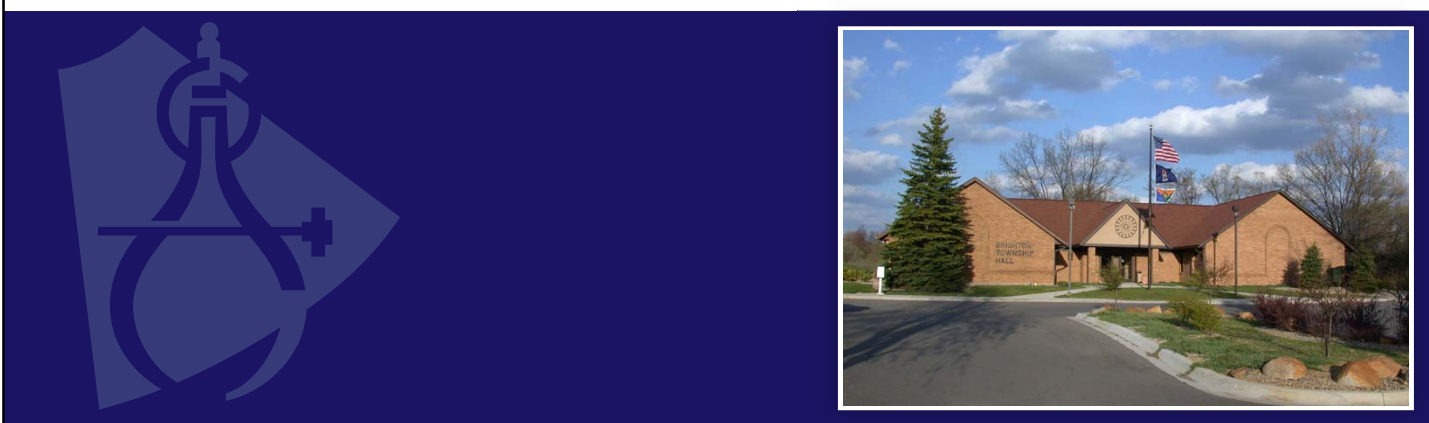


Charter Township of Brighton

Livingston County, Michigan



Engineering Standards

Adoption Date: December 17, 2007

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PURPOSE OF STANDARDS

High uniform standards must be maintained in order to protect the current and future citizens and businesses of the Township and ensure that future Boards are not burdened with costly, remedial, and retroactive solutions. Quality planning/engineering and implementation are seen as priority, and are viable goals.

These Engineering Standards are intended to:

- Provide a reasonable and proper basis for the design and construction of land improvements such as sanitary sewer and water facilities, drainage facilities, roads, parking lots, landscaping, and grading.
- Establish uniformity in Township requirements.
- Describe the required information prior to submittal of plans so that the plans will be complete and in proper form when submitted, thereby reducing the Township's and developer's time and expense in the review process.
- Enable designers and developers to properly estimate the costs of construction as early in the development process as possible.
- Provide accurate information for each project that will become permanent public records of the Township.

These standards apply to all land improvement projects including site plans, site condominiums, PUD and parallel plans, etc., as required by the Charter Township of Brighton Zoning Ordinance, and subdivision plats, as required by the Township's subdivision ordinances.

These standards are the requirements necessary to promote the public health, safety, and welfare of the people of the Charter Township of Brighton. These standards are not intended to interfere in any manner with the application or enforcement of the Ordinances of the Charter Township of Brighton, Livingston County, or the State of Michigan.

GENERAL PLAN PROCEDURES AND REQUIREMENTS

I. GENERAL PLAN REVIEW PROCEDURES AND REQUIREMENTS

The development plan review and approval process generally consists of two phases, as outlined herein. The number of submittals and requirements are further detailed by the Charter Township of Brighton Zoning Ordinance. The site plan and engineering reviews must be completed before construction can begin.

A. Site Plan Review:

The Charter Township of Brighton Zoning Ordinance outlines the first phase of review and approval. Prior to the start of any review, an application must be completed with associated fees paid to the Charter Township of Brighton. Fee amounts associated with various reviews are available from the Township. The Township's Planning Department will distribute plans to the appropriate departments and outside consultants. These agents perform a conceptual plan review of the drawings to verify that they meet zoning requirements, basic Township standards, and are generally feasible. They make recommendations to the Planning Commission, which takes action to approve, deny, or table the plan.

