HYDRAULIC COMPUTATIONS

DESIGN BASIS= 10 YEAR STORM
RATIONAL FORMULA Q= AIR
n = 0.013 FOR SIZES 84" AND SMALLER
n = 0.011 FOR SIZES LARGER THAN 84"

N= ENTRY POINT NUMBER AND AREA DESIGNATION
A= ACREAGE CONTRIBUTING
I = IMPERVIOUSNESS FACTOR
AI= EQUIVALENT AREA
R= RAINFALL RATE (IN./HR.)
T_1= TIME OF CONCENTRATION (MIN.)
T_2= TIME OF FLOW TO NEXT INLET POINT
Q= QUANITY OF RUNOFF (C.F.S.)
L= LENGTH OF PIPE BETWEEN INLET POINTS (FT.)
D=DIAMETER OF PIPE (IN.)
S= SLOPE OF HYDRAULIC GRADIENT (%)
V= VELOCITY (F.P.S.)

N	A	I	AI	ACC AI	R	Q	T_1	T_2	D	L	S	V	HYD.GR
1	26.1	0.45	11.75	11.75	3.24	38	29	1.5	36	470	0.34	5.4	957.00
2	11.1	0.45	5.00	16.75	3.15	53	30.5	4.0	42	1335	0.29	5.6	954.31
3	51.9	0.65	33.74	50.49	2.94	148	34.5	1.5	60	136	0.35	7.8	953.44
4	34.0	0.65	22.10	72.59	2.87	208	36.0	0.8	60	511	0.66	10.7	947.87
5	16.8	0.37	6.21	78.80	2.83	223	36.8	1.4	60	1923	0.80	11.8	941.50
6	4.3	0.35	1.51	80.31	2.77	223	38.2	0.4	66	267	0.45	9.6	935.32
7-3	7.0	0.50	3.50	3.50	3.89	14	20	0.7	21	353	1.40	5.8	959.72
7-2	2.1	0.35	0.74	4.24	3.83	16	20.7	0.8	18	430	2.30	9.0	954.82
7-1	3.0	0.35	1.05	5.29	3.76	20	21.5	0.8	21	504	1.70	9.0	947.93
7	3.8	0.35	1.33	86.93	2.75	239	38.6	0.5	66	325	0.56	10.5	935.19
8-3	13.6	0.33	4.49	4.49	3.80	17	21	2.2	24	742	0.60	5.6	953.45
8-2	10.2	0.35	3.57	8.06	3.63	29	23.2	0.6	27	337	1.08	7.4	948.10
8-1	10.8	0.30	3.24	11.30	3.59	40	23.8	0.7	27	353	1.80	10.4	942.36
8	9.1	0.33	3.00	101.23	2.73	277	39.1	0.9	66	672	0.76	12.2	928.27
9-1	4.6	0.35	1.61	1.61	3.89	6	20	1.1	15	307	0.80	4.7	933.83
9	3.0	0.33	0.99	103.83	2.69	280	40	0.6	72	479	0.46	10.0	928.15
10-9	13.9	0.38	5.27	5.27	3.80	20	21.1	2.4	30	585	0.24	4.1	945.00
10-8	6-1	0.33	2.01	7.28	3.81	26	23.5	1.4	30	450	0.42	5.4	943.69
10-7	3.7	0.33	1.22	8.50	3.81	30	24.9	0.8	30	380	0.56	6.2	941.71
10-6	3.0	0.33	0.99	9.49	3.45	33	25.7	0.9	30	360	0.70	6.9	940.14
10-5	5.3	0.33	1.75	11.24	3.39	38	26.6	0.9	30	437	0.93	7.9	937.62
10-4	6.6	0.33	2.18	13.42	3.33	45	27.5	0.6	36	240	0.48	6.5	933.69
10-3-1	6.6	0.40	2.64	2.64	3.80	10	21	1.0	21	248	0.42	4.2	933.58
10-3	3.1	0.33	1.02	17.08	3.30	56	28.1	0.7	42	260	0.56	6.2	932.54
10-2	8.5	0.35	2.98	20.06	3.25	65	28.8	1.4	42	662	0.48	7.2	931.63
10-1	18.6	0.35	6.51	26.57	3.17	84	30.2	0.7	42	306	0.80	9.0	928.40
10	4.1	0.33	1.35	131.75	2.66	350	40.8	0.5	72	343	0.72	12.4	925.96
11-7	25.9	0.65	16.83	16.83	3.21	54	29.6	0.6	30	394	1.80	11.0	932.26
11-6	6.3	0.50	3.15	19.98	3.17	63	30.2	1.5	42	621	0.40	6.6	930.17
11-5	18.2	0.45	8.19	28.17	3.09	87	31.7	2.2	54	725	0.20	5.5	927.69
11-4	22.8	0.60	13.69	41.86	2.97	124	33.9	1.4	60	513	0.24	6.4	926.24
11-3-2	9.3	0.35	3.25	3.25	3.89	13	20	1.5		481	0.69	5.5	935.57
11-3-1	4.7	0.35	1.65	4.90	3.76	18	21.5	1.1	21	518	1.40	7.6	932.35
11-3	9.0	0.35	3.15	43.91	2.90	145	35.3	0.9	60	379	0.32	7.5	922.10
11-2-2	6.4	0.37	2.37	2.37	3.89	9	20	1.5	18	472	0.80	5.4	932.53
11-2-1	2.7	0.37	1.00	3.37	3.76	13	21.5	1.5	21	498	0.66	5.3	933.75
11-2	6.5	0.37	2.40	55.68	2.88	159	36.2	1.0	60	512	0.40	8.4	923.79
11-1-1	4.5	0.35	1.58	1.58	3.89	6	20	1.9	18	407	0.34	3.5	934.58
11-1	7.8	0.35	2.73	59.99	2.81	169	37.2	0.6	60	292	0.44	8.7	921.74
11	6.5	0.38	3.23	194.97	2.64	515	41.3	0.7	78	605	1.00	15.0	920.30
12	20.2	0.35	7.07	202.04	2.61	527	42.0	0.5	78	573	1.04	15.6	912.83
13	29.2	0.35	10.22	212.26	2.59	550	42.6	1.2	96	766	0.27	11.0	916.87
14	19.6	0.35	6.86	219.12	2.54	556	42.8	1.2	96	784	0.28	11.3	931.80
15	32.5	0.35	11.38	230.50	2.50	576	45.0	1.2	96	850	0.39	11.6	932.60
16	86.0	0.35	30.80	261.30	2.46	642	46.2	0.9	96	709	0.36	12.5	930.25

ISSUE NO.	BID DATE
B.O. DRN. M.J.B.	DATE 4-20-81
TOPO DRN. M.J.B.	DESIGN D.V.
PROFILE DRN. M.J.B.	ENG. DRN. M.J.B.
APPROVED D.V.	SCALE V: H: 1"=400'

RECORD PLAN 11-12-82 LAR.
8-5-81 ISSUED FOR BIDS
REVISIONS

KASPER DRAIN
OAKLAND CO. PONTIAC TWP MICH.
DISTRICT MAP, SEWER ROUTE & HYDRAULIC COMPUTATIONS
CLIENT: OAKLAND COUNTY DRAIN COMMISSION

ORCHARD, PAPKE, HILTZ & McCLIMENT, INC.
CONSULTING ENGINEERS
34935 SCHOOLCRAFT ROAD
LIVONIA, MICHIGAN 48150
(313) 522-6711

TOPO: F. B.
LEVELS:
SHEET 2 OF 5
JOB NO. 105-80-010

The OCWRC office continues to collaborate with the George W. Kuhn Combined Sewer District communities in adopting Post-Construction stormwater standards to meet its Combined Sewer System NPDES permit requirements. Many of these communities have both separate and combined systems; the goal is to adopt similar Post-Construction standards that meet local and regional needs for both types of systems. Currently, the standards outlined herein are encouraged to be used in the GWK combined district; collaboration continues with a goal of adoption of these standards in both MS4 and combined sewer communities.

These standards supersede all previous versions and revisions, and updates will be available on the OCWRC's website (www.oakgov.com/water) including registration information to receive revisions and updates to these standards as they become available. These standards are intended to be a living document and updated as necessary to reflect ongoing changes to climate and regulatory conditions. Before submitting a site plan for stormwater permitting, check the OCWRC website above for the most recent version of the standards.

Part D: Channel Protection Volume Control

Channel Protection Volume Control (CPVC) is necessary to protect natural watercourses from increased erosion and sedimentation as a result of increased imperviousness and runoff volume as development occurs. CPVC also promotes groundwater recharge, stabilizes flow rates and baseflow in our natural watercourses, and addresses water quality control criteria (Total Suspended Solids).

CPVC shall be implemented to the Maximum Extent Practicable (MEP). The required Channel Protection Volume ($V_{CP\text{-}R}$) is the post-development site runoff volume from a 1.3-inch rainfall event.

The following CPVC implementation process is summarized in **Appendix F (Channel Protection Flowchart).**

The Channel Protection Volume Control (CPVC) volume is intended to control runoff volume under post-development conditions for a 1.3-inch rainfall event

1. Implement land use practices that limit the increase in runoff volume, such as LID practices including (but not limited to) a design emphasis on naturalized areas (i.e., meadow or wooded areas vs. turf grass), reduced impervious coverage, etc.

2. Calculate the required Channel Protection Volume using the following equation:

$$V_{CP-R} = 4{,}719\ x\ C\ x\ A \qquad \text{(Eq. 1)}$$

where:

C is the post-development runoff coefficient

A is the contributing area in acres

$V_{CP\text{-}R}$ is the required CPVC volume in cubic feet

3. Provide adequate infiltration and/or storage/reuse BMPs, to the MEP, to provide the calculated CPVC volume. This may include (but is not limited to) bioretention, rain gardens, bio-swales, pervious pavement, cisterns, green roofs, and infiltration trenches. For water reuse BMPs (i.e., cisterns), water demand (such as gray water or irrigation water) must be established and documented to show adequate drawdown times.

    a. When the measured in-situ infiltration rate is above 0.5 in/hr., supplemental measures, such as subsoil amendments and/or a perforated underdrain system, are not required.
    b. When the measured in-situ infiltration rate is between 0.24 in/hr. and 0.5 in/hr., soils are marginally suitable for infiltration BMPs, and supplemental measures are required. Supplemental measures may include subsoil amendment, or an underdrain located at the top of the storage bed layer to maximize infiltration.
    c. When the measured in-situ infiltration rate is less than 0.24 in/hr., infiltration is deemed impractical, and the use of this BMP is therefore waived. When infiltration is waived, other volume-reducing LID practices must be implemented to the MEP.
    d. Infiltration BMPs shall completely dewater in less than 72 hours, consisting of 24-hour dewatering for the surface volume, and 48-hour dewatering of the void space (soil storage) volume. Water storage/reuse BMPs shall also be designed to fully dewater within 72 hours.

4. Pretreatment is required for all BMPs to remove fine sediment, trash, and debris to preserve the longevity and function of the BMPs.

    a. Common methods of BMP pretreatment include mechanical separators, sediment forebays, vegetated filter strips, vegetated swales, constructed filters, and curb cuts with sediment traps.

Channel Protection Volume Control (infiltration) is required when the measured in-situ infiltration rate is ≥ 0.24 inches/hour and groundwater is at least 2 feet below the bottom layer of the proposed BMP

5. To incentivize and encourage stormwater infiltration on all sites, the *provided* Channel Protection Volume, $V_{CP\text{-}P}$) can be subtracted from the required 100-year detention volume, V_{100D} (see equations in Part G below). Upon subtracting the provided Channel Protection Volume from the required 100-year detention volume, the resulting volume cannot be less than the Extended Detention Volume (V_{ED}, see Part E below).

    For underground infiltration BMPs that are not easily accessible for inspection and maintenance, such as underground detention system infiltration, this Channel Protection Volume is generally not credited and will be evaluated on a case-by-case basis by the OCWRC's office.

    Infiltration BMPs are prohibited in areas containing contaminated soils/groundwater, wellhead protection areas, high seasonal groundwater (less than 2 feet from the bottom of the stone storage layer of the infiltration BMP to the seasonally high groundwater table) and in areas with hotspot activities and setback restrictions (foundations, property lines, drinking wells, septic fields, pavement, etc.) as defined in the standards. When any of the above adverse conditions are demonstrated, other volume-reducing LID practices must be implemented to the MEP.

Part E: Channel Protection Rate Control: Extended Detention

Channel Protection Rate Control (CPRC) is necessary to protect natural watercourses from increased erosion and sedimentation as a result of increased imperviousness and runoff rates as development occurs. Channel protection rate control is based on a 2-year / 24-hour storm. The CPRC shall be implemented to the MEP as outlined below.