B. Construction Plan Review:

The second phase of review and approval begins when the Township Planning Commission, or in some cases the Township Board, has approved the site plan. The applicant then submits detailed engineering plans, an application, and appropriate fees to the Charter Township of Brighton. The Township distributes the plans to the Township Engineer who performs a detailed review of the plans. The Township Engineer issues engineering approval when all contingent items of site plan approval have been met, the plans meet the engineering standards, and all of the review agents have offered their final approval of the plans. Additionally, the Applicant shall have paid all required fees before engineering approval is granted.

C. After construction plan approval, the project may move forward to the construction phase. However, before construction may begin, the applicant will be required to submit all bonds, fees, escrows, etc. to the Township, and hold a preconstruction meeting, as described in the Construction Procedures and Requirements section of this document.

D. A flow chart illustrating the general site plan and engineering plan review process is included in Appendix I. The chart also details the construction phase of the project, after construction plan approval.

E. Detailed descriptions of site plan, construction plan, and construction procedures and requirements are subsequently described in later sections of this document.

F. The Owner/Applicant is responsible for posting all necessary fees and escrows. A review fee schedule is available from the Township. The most current edition shall be used.

II. SITE PLAN PROCEDURES

- A. An applicant seeking site plan approval from the Charter Township of Brighton is encouraged to meet with Township staff and consultants prior to plan preparation. It is important that the plan reflect the many requirements needed to assure passage through the Township review and approval process. When the site plan is in accordance with Township ordinances and standards, a formal submittal to the Township is in order. The Township must receive all documents and fees required for Planning Commission review prior to being placed on the Planning Commission agenda, in accordance with the Township ordinances and Planning Commission calendar. A schedule of regular meeting dates is posted for public display at the Township Hall and on the Township's website.
- B. The site plan shall be submitted to the Township Planning Department and will be distributed to staff and consultants for review and comment. Plans are reviewed to determine the practicality of the project, and impact on public services and surrounding properties. Compliance with Township Ordinances and Standards will also be reviewed. Certain engineering design considerations may also be addressed, due to their potential impact on site layout.
- C. Upon completion of the review, the Township Engineer and other review parties will provide a review letter to the Township with any necessary revisions and/or corrections noted. The letter will also be provided to other regulatory agencies, the applicant, and the design engineer.
- D. Reviews will be conducted as often as is necessary to meet Township requirements. Applicants shall pay all costs in excess of review fees for adequate reviews of submittals made to the Township. The application will not be placed on the Planning Commission agenda until Township staff and consultants have determined that the plans are complete per this document and Township Ordinances.
- E. Upon determination of a complete application and plan set, the Township Planner will assemble all comments from plan reviewers and provide them to the Planning Commission for their review. The Planning Commission will approve, table, or deny the plan.
 - 1. Commercial Projects:
Upon the approval by the Township Planning Commission, the applicant may begin preparing construction plans.

2. Residential Projects:

Upon the approval by the Township Planning Commission, the plans and comments will go to the Township Board, which will approve, table, or deny the plan. Upon approval by the Township Board, the applicant may begin preparing construction plans.

No construction work may begin with only site plan approval except as specifically allowed in the zoning ordinance. When the plan is approved, the Township Planning Department will file an approved copy of the site plan and application at the Township.

- F. All documents and fees required for Planning Commission review must be received by the Township no later than 30 days prior to the next regularly scheduled Planning Commission meeting. As mentioned earlier, the schedule of regular meeting dates is posted for public display at the Township Hall and on the Township's website.
- G. As part of the review process, the Township Engineer may contact the Township, Fire Department, or other regulatory agencies for comments and feedback. If other agencies (i.e. Michigan Department of Transportation (MDOT), Michigan Department of Environmental Quality (MDEQ), Livingston County Road Commission (LCRC), Livingston County Drain Commissioner (LCDC), etc.) have not completed their reviews, the Township Engineer may request that their comments be supplied prior to site plan approval to ensure a level of preliminary acceptance of the proposed plan. All agency approvals shall be obtained, or reasonably assured, including, but not limited to Livingston County Road Commission and Livingston County Drain Commission. MDEQ water main and sanitary sewer permit applications will not be submitted until the Township Engineer grants final engineering approval.
- H. 5 complete sets of the plans are required for site plan application. It is recommended that the applicant schedule a time to meet with the Township staff/consultants before submitting any plans. All plans must be signed and sealed by a professional engineer, registered to practice in the State of Michigan. A complete submittal requires an application and fees to be paid to the Township. Upon Township staff and consultant's determination that the submitted site plan is complete, 15 sets of plans are required to be submitted for review by the Planning Commission.
- I. All phasing shall be shown on the plans, and receive site plan approval. Approvals will not be given for partial phases. All revisions on all phases must be made before site plan approval.
- J. Site plans can be approved by the Planning Commission with contingencies. Items eligible for contingent approval are those that are not significant, and do not have potential for revisions to the site layout. The contingent items will be reviewed during the Construction Plan Review, and shall be addressed prior to Construction Plan approval.
- K. The Township will not give approval until all required fees have been paid to the Township.

III. SITE PLAN REQUIREMENTS

- 1. 5 sets of plans, completed application, and review fees shall be submitted to the Township Planning Department. Plans shall be submitted on 24 inch X 36 inch paper. 15 sets of plans will be required when the plan goes to the Planning Commission.
- 2. Date of plan (with revision dates), scale, and north arrow shown.
- 3. General plan at a scale not greater than one inch equals 200 feet. All scales must be those customarily found on an engineer's scale (e.g. 10, 20, 40, 50). The information shall be presented on more than one drawing if necessary.
- 4. Property Owner and Applicant's name with address and phone numbers. If the Applicant is legally authorized to apply for site plan review, the Property Owner's signed consent must be provided.
- 5. Plans prepared and sealed by a qualified professional (as determined by the Township), licensed or registered in the State of Michigan. A qualified professional may be an architect, engineer, landscape architect, or land surveyor depending on the project.
- 6. Name, company, street address, email address, phone and fax number of designer.
- 7. A vicinity map, tax identification number, legal description of the property, and dimensions/lot area.
- 8. Lot line angles or bearings (based on a boundary survey prepared by a licensed professional surveyor) indicated on the plans where a metes and bounds description is used.
- 9. Existing topography, shown at a 1 or 2 foot contour interval, extended 100 feet beyond the site in all directions, showing existing natural features (on the site and within 100 feet of the site) such as: shrubs, bushes, trees, wooded areas, marshes, streams, ponds, and wetlands with any removals indicated.
- 10. Delineation of the 100-year floodplain. If no floodplain exists, a note shall indicate so.
- 11. Watershed for all lakes, ponds, streams, and wetlands.
- 12. Delineation of any wetlands or watercourses.
- 13. Description and delineation of Wellhead and Natural Features Protection Areas, as recognized by the Township.

- ❑ 14. Location, size, and type of existing deciduous trees of six inch diameter or larger (measured 3.5 feet from ground) and evergreen trees ten feet in height or higher. Groups of trees (defined as at least four trees with overlapping canopies) can be shown by an approximate outline of the total canopy. The plans shall identify those materials marked for removal and those marked for preservation.
- ❑ 15. Existing buildings and structures, on the site and within 100 feet of the site in all directions, including but not limited to drives, utility poles and towers, pipelines, excavations, ditches, bridges, and culverts, with any removals indicated.
- ❑ 16. Information on adjacent properties indicated (use, zoning classification, location and outline of buildings, drives, parking lots, and other improvements).
- ❑ 17. Existing public utilities serving the property (location, size, and inverts for sanitary sewer and storm sewer lines; location of manholes and catch basins; location and size of wells, septic tanks, and drain fields and location and size of water lines and hydrants).
- ❑ 18. Existing drainage patterns shown.
- ❑ 19. Identify all existing and proposed easements (location, width and purpose).
- ❑ 20. Name and rights-of-way of existing streets adjacent to the property-the following shall be indicated: surface type, width, and spot elevations of street surface.
- ❑ 21. Proposed buildings and/or structures (number, location, general dimensions, outline, floor area, number of floors, height and type of unit, and distances between all). For residential projects, a typical concept shall be indicated.
- ❑ 22. Location, size, and type of electric, telephone, gas, and cable utilities.
- ❑ 23. If applicable, the location and size of underground tanks and outdoor incinerators.
- ❑ 24. Grading plan, showing finished contours at a minimum interval of one foot.
- ❑ 25. All proposed contour lines are to be connected to existing contour lines at or inside the property lines.
- ❑ 26. Location and size of proposed recreational areas and open spaces. Maintenance provisions shall be provided for these areas in the Master Deed.