1. Extended Detention is required for the site's post-development runoff volume from a 1.9-inch rainfall event. This Extended Detention Volume (V_{ED}) shall be dewatered in not less than 48 hours.
2. Calculate the required Extended Detention Volume using the following equation:

$$V_{ED} = 6{,}897\ x\ C\ x\ A \qquad \text{(Eq. 2)}$$

where:

C is the post-development runoff coefficient

A is the contributing area in acres

V_{ED} is the required Extended Detention Volume in cubic feet

3. The Extended Detention requirement effectively maintains the 2-year pre-settlement peak flow rates, to the MEP, for new developments and reduces the existing 2-year peak flow rates for redevelopments.

Part F: Water Quality Control

Water Quality Control (WQC) focuses on limiting the concentration of Total Suspended Solids (TSS) in post-development runoff to either of the following water quality standards: 80 mg/L, or 80% TSS reduction. WQC shall be implemented to the MEP as outlined below.

WQC can be achieved one of several ways:

1. Infiltration (i.e., runoff volume-reducing) or water reuse BMPs that achieve the required Channel Protection Volume (V_{CP-R}, see Part D) meet the TSS requirements for only areas tributary to an infiltration BMP. If any areas on a site plan bypass infiltration BMPs, those areas must receive alternative TSS treatment (see below for other options).

2. Mechanical separators designed for the required TSS removal at a peak flow rate (Q_{WQ}) generated by a 1-year peak flow as calculated below:

$$Q_{WQ} = C\ x\ I_1 x\ A \qquad \text{(Eq. 3)}$$

where:

C is the post-development runoff coefficient

$$I_1 = \frac{30.2}{(T_C\ +\ 9.17)^{0.81}} \qquad \text{(Eq. 4)}$$

T_c = Time of Concentration (minutes)

maximum peak intensity ($I_{1\text{-}Max}$) = 2.0 inches/hour for smaller sites with time of concentration equal to or less than 15 minutes

minimum peak intensity ($I_{1\text{-}Min}$) = 1.0 inches/hour for larger sites with a time of concentration equal to or greater than 1 hour

A is the contributing area in acres

Q_{WQ} is the peak flow rate for mechanical separator design in cfs

3. Sediment forebay(s), when combined with downstream Extended Detention. Forebays shall be designed with a volume equal to 15% of the Water Quality Volume (0.15 x V_{WQ}) and capture heavy sediment at inlet pipe locations where access is provided to accommodate sediment removal equipment. The required sediment forebay volume, V_F, is calculated below:

$$V_F = 0.15 V_{WQ} =\ 545\ x\ C\ x\ A \qquad \text{(Eq. 5)}$$

where:

C is the post-development runoff coefficient

A is the contributing area in acres

V_{WQ} is the required Water Quality volume in cubic feet

4. The following treatment trains are effective at meeting the OCWRC water quality requirements:
   a. Bioretention BMPs (infiltration), discharging to a conventional detention basin* (wet or dry)
   b. Mechanical separator(s), discharging to a conventional detention basin* (wet or dry)
   c. Sediment forebay(s), discharging to a conventional detention basin* (wet or dry)

   * *Conventional detention basins include hydraulic controls for both V_{ED} and V_{100D}*

Part G: Detention & Flood Control

Detention and flood control is a critical component in stormwater design as it helps to prevent excess peak flows and reduces the likelihood of flooding downstream of a development site. The regional collaboration has resulted in the following Detention and Flood Control standards.

Detention and Flood Control shall be implemented to manage the ***100-year peak runoff rate*** for developed sites as outlined below. The allowable 100-year post-development peak flow rate (Q_{100P}) shall be approved by the OCWRC office on a case-by-case basis and will be calculated one of two ways:

1. Using the Variable Release Rate (see equations below)
2. County-determined peak flow rate based on a documented County Drain flow capacity or other known downstream capacity limitations (flow rate provided in cfs/acre)

OCWRC (or any local review authority) reserves the right to set a specific discharge rate that is below the Variable Release Rate where outlet capacity is restricted

Prior to commencing with site plan design, contact OCWRC staff to confirm which of the above methods is more restrictive and will apply to your site. The chosen method to determine the 100-year post-development peak flow rate can have a significant impact on required detention pond volume.

The Variable Release Rate and corresponding post-development peak flow rate are calculated as follows:

$$Q_{VRR} = 1.1055 - 0.206\ln(A) \quad \text{(Eq. 6)}$$

where:

Q_{VRR} is the allowable release rate in cfs/acre

A is the contributing area in acres

The variable release rate (cfs/acre) is capped at 1.0 cfs/acre for developments 2 acres or less. For all developments equal to or greater than 100 acres, the variable release rate is 0.15 cfs/acre.

$$Q_{100P} = Q_{VRR}\, x\, A \quad \text{(Eq. 7)}$$

where:

Q_{100P} is the allowable 100-year post-development peak flow rate in cfs

A is the contributing area in acres

If downstream capacity is insufficient for the proposed development, the developer can make improvements that may include construction of additional off-site conveyance capacity, improvements to the existing drain, acquisition of easements from downstream property owners, etc. The developer is responsible for securing all necessary easement(s) from downstream property owners and is responsible for all improvement costs.

All stormwater discharges from the proposed development site shall outlet within the watershed where flows originated, unless approval is obtained from the OCWRC's office. Offsite runoff shall bypass the proposed site's stormwater system. If this cannot be achieved, detailed hydrologic and hydraulic calculations shall be provided to the OCWRC office to demonstrate no adverse impacts downstream for the 10-year and 100-year storms.

When calculating the required detention volume, all on-site contributing drainage areas shall be used in the calculation. Volume stored within the forebay and extended detention area may be applied towards the required detention volume. Please refer to the **Appendix C – Variables, Profiles and Calculations** for typical detention basin profiles and stormwater design calculations.

The required 100-year detention volume (V_{100D}) is calculated as follows:

1. Calculate the total 100-year runoff volume (V_{100R}) under post-development conditions:

$$V_{100R} = 18{,}985 \; x \; C \; x \; A \qquad \text{(Eq. 8)}$$

where:

C is the post-development runoff coefficient

A is the contributing area in acres

V_{100R} is the post-development 100-year runoff volume in cubic feet

2. Calculate the 100-year peak inflow rate, Q_{100IN}, into the detention basin; this is the post-development peak instantaneous flow prior to (upstream of) the detention basin:

$$Q_{100IN} = C \; x \; I_{100} \; x \; A \qquad \text{(Eq. 9)}$$

$$I_{100} = \frac{83.3}{(T_C \; + \; 9.17)^{0.81}} \qquad \text{(Eq. 10)}$$

where:

Q_{100IN} is the 100-year post-development peak inflow rate in cfs

C is the post-development runoff coefficient

A is the contributing area in acres

I_{100} is the 100-year peak rainfall intensity in inches/hour

T_c is the Time of Concentration for the development site in minutes

3. Calculate the Storage Curve Factor for the 100-year detention volume (R):

$$R = [0.206 - 0.15\ln\left(\frac{Q_{100P}}{Q_{100IN}}\right)] \quad \text{(Eq. 11)}$$

where:

Q_{100IN} is the 100-year post-development peak inflow rate in cfs

Q_{100P} is the 100-year post-development peak flow rate in cfs

R is the Storage Curve Factor (dimensionless)

4. Finally, calculate the 100-year detention basin size, identifying any credits to the detention basin volume to reflect the provided Channel Protection Volume (V_{CP-P}))

$$V_{100D} = (V_{100R}\, x\, R) - V_{CP-P} \quad \text{(Eq. 12)}$$

where:

V_{100D} is the required 100-yr detention volume in cubic feet

V_{100R} is the 100-year runoff volume in cubic feet

R is the Storage Curve Factor (dimensionless)

V_{CP-P} is the ***provided*** CVPC volume in cubic feet

KEY RULE: $V_{100D} \geq V_{ED}$

When taking credit for infiltration volume, the resulting detention volume can never be less than the Extended Detention Volume (V_{ED})

Check to verify the adjusted 100-year detention basin volume is equal to or greater than the Extended Detention Volume (V_{ED}). Under no circumstances shall the adjusted detention basin volume be less than V_{ED}.

Part I: Stormwater Tracking & Mapping

Collecting data on site runoff characteristics is critical for OCWRC and the local review jurisdiction (if applicable) to meet ongoing EGLE permit requirements. This will be accomplished with a ***Land Use Summary Table***, which must be included on the O&M Plan Sheet of each submitted site plan (see table below). Additionally, GIS-based site data (in the form of a shapefile) will be required as a condition of site plan approval. GIS data will be limited to key stormwater components that will require future inspection and maintenance.

Land Use Summary

must be included on the O&M Plan Sheet for all site plans

	Characteristic	Existing Conditions	Proposed Conditions
	Total Development Area (ac)		
	Impervious Area (ac)		
	Total Pervious Area (ac)		
Pervious Area Land Use Data	**Pervious Area Breakdown by Cover Type**		
	Meadow/fallow/natural areas (non-cultivated)	x.xx acres	x.xx acres
	Predominant NRCS Soil Type (A, B, C, or D)		
	Improved areas (turf grass, landscape, row crops)	x.xx acres	x.xx acres
	Predominant NRCS Soil Type (A, B, C, or D)		
	Wooded Areas	x.xx acres	x.xx acres
	Predominant NRCS Soil Type (A, B, C, or D)		
	CPVC Volume ***Calculated*** (cubic feet)		
	CPVC Volume ***Provided*** (cubic feet)		
	CPRC Volume Provided (cubic feet)		

The Professional Engineer who signs and seals this site plan certifies that the values in this table reflect the OCWRC stormwater calculations required for this development and that geotechnical investigations were performed that provide conclusive documentation that demonstrates whether infiltration (i.e., CPVC Volume Control) is practicable.

Notes:

- *The Professional Engineer Certification Statement (see above) must be included with the Land Use Summary Table.*
- *Areas to be shown to the nearest 0.01 acre*
- *'Predominant' soil type shall the soil type with the largest percentage coverage over the designated land use (e.g., 70% Soil Type B and 30% Soil Type C shall be listed in the table as "Soil Type B")*
- *USDA soil types cannot be used to determine site suitability for infiltration and meeting the CPVC volume standard; direct infiltration testing will be required to determine site suitability for infiltration*
- *If CPVC requirement is waived, enter ZERO for the 'CPVC Volume Provided'*
- *When more than one soil type exists in one area, assign the predominant soil type for that area*
- *Use NRCS/USDA Online Soil Survey Map to determine soil type (A, B, C, or D):*
  https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

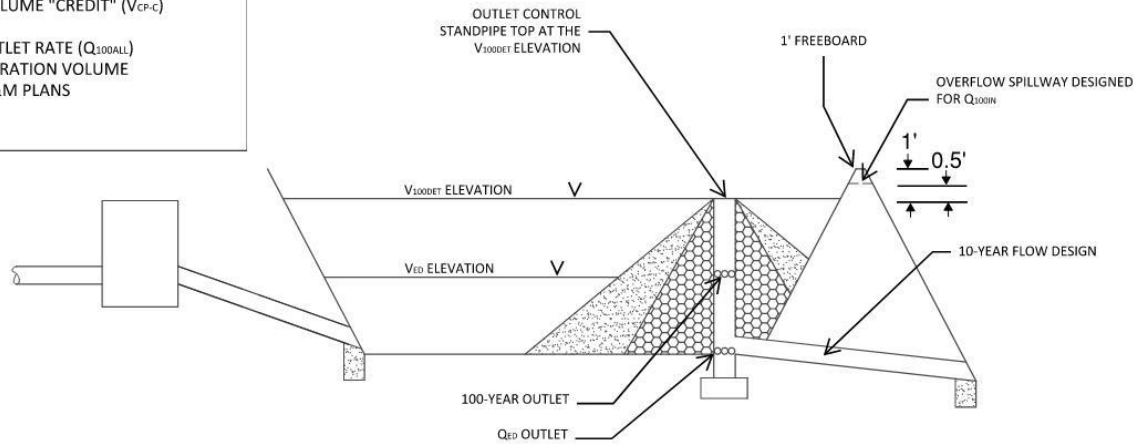
WRC
WATER RESOURCES COMMISSIONER
Jim Nash

Typical Detention Basin/Forebay Cross Sections

TYPICAL DETENTION BASIN WITH MECHANICAL SEPERATOR

REQUIRED PROFESSIONAL ENGINEER CERTIFICATIONS

-CHANNEL PROTECTION VOLUME "CREDIT" (V_{CP-C})
-INFILTRATION RATES
-100-YEAR ALLOWABLE OUTLET RATE (Q_{100ALL})
-MEP FOR ACHIEVED INFILTRATION VOLUME
-STORMWATER SYSTEM O&M PLANS