- ❑ 27. Location, width, and surface of proposed recreational pathways or sidewalks.
- ❑ 28. Location and type of proposed screens and fences with height, typical elevation, vertical section of screens, and material type and dimensions shown.
- ❑ 29. Outdoor trash container enclosure with size, typical elevation, vertical section of enclosures, and material type and dimensions shown.
- ❑ 30. Type, size, location, area, and height of all proposed signs.
- ❑ 31. Landscape plan showing size, location and type of all plant materials.
- ❑ 32. All soil erosion and sedimentation control measures must be shown and maintained during grading and construction operations or until a permanent groundcover is established.
- ❑ 33. Location of proposed retaining walls with the following information provided: dimensions, materials, fill materials, typical sections, and restoration notes.
- ❑ 34. Location and area of development phases including projected schedule.
- ❑ 35. Indication of how the site will be served with sewer and water. Preliminary layout of proposed wastewater and water systems shall be shown, including the basis of design.
- ❑ 36. Layout of proposed storm management system, including outlet, if applicable.
- ❑ 37. Location and size of detention/retention ponds with calculations shown on the plans and side-slopes indicated.
- ❑ 38. Proposed street and drive information including but not limited to alignment, proposed street name, public/private, right-of-way, pavement cross-sections, curb details, grades and surface elevations of entries/exits, curve-radii, turning lanes.
- ❑ 39. If applicable, right-of-way expansion indicated with reservation or dedication clearly noted.
- ❑ 40. Location and dimensions of proposed parking lots with numbers of spaces in each lot, drainage pattern, dimensions of spaces and aisles, typical cross-section, and angle of spaces indicated.

- ❑ 41. The plan will be reviewed from a traffic perspective for internal circulation. Adequate space must be provided for turning movements of vehicles including trucks and fire engines. Typically, site plans should be designed to accommodate a WB-50 truck, as defined by AASHTO.
- ❑ 42. If on-site sewer facilities are to be used, a letter from the Livingston County Department of Public Health shall be provided verifying the acceptability of soils on the site.
- ❑ 43. A Traffic Impact Study shall be provided for review, as required by the Township Zoning Ordinance.
- ❑ 44. A preliminary approval letter from the Brighton Area Fire Department shall be provided indicating acceptance of site layout. The plans shall meet the currently adopted Fire Code.
- ❑ 45. A preliminary approval letter from the Livingston County Drain Commission shall be obtained for any project that may affect a county drain or drainage district, or for a project proposing to establish a new drainage district.
- ❑ 46. A preliminary approval letter from the Livingston County Road Commission shall be obtained for any action within the county right-of-way.
- ❑ 47. The proposed development conforms to all regulations of the Zoning Ordinance for the district in question.
- ❑ 48. Any grading will not adversely affect neighboring properties.
- ❑ 49. The plan meets the standards of other government agencies and the approval of such agencies is obtained or assured.
- ❑ 50. Copies of all permits and permit applications, obtained to date, shall be forwarded to outside regulatory agencies. The status of all necessary permits shall be included on the cover sheet.

IV. CONSTRUCTION PLAN PROCEDURES

- A. Following approval of the site plan by the Township, the applicant shall submit the construction plan application form and three copies of a detailed itemized construction cost estimate for all water main, sanitary sewer, paving, grading, soil erosion control and drainage improvements. The estimate must be signed and sealed by a Design Engineer licensed in the State of Michigan. The estimate shall be reviewed and approved by the Township's engineer prior to submittal of the Construction Plans.
- B. Upon approval of the engineer's estimate of costs, the applicant shall submit to the Township Planning Department five (5) copies of construction plans, the review fee, a completed application form (see Appendix II), and any other data and exhibits hereinafter required. Subsequent plan submittals resulting from addressing review comments shall be made to the Township. The Township will then forward plans to the Township Engineer for review.
- C. The construction plans shall address the same concerns as the site plan but shall include much greater detail in accordance with the adopted Charter Township of Brighton Engineering Standards. Approval of the construction plans by the Township Engineer, as well as other agencies, is required prior to beginning construction.
- D. As part of the Construction Plan review process (as in the site plan review process), the Township Engineer may contact the Township, Fire Department, or other regulatory agencies for comments and feedback. If other agencies (i.e. MDOT, MDEQ, LCRC, LCDC, etc.) have not completed their reviews, the Township Engineer may request that their comments be supplied to the Township Engineer prior to final approvals. In general, the following agencies shall have review authority over the types of associated improvements listed below:
 - 1. Charter Township of Brighton
 - a. Public and Private water distribution system and appurtenances
 - b. Public and Private sanitary sewer and appurtenances
 - c. Private storm sewer and appurtenances
 - d. Storm water management (detention, retention, etc)
 - e. Public and Private roads and paved areas
 - f. Pathways and sidewalks
 - g. Grading and restoration
 - h. Any other improvements not regulated by another agency