MECHANICAL SEPARATOR

REQUIRED WATER QUALITY TREATMENT IS 80 MG/L TSS, OR 80% TSS REMOVAL

SIZED BASED ON THE 1-YEAR WATER QUALITY PEAK FLOW RATE (Q_{WQ})

$Q_{WQ}= (C)(i_1)(A)$

REPLACES FOREBAY REQUIREMENT

INSTALLED OFFLINE AND UPSTREAM OF ANY DETENTION OR RETENTION BASIN

NOTES:
-MUST BE NJDEP CERTIFIED
-EXCLUDES UPSTREAM CONTRIBUTING AREA'S WHERE 1-INCH WATER QUALITY CONTROL IS PROVIDED THROUGH OTHER BMP'S

EXTENDED DETENTION VOLUME (V_{ED})

EXTENDED DETENTION CONTROLS THE 2-YEAR BANK FULL RELEASE RATE BY DEWATERING THE V_{ED} OVER 48-HOURS

$V_{ED}= (6,897)(C)(A)$

EXTENDED DETENTION OUTLET RATE

$Q_{ED}=(V_{ED})/(172,800)$

$H_{ED}=(V_{ED})/((4,666)(h)^{(1/2)})$

H_{ED}= NUMBER OF 1-INCH DEWATERING HOLES
h=TOTAL HEAD ON THE ORIFICES

100-YEAR POST-CONSTRUCTION INLET RATE (Q_{100IN})

$Q_{100IN}=(C)(I_{100})(A)$

$I = [(30.2033)(P^{0.2203})]/[(T_C + 9.1747)^{0.8069}]$

100-YEAR ALLOWABLE OUTLET RATE (Q_{100ALL})

THE ALLOWABLE 100-YEAR OUTLET RATE IS THE LESSER OF:

-OCWRC RESTRICTED RATE FOR THE DRAIN (Q_R)
-PRO-RATED SHARE OF THE DRAINS CAPACITY (Q_P)
OR
-THE VARIABLE RELEASE RATE (Q_{VRR})

$Q_{VRR}=1.1055 - 0.206LN(A)$

100-YEAR DETENTION VOLUME (V_{100DET})

$R=0.206-(0.15)(LN(Q_{100ALL}/Q_{100IN}))$

R=STORAGE CURVE FACTOR

$V_{100RUN}=(18,900)(C)(A)$

$V_{100DET}=(V_{100RUN})(R)-V_{CP-C}$

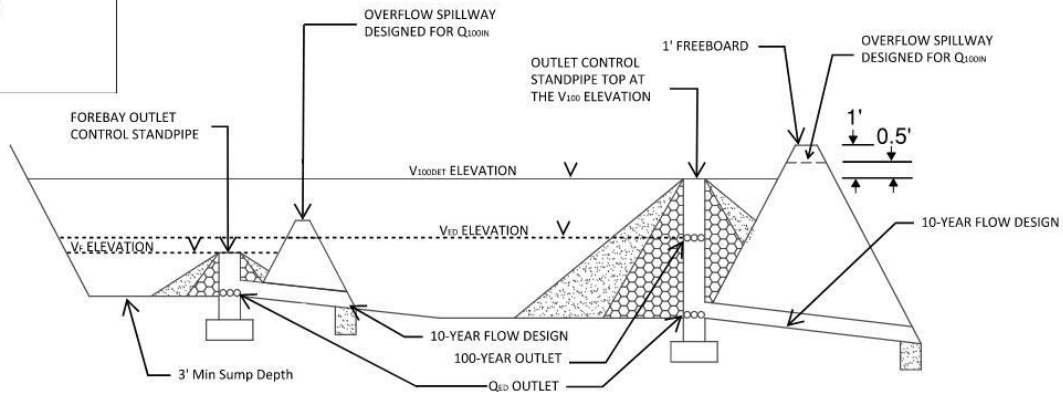
REV-11/22/2021

WRC
WATER RESOURCES COMMISSIONER
Jim Nash

TYPICAL DETENTION BASIN WITH FOREBAY

REQUIRED PROFESSIONAL ENGINEER CERTIFICATIONS

-CHANNEL PROTECTION VOLUME "CREDIT" (V_{CP-C})
-INFILTRATION RATES
-100-YEAR ALLOWABLE OUTLET RATE (Q_{100ALL})
-MEP FOR ACHIEVED INFILTRATION VOLUME
-STORMWATER SYSTEM O&M PLANS



FOREBAY VOLUME (V_F)

A FOREBAY FOR ALL INLETS SHALL CAPTURE SILT, SAND, TRASH AND DEBRIS FOR REMOVAL. THEY ARE SIZED AT 15% OF THE WATER QUALITY VOLUME (V_{WQ})

$V_F = (545)(C)(A)$

V_F IS A MINIMUM OF V_{WQ} WHEN DOWNSTREAM INFILTRATION IS PROPOSED

FOREBAY OUTLET SIZE

THE FOREBAY OUTLET SIZE IS THE SAME AS THE EXTENDED DETENTION OUTLET SIZE

NOTE: ALTERNATIVE FOREBAY OUTLETS REQUIRE PRE-APPROVAL FROM THE OCWRC

EXTENDED DETENTION VOLUME (V_{ED})

EXTENDED DETENTION CONTROLS THE 2-YEAR BANK FULL RELEASE RATE BY DEWATERING THE V_{ED} OVER 48-HOURS

$V_{ED} = (6,897)(C)(A)$

EXTENDED DETENTION OUTLET RATE

$Q_{ED}=(V_{ED})/(172,800)$

$H_{ED}=(V_{ED})/((4,666)(h)^{(1/2)})$

H_{ED}= NUMBER OF 1-INCH DEWATERING HOLES
h=TOTAL HEAD ON THE ORIFICES

100-YEAR POST-CONSTRUCTION INLET RATE (Q_{100IN})

$Q_{100IN}=(C)(I)(A)$

$I = [(30.2033)(P^{0.2203})]/[(T_C + 9.1747)^{0.8069}]$

100-YEAR ALLOWABLE OUTLET RATE (Q_{100ALL})

THE ALLOWABLE 100-YEAR OUTLET RATE IS THE LESSER OF:

-OCWRC RESTRICTED RATE FOR THE DRAIN (Q_R)
-PRO-RATED SHARE OF THE DRAINS CAPACITY (Q_P)
OR
-THE VARIABLE RELEASE RATE (Q_{VRR})

$Q_{VRR}=1.1055 - 0.206LN(A)$

100-YEAR DETENTION VOLUME (V_{100DET})

$R=0.206-(0.15)(LN(Q_{100ALL}/Q_{100IN}))$

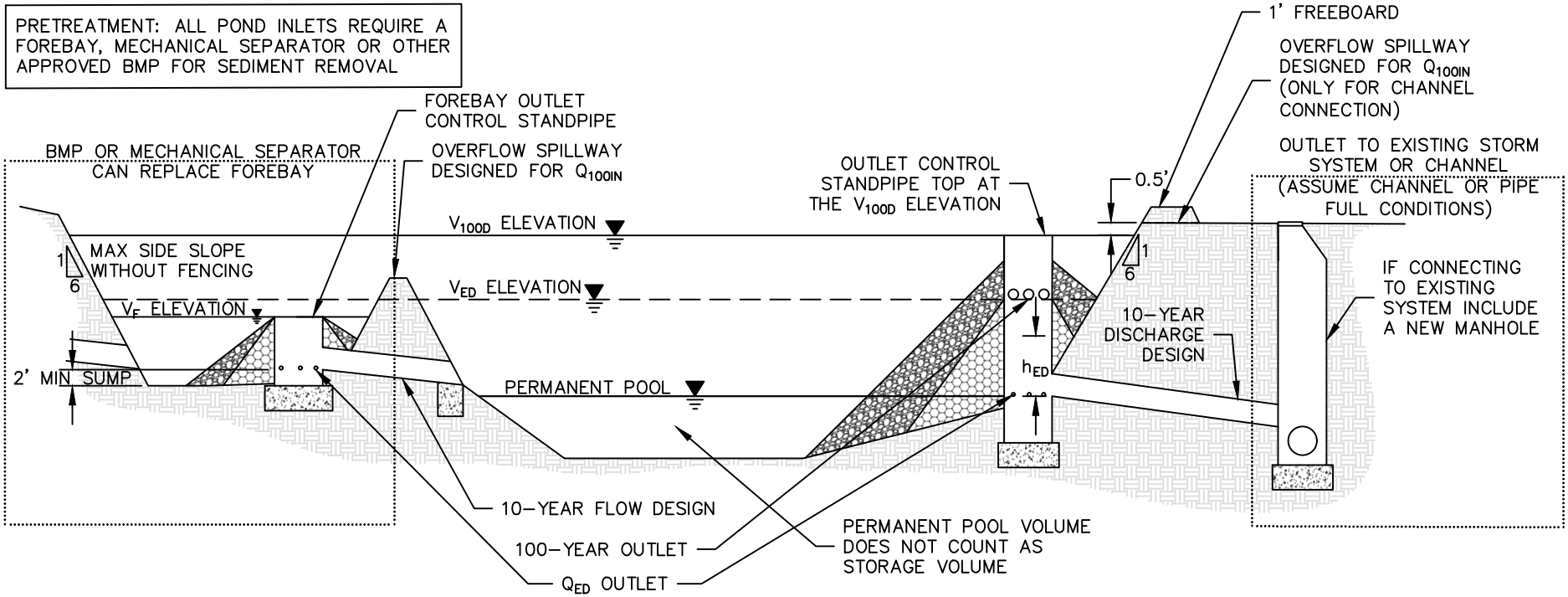
R=STORAGE CURVE FACTOR

$V_{100RUN}=(18,900)(C)(A)$

$V_{100DET}=(V_{100RUN})(R)-V_{CP-C}$

REV-11/22/2021

PRETREATMENT: ALL POND INLETS REQUIRE A FOREBAY, MECHANICAL SEPARATOR OR OTHER APPROVED BMP FOR SEDIMENT REMOVAL



FOREBAY VOLUME (V_F)

A FOREBAY FOR ALL INLETS SHALL CAPTURE SILT, SAND, TRASH, AND DEBRIS FOR REMOVAL. THEY ARE SIZED AT 15% OF THE WATER QUALITY VOLUME (V_{WQ})

$V_F = 545 \times C \times A$

NOTE: ALTERNATIVE FOREBAY OUTLETS REQUIRE PRE-APPROVAL FROM THE OCWRC

EXTENDED DETENTION VOLUME (V_{ED})

$V_{ED} = 6{,}897 \times C \times A$

EXTENDED DETENTION OUTLET RATE

EXTENDED DETENTION CONTROLS THE 2-YEAR BANK FULL RELEASE RATE BY DEWATERING THE V_{ED} OVER 48-HOURS

$Q_{ED} = V_{ED} / 172{,}800$

h_{ED} is based on the water level at 50% of V_{ED}

IF MAIN DETENTION BASIN IS USED FOR INFILTRATION, THEN UPSTREAM FOREBAY SHALL BE SIZED FOR THE FULL WATER QUALITY VOLUME (V_{WQ})

ALLOWABLE 100-YEAR POST-DEVELOPMENT PEAK RUNOFF RATE (Q_{100P})

Q_{100P} IS THE LESSER OF:

1. THE VARIABLE RELEASE RATE (Q_{VRR})
   $Q_{VRR} = 1.1055 - 0.206\,LN(A)$
   $Q_{100P} = Q_{VRR} \times A$
2. OCWRC RESTRICTED RATE FOR THE DRAIN (Q_R)

100-YEAR RUNOFF VOLUME (V_{100R})

$V_{100R} = 18{,}985 \times C \times A$

100-YEAR POST-CONSTRUCTION INLET RATE (Q_{100IN})

$Q_{100IN} = C \times I_{100} \times A$

$I_{100} = 83.3 / (T_C + 9.17)^{0.81}$

100-YEAR DETENTION VOLUME (V_{100D})

STORAGE CURVE FACTOR (R)

$R = 0.206 - 0.15 \times LN(Q_P / Q_{100IN})$

$V_{100D} = (V_{100R} \times R) - V_{CP-P}$

C = POST-DEVELOPMENT RUNOFF COEFFICIENT
A = DRAINAGE AREA (ACRES)
T_C = TIME OF CONCENTRATION FOR THE DEVELOPMENT SITE (MIN)

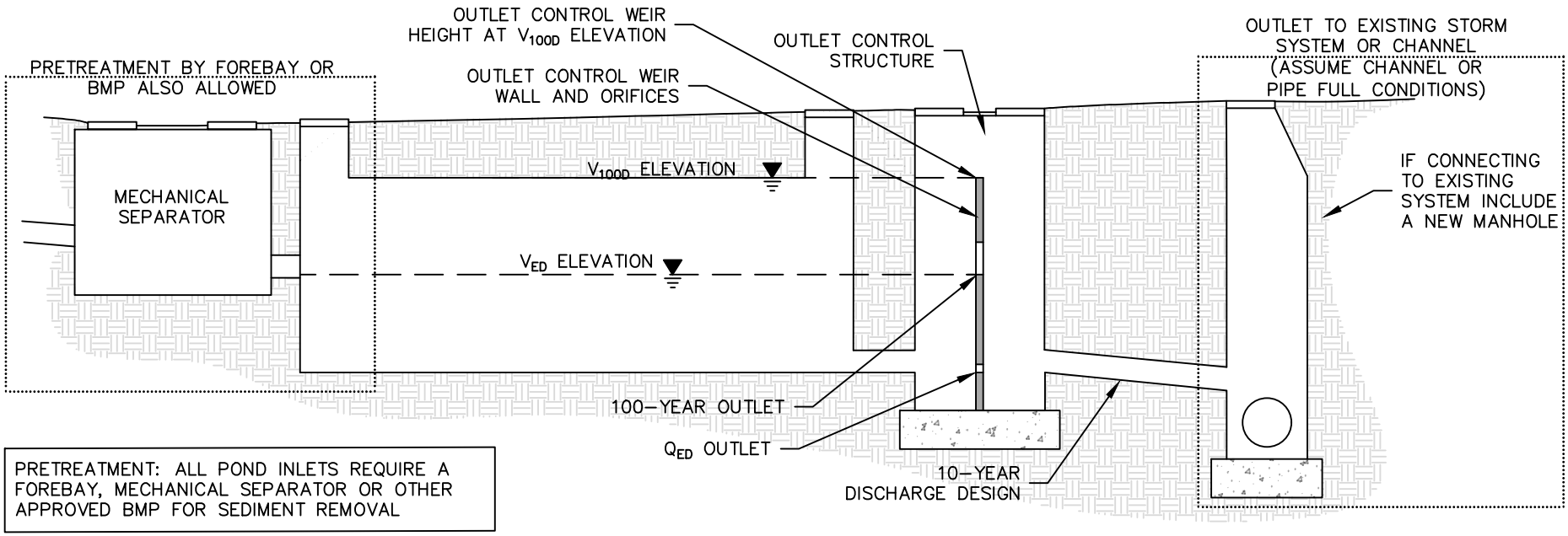
REQUIRED PROFESSIONAL ENGINEER CERTIFICATIONS

- INFILTRATION RATES
- 100-YEAR ALLOWABLE OUTLET RATE (Q_{100P})
- PROVIDED INFILTRATION VOLUME (V_{CP-P})
- STORMWATER SYSTEM O&M PLANS

WRC
WATER RESOURCES COMMISIONER

TYPICAL WET DETENTION BASIN WITH FOREBAY

REVISION:
04/19/2021



PRETREATMENT: ALL POND INLETS REQUIRE A FOREBAY, MECHANICAL SEPARATOR OR OTHER APPROVED BMP FOR SEDIMENT REMOVAL

MECHANICAL SEPARATOR

REQUIRED WATER QUALITY TREATMENT IS 80 MG/L TSS, OR 80% TSS REMOVAL

SIZED BASED ON THE 1-YEAR WATER QUALITY PEAK FLOW RATE (Q_{WQ})

$Q_{WQ} = C \times I_1 \times A$

$I_1 = 30.2 / (T_C + 9.17)^{0.81}$

(MAXIMUM PEAK INTENSITY = 2.0 IN/HR FOR SMALLER SITES WITH TC $\leq$15 MIN)

(MINIMUM PEAK INTENSITY = 1.0 IN/HR FOR LARGER SITES WITH $T_C \geq 1$ HOUR)

REPLACES FOREBAY REQUIREMENT

INSTALLED OFFLINE AND UPSTREAM OF ANY DETENTION OR RETENTION BASIN

EXTENDED DETENTION VOLUME (V_{ED})

$V_{ED} = 6{,}897 \times C \times A$

EXTENDED DETENTION OUTLET RATE

EXTENDED DETENTION CONTROLS THE 2-YEAR BANK FULL RELEASE RATE BY DEWATERING THE V_{ED} OVER 48-HOURS

$Q_{ED} = V_{ED} / 172{,}800$

h_{ED} is based on the water level at 50% of V_{ED}

C = POST-DEVELOPMENT RUNOFF COEFFICIENT
A = DRAINAGE AREA (ACRES)
T_C = TIME OF CONCENTRATION FOR THE DEVELOPMENT SITE (MIN)

REQUIRED PROFESSIONAL ENGINEER CERTIFICATIONS

- INFILTRATION RATES
- 100-YEAR ALLOWABLE OUTLET RATE (Q_{100P})
- PROVIDED INFILTRATION VOLUME (V_{CP-P})
- STORMWATER SYSTEM O&M PLANS

ALLOWABLE 100-YEAR POST-DEVELOPMENT PEAK RUNOFF RATE (Q_{100P})

Q_{100P} IS THE LESSER OF:

1. THE VARIABLE RELEASE RATE (Q_{VRR})
   $Q_{VRR} = 1.1055 - 0.206 LN(A)$
   $Q_{100P} = Q_{VRR} \times A$
2. OCWRC RESTRICTED RATE FOR THE DRAIN (Q_R)

100-YEAR RUNOFF VOLUME (V_{100R})

$V_{100R} = 18{,}985 \times C \times A$

100-YEAR POST-CONSTRUCTION INLET RATE (Q_{100IN})

$Q_{100IN} = C \times I_{100} \times A$

$I_{100} = 83.3 / (T_C + 9.17)^{0.81}$

100-YEAR DETENTION VOLUME (V_{100D})

STORAGE CURVE FACTOR (R)

$R = 0.206 - 0.15 \times LN(Q_P / Q_{100IN})$

$V_{100D} = (V_{100R} \times R) - V_{CP-P}$

FREEBOARD ABOVE V_{100D} IS RECOMMENDED

WRC
WATER RESOURCES COMMISIONER

TYPICAL UNDERGROUND DETENTION BASIN WITH MECHANICAL SEPERATOR

REVISION:
04/19/2021

APPENDIX G

RETAINING WALL CERTIFICATION FORM

Date: _____

Ron Melchert, Director of Public Works
CITY OF AUBURN HILLS
1500 Brown Road
Auburn Hills, Michigan 48326

Regarding: Retaining Wall Review for: _____
P.C. #: _____
Sidwell #: _____

Design Engineer and Firm Name:_____
Address:_____
Phone:_____Fax:_____

Owner:_____
Address:_____
Phone:_____Fax:_____

A retaining wall(s) is proposed for the above referenced site. The wall(s) was designed to all applicable structural design codes, more specifically known as _____, and all necessary loads (including vehicular surcharge) have been incorporated into the design. In addition, the wall meets or exceeds minimum factors of safety against both overturning and sliding, where the safety factors are as follows _____.

A retaining wall detail has been incorporated into the drawings and has been submitted for review.

Sincerely,

Seal

_____
Printed Name of Professional Engineer

_____
Signature

cc: Andrew Cousino, P.E., OHM Advisors, 2365 Pontiac Road, Auburn Hills MI 48326

APPENDIX H

ADA COMPLIANCE CERTIFICATION FORM

Date: _____

Ron Melchert, Director of Public Works
CITY OF AUBURN HILLS
1500 Brown Road
Auburn Hills, Michigan 48326

Regarding: ADA Compliance for: _____
P.C. #: _____
Sidwell #: _____

Design Engineer and Firm Name: _____
Address: _____
Phone: _____ Fax: _____

Owner: _____
Address: _____
Phone: _____ Fax: _____

Sidewalk, pathway and or barrier free parking spaces (herein referred to as pavement) are proposed for the above referenced site. The pavement was designed and constructed to all applicable Americans with Disabilities Act (ADA) Standards for Accessible Design.

Seal

Sincerely,

_____
Printed Name of Professional Engineer

_____
Signature

_____
Printed Name of Contractor

_____
Signature

cc: Andrew Cousino, P.E., OHM Advisors, 2365 Pontiac Road, Auburn Hills, MI 48326

APPENDIX I

PUBLIC ROAD ACCEPTANCE LIST
& PUBLIC SIGN REQUIREMENTS

PUBLIC ROAD ACCEPTANCE LIST

Prior to City acceptance of any privately constructed roads as public, the following items shall be submitted and approved, or otherwise addressed to the City's satisfaction:

- Quit Claim deed and any necessary easement documents (recorded), and in cases of platted subdivisions, the final plat must be complete and recorded.

- Final walk through with City and City Engineer representatives to occur after all punchlist items have been addressed. Note that initial punchlists may be general in nature, depending on the scope of work outstanding at the time.

- All construction complete, with full ROW restoration. ROW greenbelts must have vigorous growth prior to acceptance.

- All public utilities constructed for/by the development within the existing public ROW must be accepted by City.

- Storm sewer completely cleaned and all soil erosion problems addressed and measures removed.

- Striping/signing shall be complete and in new condition.

- Releases provided from all other permitting agencies and easement grantors.

- Maintenance and Guarantee Bond(s) provided for all public utilities and road ROW construction (including restoration). Terms of this bond shall be for a duration of two (2) years after the date of acceptance, for 50% of cost of the project. Amount of the bond shall be based on a cost summary submitted by the Developer's Engineer and approved by the City, based on current fair market prices for the items of work. This cost summary must be sealed by a State of Michigan registered professional engineer.

- Record Drawings approved by the City, and submitted in the current approved manner as described in the Engineering Standards and as requested in the approval letter for the Record Drawings, i.e. mylar, blueline and/or electronic copies.

- All materials testing information submitted and approved by the City. Letter of certification recommending acceptance by the City also required from the testing company. Required testing shall be established on a case by case basis and shall include but not be limited to the following:

    a. Sieve analysis and compaction testing of sub-base and base materials, and any trench backfill within a 1:1 influence of the roadway.

    b. Concrete/asphalt pavement/curb testing as described in the current MDOT "Standard Specifications for Construction".

- In addition, full-time inspection by the City or their Consultant shall be required during construction, for all work within the public ROW or future public ROW.

Some examples of when full-time inspection shall be required including but not limited to the following:

- Anytime an outside testing firm is not present during filling/mass grading operations. The City Engineer must be notified of the operation regardless of whether or not a testing company is on site.

- During proof-rolling operations.

- Adequate time should be allowed, approximately a half day to a day, to measure the road and check the cross-slopes (crown) prior to the placement of all of the following: 1) the sand subbase, 2) the aggregate base and 3) the pavement.

- During the preparation and placement of curb and gutter, and if called for on approved plans, edge drain installations.

Sign Standard

Post Requirements

1. Street name signs shall be mounted on **square** tubular posts inserted into and bolted to a square tubular receiver driven a minimum of 2.5' into the ground.
    a. The sign post shall be a 1 ¾ x 9' or 10', 14 Ga. Telespar by Unistrut or equivalent.
    b. The receiver shall be a 2" x 3', 14 Ga. Telespar by Unistrut or equivalent.

2. All other signs will be mounted on 8' square green sign posts which have been bolted to a 4' section of the same post driven a minimum of 3' into the ground.
    a. These posts shall be 3 lb per foot, rail type, steel.
    b. These posts shall be tapered and punched full length with 3/8" round holes.

Sign Requirements

1. All signs shall conform to the most recent edition of the Michigan Manual on Uniform Traffic Control Devices (MMUTCD).
2. City street name signs shall be green translucent film over white 3M Diamond Grade VIP reflective background, producing a highly reflective green sign with white letters and a ½" white border.
    a. Speed limit 25 MPH or less
        i. 9" .080 GA flat aluminum blades, mounted as double blade
        ii. Minimum blade length – 18"
        iii. The street names shall be spelled with the first letter of each word being upper case, the rest lower case. These shall be 8" Series B letters.
        iv. The suffix (Av, Bl, Rd, etc.) shall be 4" Series B letters and limited to a two letter abbreviation with the first letters being upper case. The suffix is to be located on the upper right hand side of the sign, at the end of the street name.
        v. At intersections of streets where one is posted at 25 MPH or less and one is posted at a speed greater than 25 MPH, the provisions for the street posted at a speed greater than 25 MPH shall apply.
    b. Speed limit greater than 25 MPH
        i. 12" .080 GA flat aluminum blades, mounted as double blade
        ii. Minimum blade length – 24"
        iii. The street names shall be spelled with each letter of each word being upper case. These shall be 8" Series C letters.
        iv. The suffix (Av, Bl, Rd, etc.) shall be 4 ½ " Series C letters and limited to a two letter abbreviation with the first letters being upper case. The suffix is to be located on the upper right hand side of the sign, at the end of the street name.