2. Livingston County Road Commission (LCRC)
 - a. Private and commercial approaches to public roads, residential driveways to public roads, connection to public utilities in the road right-of-way, storm sewer located within the road right-of-way
3. Livingston County Drain Commissioner (LCDC)
 - a. Public storm sewer and appurtenances
 - b. Storm water management (detention, retention, etc)
 - c. Soil Erosion Control
 - d. Private on-site wastewater treatment systems
4. Livingston County Department of Public Health
 - a. Private sewer fields
 - b. Private water wells
5. Livingston Community Water Authority (LCWA) or other water system
 - a. Public water distribution system and appurtenances
6. Brighton Area Fire Department (BAFD)
 - a. Overall safety, emergency access, availability of water
7. Michigan Department of Environmental Quality (MDEQ)
 - a. Established 100-yr floodplain
 - b. Regulated wetland areas
 - c. Public sanitary sewer
 - d. Public water main
8. Michigan Department of Transportation (MDOT)
 - a. State governed public roads, streets and rights-of-way

- E. All public improvement plans submitted for permits must carry the seal and signature of the Design Engineer. Note that the amount and type of sanitary and/or water main pipe must be summarized on the cover sheet when MDEQ permitting is required.
- F. The applicant shall be responsible for submitting directly to the LCRC, LCDC, and other separate regulatory agencies (MDOT, MDEQ for wetland permitting, etc.). Any such approvals shall be forwarded to the Township Planning Department and the Township Engineer prior to beginning construction.
- G. When plans are complete and ready for approval, the Township Engineer will request that additional sets of plans be submitted for distribution to MDEQ for sanitary sewer and water main permitting.
 - 1. Sanitary sewer plans, along with a completed MDEQ Sanitary Sewer Part 41 Permit Application, shall be provided to the Township Engineer. Pertinent design information will be supplied by the Township Engineer. The Township Engineer will have the Township execute the permit application and then forward the application and plans to the MDEQ for permitting.
 - 2. Water main plans, along with a completed MDEQ Water Main Act 399 Permit Application, shall be provided to the Township Engineer. Pertinent design information will be supplied by the Township Engineer. The Township Engineer will have the Township execute the permit application and then forward the application and plans to the MDEQ for permitting.
- H. Preconstruction meeting requests must be made at least 10 business days prior to the date of the proposed meeting. This meeting will not be scheduled until all permits have been received, all fees and escrows have been paid to the Township, and final engineering approval has been granted.
- I. Before issuing substantial completion (as defined by Section XIII), record drawings will be prepared and certified by a professional engineer or surveyor licensed and registered in the State of Michigan and submitted to the Township for review by the Township Engineer. The record drawings, or as-constructed plans, will show the location of all utilities and final grades for all water main, sanitary sewer, storm sewer, storm water management systems, and appurtenances. The as-constructed plan checklist is provided in Appendix VIII. After approval of the plans by the Township Engineer, as-constructed plans shall then be submitted for acceptance by the Township. An electronic copy of the as-constructed plans, conforming to the Township's GIS standards, will also be required at this time along with a maintenance and guarantee bond (see Section IX of these standards). Guidelines for GIS standards can be found in Appendix IX.

V. CONSTRUCTION PLAN REQUIREMENTS

The following is a list of requirements that shall be used to assist in Construction Drawing and Record Drawing preparation. Any engineering items not specifically covered under these Engineering Standards or the Charter Township of Brighton Zoning Ordinance shall be submitted to the Township for approval. Approval will be, based on the discretion of the Township, Township staff and consultant's, and other agencies as to appropriate standards, regulations, or local impact.