3. Private street name signs shall be black letters on a white engineering grade, or better, reflective background. Private streets are streets that have businesses or residences addressed to them but have not been accepted by the city for jurisdiction.

4. Stop signs and street name signs located at the intersection of a private street and a public street shall be installed and maintained by the City.

5. All intersections shall have street name signs designating the names of both streets so as to give clear location to all traveling in any direction.

6. Street name signs installed at the corner of a major and a local street will have the sign for the major street placed on top. An exception to this rule should be applied when there is a significant difference between the size of each sign and the appearance needs to be considered.

7. Advanced warning street name signs shall be a minimum of 18" high with a 1" white border and 7" upper case letters. The suffix shall consist of two to four letters and shall also be 7" upper case. These signs shall be white letters on green background and may constructed of .080 GA aluminum or 5/8" high density outdoor (HDO) plywood covered with 3M engineer grade sheeting.

8. Where available, traffic signal and light posts should be utilized for sign installations to reduce sign post clutter.

9. As a method of identifying the installation date of the sign, a small permanent sticker shall be placed on the back of all signs that have one unfinished side. Signs such as a street name sign shall have the sticker applied to the post, near the top bracket facing the opposite side of oncoming traffic. Other two side signs shall have the sticker applied on one side near the bottom edge. If the support post has a flat surface it should be used for the sticker instead of the sign. This sticker shall designate the month and year of installation. Whenever possible the sticker should be installed in an area where it cannot be seen bet the public. When the signs are installed someone other than the City, the City will apply the sticker when the City accepts the road. Whenever possible, the sticker should be installed in an area where it cannot be seen by the public.

10. No Parking signs shall contain the "no parking" symbol. The minimum sign size shall be 12" x 12". Larger signs may be used to meet special conditions. "No Stopping, Standing, Parking" signs will not be allowed without a Traffic Control Order. Other signs, such as Fire Lane, and time restrictions, shall also be specified in Traffic Control Orders.

APPENDIX J

RCOC STANDARD LANE ADDITION DETAILS

ROAD COMMISSION FOR OAKLAND COUNTY

PERMIT RULES, SPECIFICATIONS AND GUIDELINES

ROAD COMMISSION FOR OAKLAND COUNTY

DEPARTMENT OF CUSTOMER SERVICES

PERMITS DIVISION

2420 PONTIAC LAKE ROAD

WATERFORD, MI 48328

MARCH 14, 2013

RULE 6.3 DEFINITIONS OF STANDARD DRIVEWAY DIMENSIONS

The design features described herein with their appropriate illustrations of various driveway features as shown in Tables 6-2 through 6-9 shall be used by Applicants in dimensioning proposed driveways or driveway systems on plans accompanying driveway permit applications. These standard dimensions will be used unless conditions require a deviation and the Applicant can show cause for deviation. The Permits Division reserves the right to determine whether a deviation shall be granted, and may specify particular dimensions, in order that a particular driveway system will accommodate the vehicles normally expected without creating undue congestion or hazard on the road. The letters in parentheses accompanying the following design feature titles are used to illustrate these design features in Tables 6-2 through 6-9.

6.3.1 "Intersecting Angle" (A), the clockwise angle from the road edge of pavement, or road centerline if unpaved, to the driveway reference line (the centerline or edge of the driveway).

6.3.2 "Driveway Width" (B), the distance between driveway edges of pavement (or edges of the gravel surface, if applicable) measured at the point where the edges of the driveway become parallel (point b in the sketches). If the Right-of-Way Line is so close to the pavement that point b falls on the Driveway Property, then the width of the driveway at the Right-of-Way Line shall be based on the projected Driveway width.

6.3.3 "Entering Radius" (C), the radius of the driveway edge curve on the right side of a vehicle entering the Driveway Property.

6.3.4 "Exiting Radius" (D), the radius of the driveway edge curve on the right side of a vehicle exiting the Driveway Property.

6.3.5 "Curb Ending" (E), the length of a driveway curb taper from full curb height to ground level shall be a minimum length of ten feet.

6.3.6 "Right-Turn Lane Length" (F), the length of auxiliary lane constructed preceding the driveway to accommodate traffic entering the Driveway Property.

6.3.7 "Right-Turn Lane Width" (G), the width of pavement from the outside edge of the through lane to the outside edge of the Right-Turn Lane, or the width of road from outside edge of the through lane to the outside edge at the full width of the Entering and Exiting tapers.

6.3.8 "Entering Taper" (H), the length of the diagonal pavement widening, preceding the driveway.

6.3.9 "Exiting Taper" (J), the length of the diagonal pavement widening, following the driveway.

6.3.10 "Entrance Drive Width" (K), the width of the entrance half of a Divided or a Directional Driveway which has been designated for the use of a vehicle entering the Driveway Property.

6.3.11 "Exit Drive Width" (L), the width of the exit half of a Divided or a Directional Driveway which has been designated for the use of a vehicle exiting the Driveway Property.

6.3.12 "Island Width" (M), the edge-to-edge distance between the Entrance Drive and Exit Drive of a Divided Driveway.

6.3.13 “Island Length” (N), the distance between ends of the island, measured parallel to the Entrance and Exit Driveways.

6.3.14 “Nose Offset” P), the distance between the edge of the turn lane or through lane and the traffic island of a Divided or a Directional Driveway.

6.3.15 “Curb Opening/Cut” (R), the length of the opening along the road curb for an approach and its radii.

6.3.16 “Passing Lane Approach Length” (S), the length of auxiliary lane constructed on the opposite side of the road preceding the driveway to accommodate Through Traffic passing the left turn traffic entering the Driveway Property.

6.3.17 “Passing Lane Departing Length” (T), the length of auxiliary lane constructed on the opposite side of the road following the driveway to accommodate Through Traffic passing the left turn traffic entering the Driveway Property.

6.3.18 “Passing Lane Width” (U), the width of pavement from the outside edge of the through lane to the outside edge of the Passing Lane.

6.3.19 “Passing Lane Approaching Taper’ (V), the length of the diagonal pavement widening preceding the Passing Lane.

6.3.20 “Passing Lane Departing Taper” (W), the length of the diagonal pavement widening following the Passing lane.

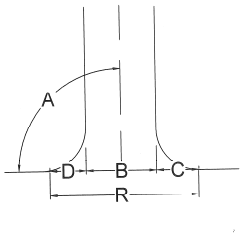
6.3.21 “Exiting Lane Length” (X), The length of auxiliary lane constructed following the driveway to accommodate traffic exiting Driveway Property.

RULE 6.4 STANDARD DIMENSIONS FOR RESIDENTIAL DRIVEWAYS

The dimensions of a Residential Driveway shall conform to those given in Tables 6-2 and 6-3.

Table 6-2:
Residential Driveway

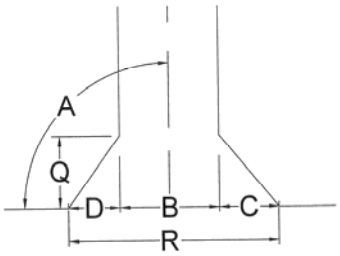
Design Features		**Typical**	**Range**
Intersecting Angle	A	90º	60º to 90º
Driveway Width	B	16'	12' to 35'
Entering Radius	C	10’	5' to 35'
Exiting Radius	D	10’	5' to 35'
Total Opening B+C+D=	R	36'	14' to 55'



NOTE:
The TYPICAL dimension shall be used unless the Permits Division specifies or the Applicant shows cause for, and the Permits Division approves, a different value. The RANGE in dimensions indicates the working value for each design feature.

Table 6-3:
Residential Driveway - Subdivision

Design Features		Typical	Range
Intersecting Angle	A	90º	60° to 90°
Driveway Width	B	16'	10' to 25'
Entering Taper Width	C	6'	2' to 15'
Exiting Taper Width	D	6'	2' to 15'
Taper Depth	Q	10'	10' to 20'
Total Opening B+C+D=	R	24'	14' to 55'



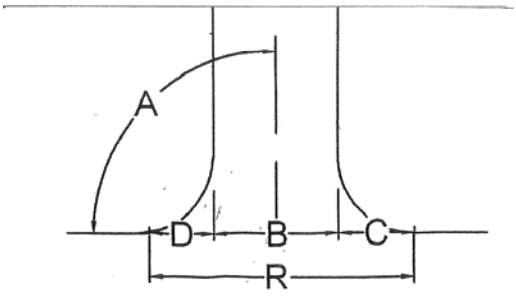
NOTE:
The TYPICAL dimension shall be used unless the Permits Division specifies or the Applicant shows cause for, and the Permits Division approves, a different value. The RANGE in dimensions indicates the working value for each design feature.

RULE 6.5 STANDARD DIMENSIONS FOR COMMERCIAL DRIVEWAYS AND PRIVATE ROADS

6.5.1 Two-way Commercial Driveways shall be designed to accommodate one lane of traffic in each direction. The dimensions of a Two-way Commercial Driveway shall conform to those given in Table 6-4.

Table 6-4:
Two-Way Commercial Driveway Dimensions

Design Features		Typical	Range
Intersecting Angle	A	90º	60° to 90°
Driveway Width	B	24'	22' to 40'
Entering Radius	C	35'	10' to 35'
Exiting Radius	D	35'	10' to 35'
Total Opening B+C+D=	R		42' to 105'



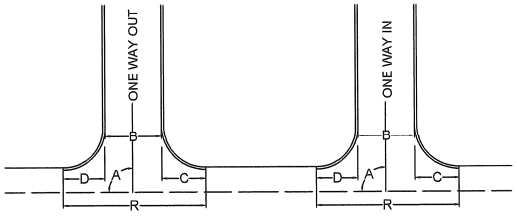
NOTE: The TYPICAL dimension shall be used unless the Permits Division specifies or the Applicant shows cause for, and the Permits Division approves, a different value. The RANGE in dimensions indicates the working value for each design feature.

6.5.2 The dimensions of a Directional One-way Commercial Driveway system shall conform to those given in Table 6-5.

NOTE:
The TYPICAL dimension shall be used unless the Permits Division specifies or the Applicant shows cause for, and the Permits Division approves, a different value. The RANGE in dimensions indicates the working value for each design feature.

Table 6-5:
Directional (One-Way) Commercial Driveway Dimensions

	Design Features		Typical	Range
	Intersecting Angle	A	90º	60° to 90°
	Driveway Width	B	16'	16' to 20'
One Way IN	Entering Radius	C	35'	20' to 35'
	Exiting Radius	D	5'	5' to 10'
One Way Out	Entering Radius	C	5'	5' to 10'
	Exiting Radius	D	35'	10' to 35'
	Total B+C+D=	R	25'	42' to 105'

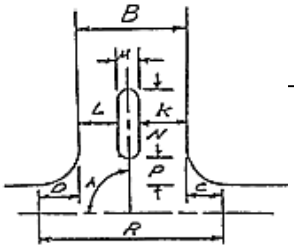


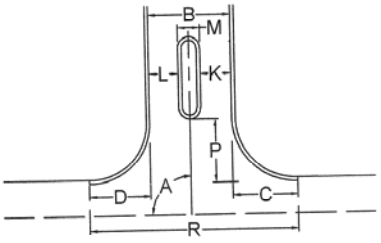
NOTE:
The TYPICAL dimension shall be used unless the Permits Division specifies or the Applicant shows cause for, and the Permits Division approves, a different value. The RANGE in dimension indicates the working value for each design feature.

6.5.3. A Divided Commercial Driveway shall have a curbed island separating the entrance drive and the exit drive. The radii forming the edges on this island shall be designed to accommodate the largest vehicle that will normally use the driveway. The minimum area of the island shall be 50 square feet. The dimensions of a Divided Commercial Driveway shall conform to those given in Table 6-6.

Table 6-6:

Design Features		**Typical**	**Range**
Intersecting Angle	A	90º	60° to 90°
Driveway Width	B	60'	46' to 78'
Entering Radius	C	35'	15' to 35'
Exiting Radius	D	35'	10' to 35'
Entrance Drive Width	K	22'	20' to 27'
Exit Drive Width	L	22'	20' to 27'
Nose Offset	P	12'	6' to 18'
Island width	M	16'	6' to 24'
Total B+C+D=	R		71' to 148'





NOTE:
The TYPICAL dimension shall be used unless the Permits Division specifies or the Applicant shows cause for, and the Permits Division approves, a different value. The RANGE in dimension indicates the working value for each design feature.

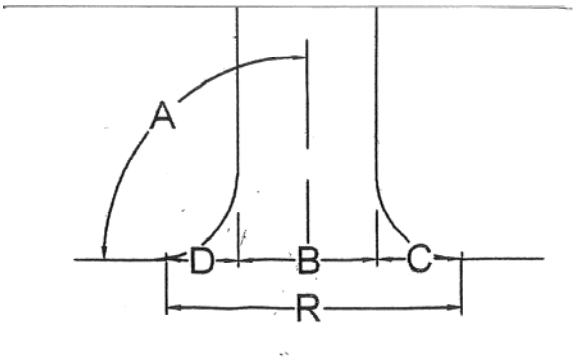
RULE 6.6 STANDARD DIMENSIONS FOR UTILITY DRIVEWAY ENTRANCES

The dimensions of an Utility Driveway entrance shall conform to those given in Table 6-7.

Table 6-7:

Utility Driveway

Design Features		Typical	Range
Intersecting Angle	A	90º	60° to 90°
Driveway Width	B	16'	12' to 35'
Entering Radius	C	10'	5' to 35'
Exiting Radius	D	10'	5' to 35'
Total Opening B+C+D=	R	36'	22' to 105'



NOTE:
The TYPICAL dimension shall be used unless the Permits Division specifies or the Applicant shows cause for, and the Permits Division approves, a different value. The RANGE in dimensions indicates the working value for each design feature.

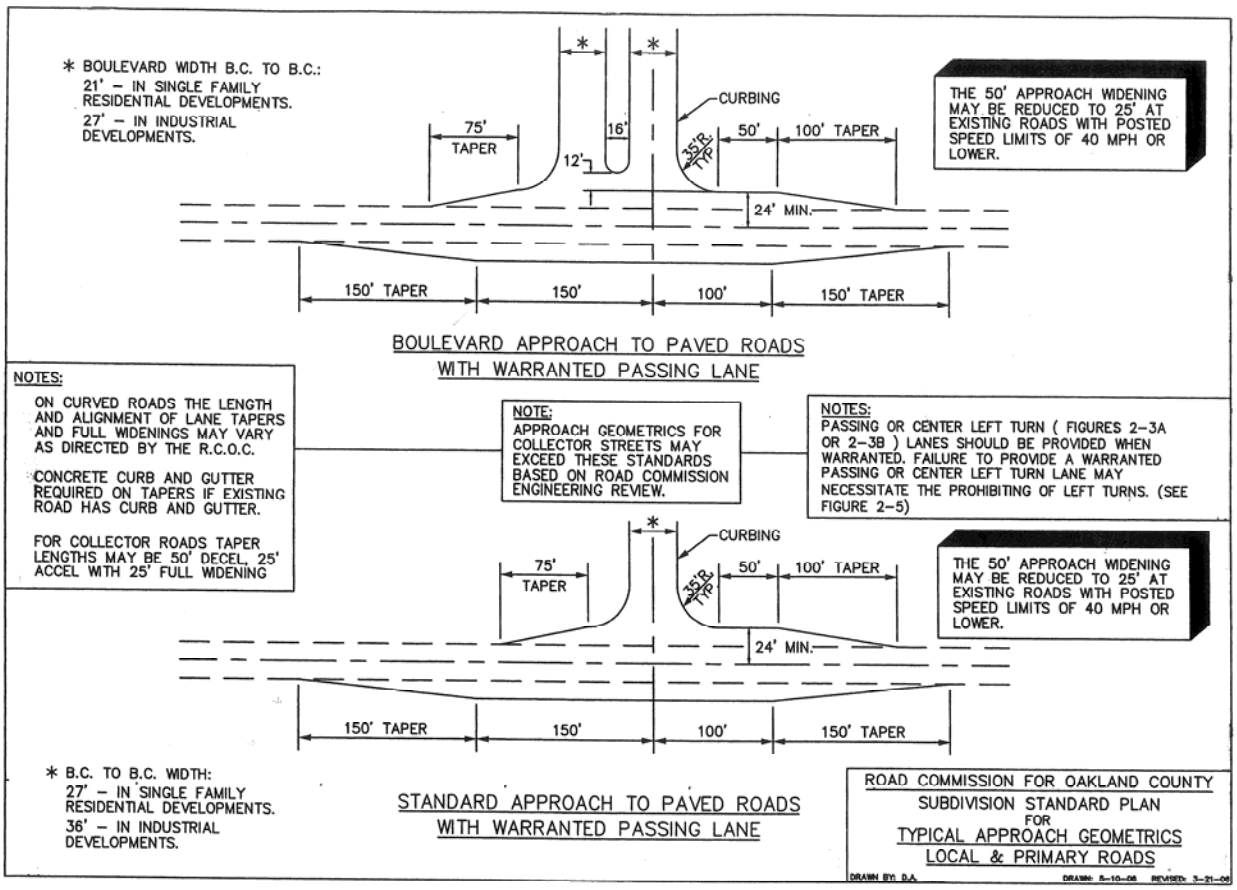
RULE 6.7 AUXILIARY LANE AND TAPER REQUIREMENTS

6.7.1 Applicant is strongly encouraged to consider the benefits of auxiliary right-turn deceleration lanes and left-turn passing lanes. These additional lanes, located at the driveway, will enhance the accessibility, safety and image of the proposed development. Traffic volumes or safety issues may warrant the prohibition of left turns at driveways on two-way, two-lane roads without passing lanes.

6.7.2 Figure 6-2 shows when left turn prohibition is warranted. Table 6-8 shows the dimensions of passing lanes.

Table 6-8:
Passing Lane

Design Features		Typical	Range
Approaching Taper	V	150'	100' to 150'
Departing Taper	W	150'	100' to 150'
Approaching Lane Length	S	150'	100' to 200'
Departing Lane Length	T	100'	50' to 100'
Pavement in Width passing lane	U	12'	11' to 12'



The TYPICAL dimension shall be used unless the Permits Division specifies or the Applicant shows cause for, and the Permits Division approves, a different value. The RANGE in dimensions indicates the working value for each design feature.

FIGURE 6-2

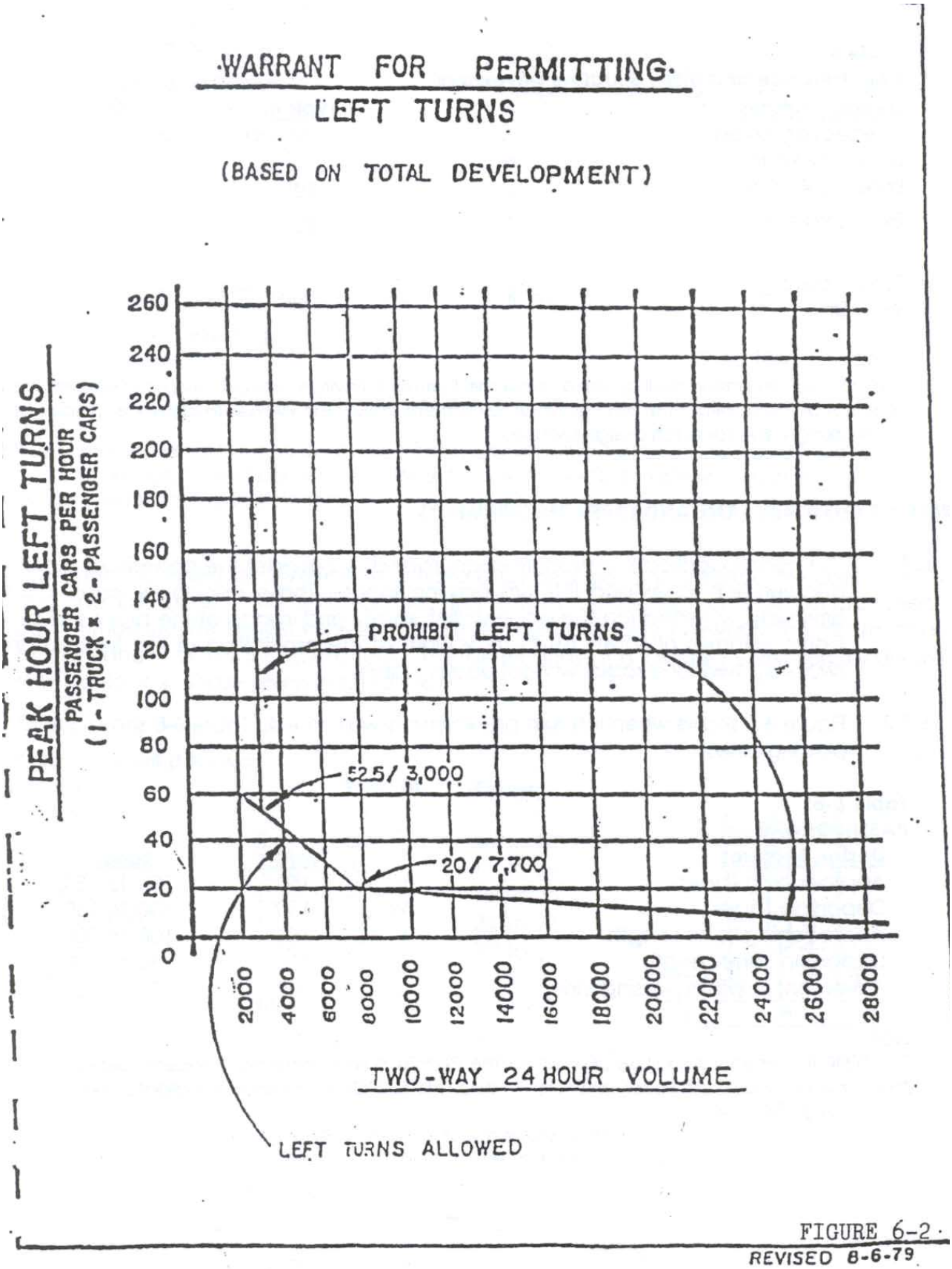


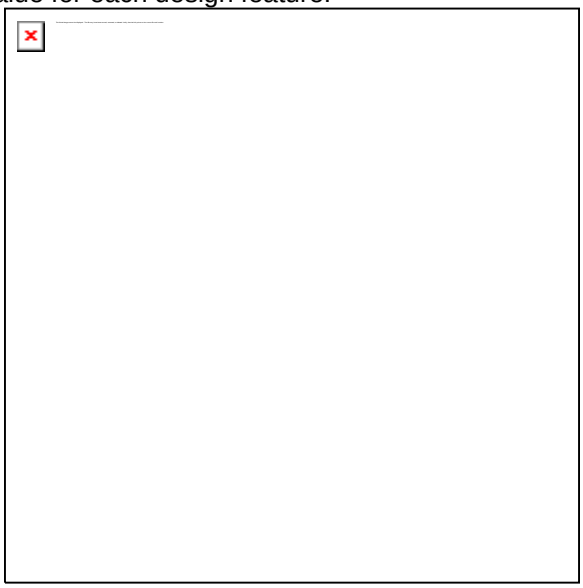
FIGURE 6-2
REVISED 8-6-79

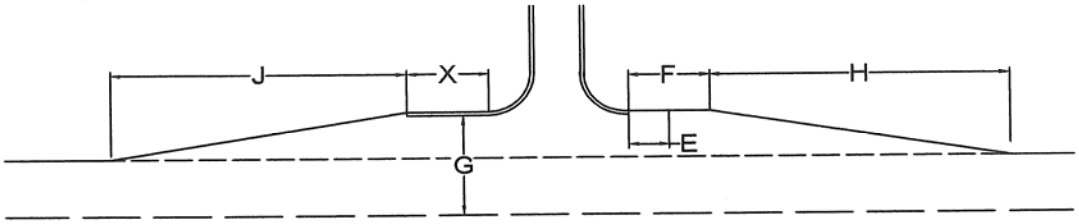
6.7.3 Figure 6-3 shows when a right-turn deceleration lane or taper is warranted. Table 6-9 shows the dimensions of right-turn deceleration lanes and tapers for Commercial Driveway or Private Road approaches.

Table 6-9:
RIGHT-TURN LANE AND TAPERS FOR COMMERCIAL DRIVEWAYS AND PRIVATE ROAD APPROACHES

		Curbed Road		Uncurbed Road	
Design Features		**Typical**	**Range**	**Typical**	**Range**
Curb Ending	E	Not Applicable		10'	(No Range)
Right-Turn Lane Length	F	25'	0' to 150'	25'	0' to 150'
Pavement/Width from CL of Road	G	24'	22' to 24'	24'	22' to 24'
Entering Taper	H	100'	75' to 150'	100'	75' to 150'
Exiting Lane Length	X	25'	0' to 100'	25'	0' to 100'
Exiting Taper	J	75'	50' to 100'	75'	50' to 100'

NOTE:
The TYPICAL dimension shall be used unless the Permits Division otherwise specifies or the Applicant shows cause for, and the Permits Division approves, a different value. The RANGE in dimensions indicates the working value for each design feature.





6.7.4 Where center left turn operation exists or is warranted due to the proposed approach, see Figures 6-4 and 6-5. Figure 6-4 shall be used for lane shifts of not more than 6 feet. Where an eccentric lane shift is proposed, the taper length shall be in accordance with the M.M.U.T.C.D.

6.7.5 If proposed entrance or exit tapers overlap with current existing tapers, the Applicant shall indicate the overall lane length that will result and the A.A.S.H.T.O. required exit taper lengths and signing requirements.

FIGURE 6-3

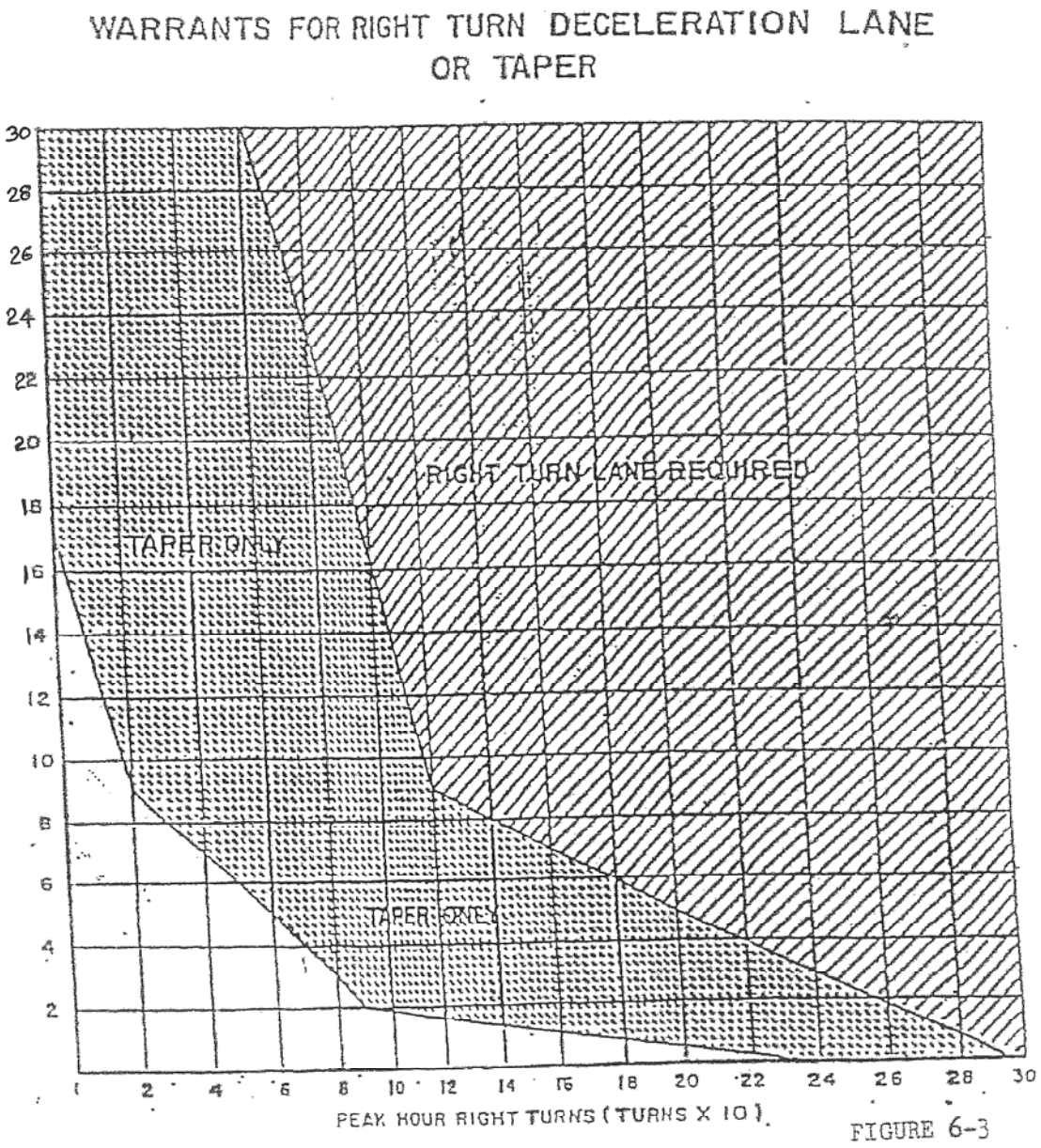


FIGURE 6-3

FIGURE 6-4

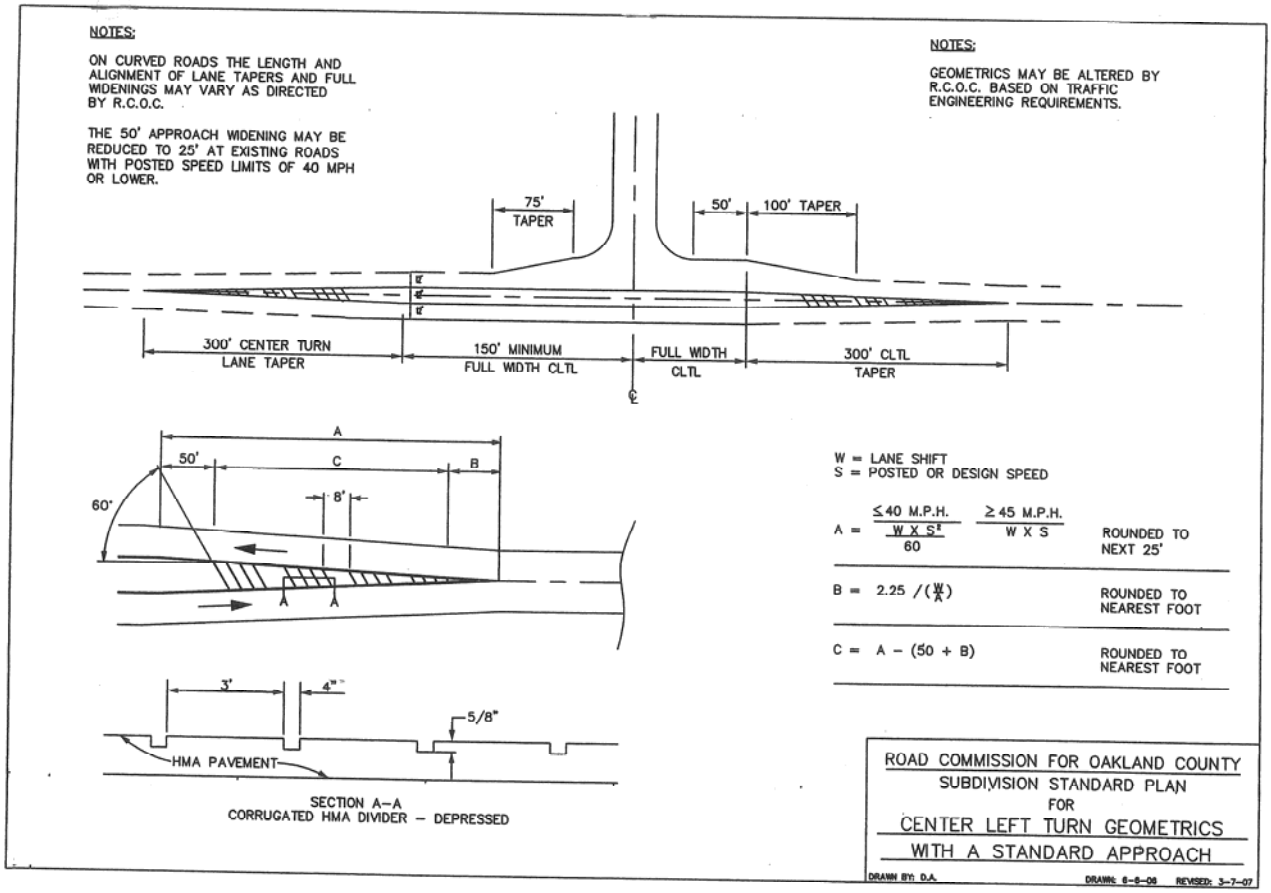
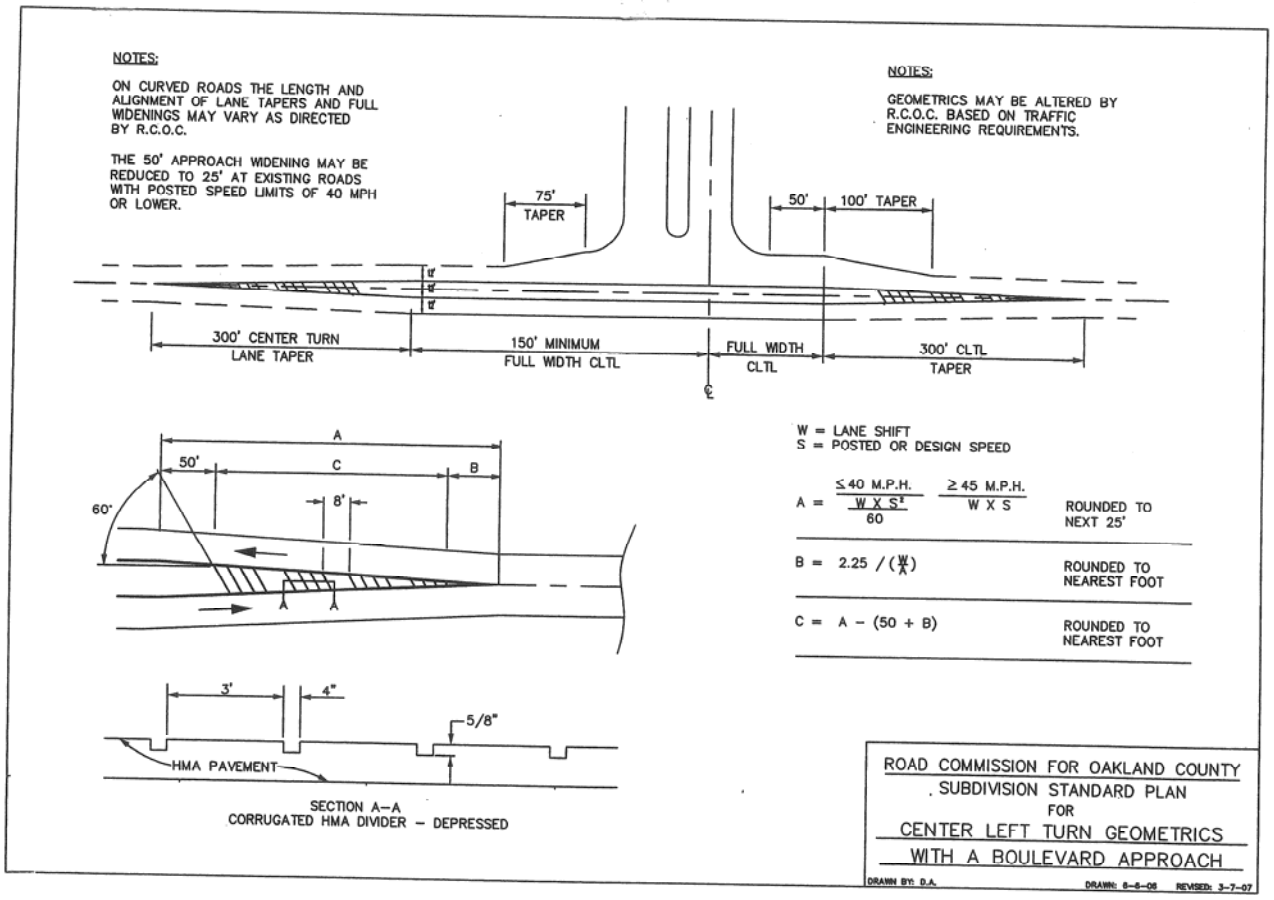
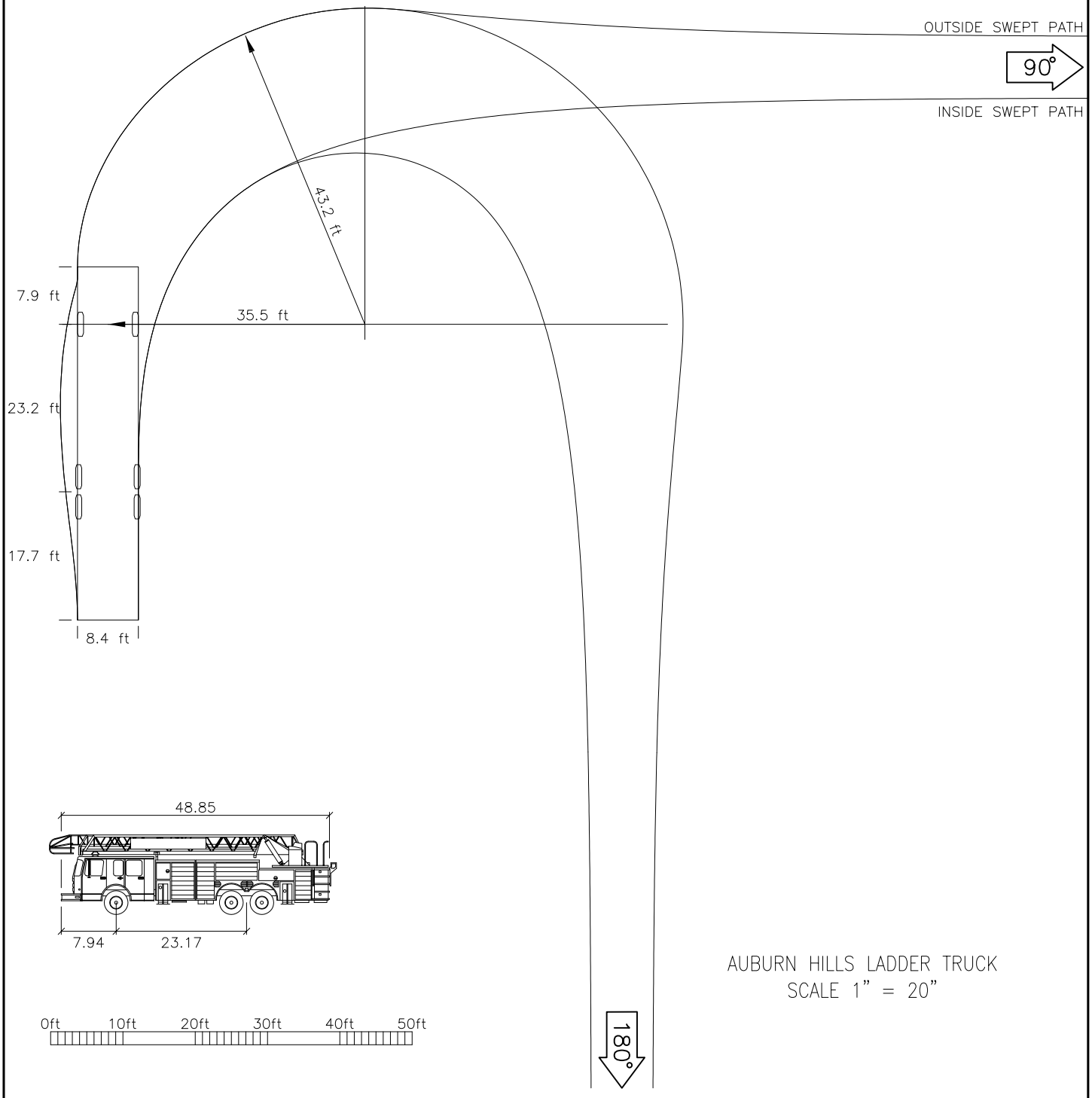

NOTES:
ON CURVED ROADS THE LENGTH AND ALIGNMENT OF LANE TAPERS AND FULL WIDENINGS MAY VARY AS DIRECTED BY R.C.O.C.
THE 50' APPROACH WIDENING MAY BE REDUCED TO 25' AT EXISTING ROADS WITH POSTED SPEED LIMITS OF 40 MPH OR LOWER.
NOTES:
GEOMETRICS MAY BE ALTERED BY R.C.O.C. BASED ON TRAFFIC ENGINEERING REQUIREMENTS.
75' TAPER
50'
100' TAPER
300' CENTER TURN LANE TAPER
150' MINIMUM FULL WIDTH CLTL
FULL WIDTH CLTL
300' CLTL TAPER
A
50'
C
B
60°
8'
3'
4"
5/8"
HMA PAVEMENT
SECTION A–A
CORRUGATED HMA DIVIDER – DEPRESSED
W = LANE SHIFT
S = POSTED OR DESIGN SPEED
A = ≤40 M.P.H. W X S²/60 ≥45 M.P.H. W X S ROUNDED TO NEXT 25'
B = 2.25 /(W/A) ROUNDED TO NEAREST FOOT
C = A – (50 + B) ROUNDED TO NEAREST FOOT
ROAD COMMISSION FOR OAKLAND COUNTY
SUBDIVISION STANDARD PLAN
FOR
CENTER LEFT TURN GEOMETRICS
WITH A STANDARD APPROACH
DRAWN BY: D.A.
DRAWN: 6-8-06
REVISED: 3-7-07

FIGURE 6-5


NOTES:
ON CURVED ROADS THE LENGTH AND ALIGNMENT OF LANE TAPERS AND FULL WIDENINGS MAY VARY AS DIRECTED BY R.C.O.C.
THE 50' APPROACH WIDENING MAY BE REDUCED TO 25' AT EXISTING ROADS WITH POSTED SPEED LIMITS OF 40 MPH OR LOWER.
NOTES:
GEOMETRICS MAY BE ALTERED BY R.C.O.C. BASED ON TRAFFIC ENGINEERING REQUIREMENTS.
75' TAPER
50'
100' TAPER
300' CENTER TURN LANE TAPER
150' MINIMUM FULL WIDTH CLTL
FULL WIDTH CLTL
300' CLTL TAPER
A
50'
C
B
60°
8'
W = LANE SHIFT
S = POSTED OR DESIGN SPEED
A = ≤40 M.P.H. W X S²/60 ≥45 M.P.H. W X S — ROUNDED TO NEXT 25'
B = 2.25 / (W/A) — ROUNDED TO NEAREST FOOT
C = A − (50 + B) — ROUNDED TO NEAREST FOOT
3'
4"
5/8"
HMA PAVEMENT
SECTION A–A
CORRUGATED HMA DIVIDER – DEPRESSED
ROAD COMMISSION FOR OAKLAND COUNTY
SUBDIVISION STANDARD PLAN
FOR
CENTER LEFT TURN GEOMETRICS
WITH A BOULEVARD APPROACH
DRAWN BY: D.A.
DRAWN: 8-6-06 REVISED: 3-7-07

APPENDIX K

AUBURN HILLS FIRE DEPARTMENT
LADDER TRUCK TURNING TEMPLATE



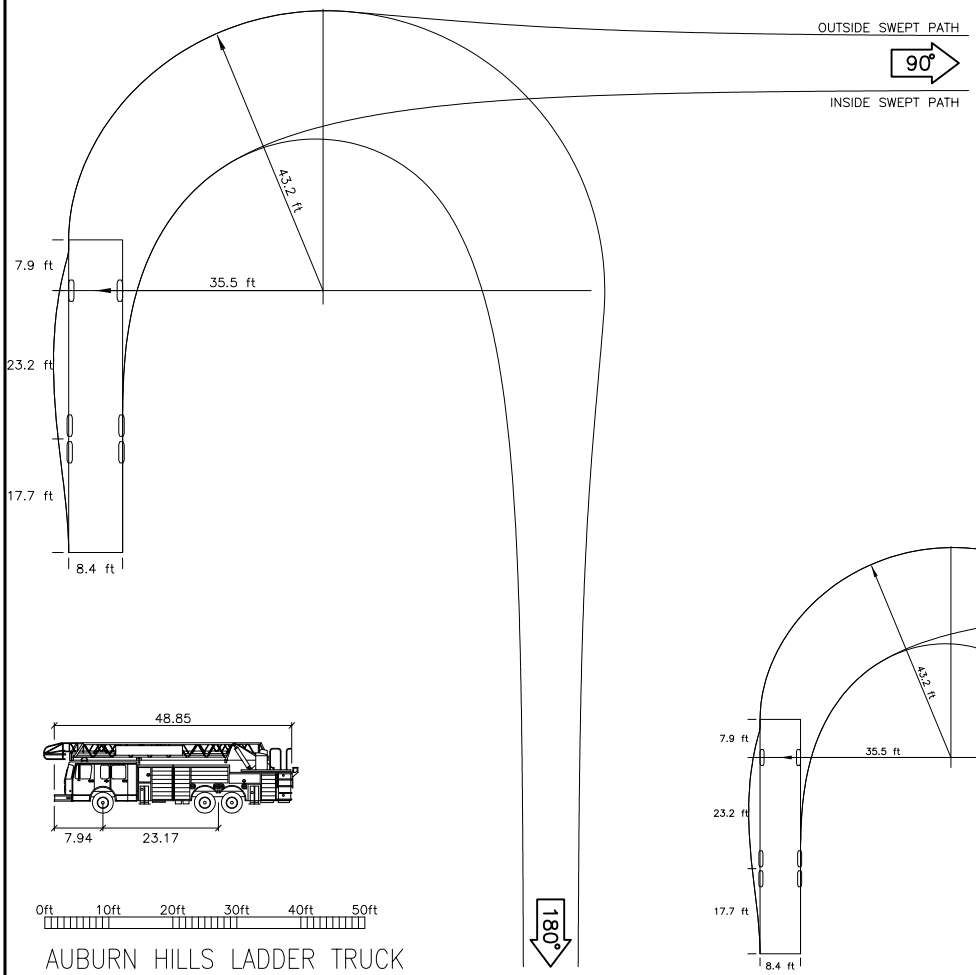
AUBURN HILLS LADDER TRUCK
SCALE 1" = 20"

INFORMATION CONTAINED HEREIN WAS PROVIDED BY THE AUBURN HILLS FIRE DEPARTMENT

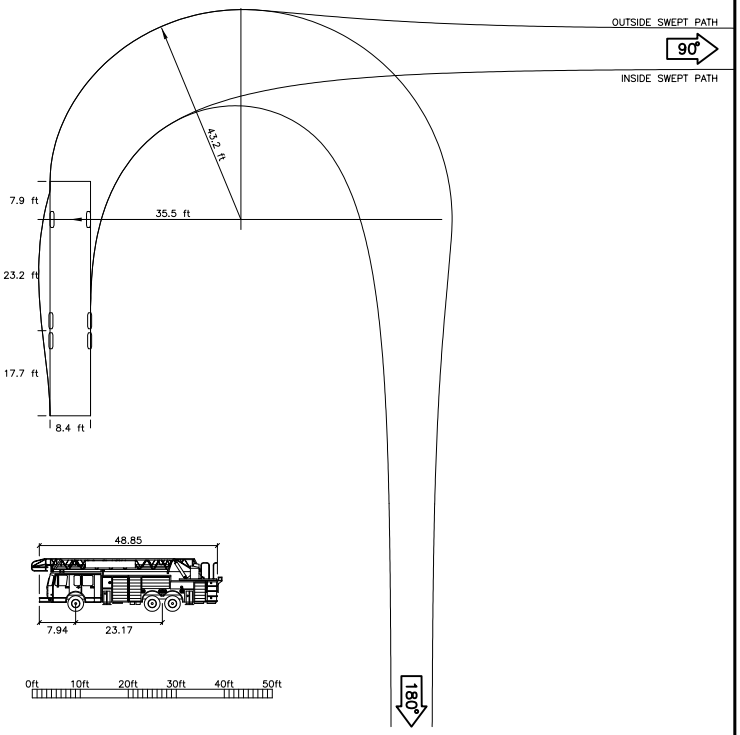
AUBURN HILLS

OHM
ARCHITECTS ENGINEERS PLANNERS
34000 Plymouth Road
Livonia, MI 48150
P (734) 522-6711 | F (734) 522-6427
OHM-ADVISORS.COM

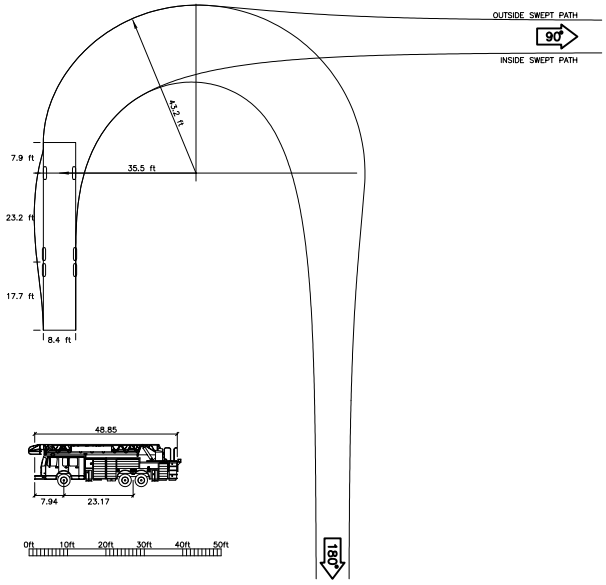
DRAWING PATH: S:\CVT\AuburnHillsCity\Standards_CADD\Fire Truck Template\2017 Fire Truck Templates.dwg Feb 09, 2018 - 9:36am



AUBURN HILLS LADDER TRUCK
SCALE 1" = 30"



AUBURN HILLS LADDER TRUCK
SCALE 1" = 40"



AUBURN HILLS LADDER TRUCK
SCALE 1" = 50"

INFORMATION CONTAINED HEREIN WAS PROVIDED BY THE AUBURN HILLS FIRE DEPARTMENT

AUBURN HILLS

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