A. PLAN REQUIREMENTS

1. GENERAL

- a. Plan paper shall be 24" x 36".
- b. Plan scale shall be a minimum horizontal scale of 1" = 50' and vertical scale of 1" = 5'. Other acceptable scales are 1" = 20', 1" = 30', and 1" = 40'.
- c. Plan cover sheet shall include the following:
 - i. Project name;
 - ii. The words "Charter Township of Brighton, Livingston County, Michigan";
 - iii. Proprietor's, engineer's, architect's and landscape architect's name, address, phone and fax number;
 - iv. Location map showing section number and major thoroughfares
 - v. Date, revision dates, north arrow and scale
 - vi. Property sidwell number(s);
 - vii. Listing of the required approval agencies (i.e. LCRC, MDEQ, etc);
 - viii. Plan sheet index;
 - ix. Professional seal and signature of engineer licensed to practice on the State of Michigan.
 - x. MISS DIG notice
- d. A title block shall be present on each plan sheet.
- e. The legal description for the property shall be included. It must also be represented by bearing angles and distances in plan view, and shall have a ratio of closure no greater than 1 part in 5000.
- f. Zoning information including zoning designation, land use, minimum lot area, frontage, building separation, setbacks, and maximum lot coverage and building height requirements for the site's zoning designation.
- g. A topographic survey plan sheet shall be included; additional requirements are outlined in Section II, Topographical Survey, of this document.
- h. A general area plan shall be included at 1"=100' or 1"=200' when size of the site prohibits a single sheet. The general plan shall show existing and proposed roadways and rights-of-way, site location and dimensions, utilities, building structures, landscaping, and topography.

- i. A landscaping plan shall be included. Plantings and landscape features must not interfere with utilities or public easements.
- j. Location of wetlands, drainage courses, and floodplain areas shall be shown.
- k. On and offsite permanent and temporary easements shall be shown on the plans.
- l. Storm sewer, sanitary sewer and water main shall be shown on the same plan view.
- m. Drainage and detention calculations must be submitted and incorporated into the plan drawings.
- n. Private and public roadways, existing and future road right-of-way, and road easements shall be shown on the plans.
- o. Dimensions for existing and proposed road right-of-way and/or easements, roadways, parking areas, driveways, sidewalks, and pathways shall be shown on the plans and shall be in accordance with the Charter Township of Brighton Zoning Ordinance, Livingston County Road Commission Standards for Plat Development, and/or and the requirements outlined herein.
- p. Exact drive locations, as approved by LCRC on County Roads and MDOT on State Roads, must be shown on the engineering drawings including the utility plan sheet. Structures (e.g. gate valves, sanitary manholes and storm manholes) will not be allowed in paved surfaces (e.g. sidewalks / driveways) including the road. Exceptions will only be allowed with approval by the Township Engineer.
- q. Walls or berms must be shown in cross-section. Walls in height of 4-feet (measured from top of wall to finished bottom grade) or greater shall be considered retaining walls and require a structural engineering review. Standards for retaining wall design can be found in Section J.3.

B. TOPOGRAPHICAL SURVEY

1. GENERAL

- a. A complete topographical survey is required for all sites. Existing offsite elevations must be given at a minimum of 100 feet abutting the entire perimeter of the site. Onsite contours are required to establish the existing site drainage. Grades shall be indicated at all property corners and along all property lines. Contours shall be at the following spacing:
 - i. 1-foot contours if scale of plan is less than or equal to 1"=50'
 - ii. 2-foot contours if scale of plan is greater than 1"=50'
- b. A minimum of two (2) benchmarks, based on NAVD88 datum, must be included. The datum shall be clearly referenced.
- c. Property lines shall be indicated by bearing and distance on the plan view.
- d. All existing conditions shall be shown, including but not limited to the following items (location and elevation):
 - i. All utilities including sanitary, water main, gas, telephone, cable, and electrical (including rim and invert elevations);
 - ii. Along property lines;
 - iii. The building finished floor;
 - iv. Sidewalks and pathways;
 - v. Retaining walls;
 - vi. Finished grades of all adjacent buildings;
 - vii. All easements;
 - viii. 100-year floodplain;
 - ix. Existing drainage courses and wetlands;
 - x. Upstream and downstream culverts;
 - xi. Trees;
 - xii. Adjoining road right-of-way.
- e. For developments greater than 5 acres, the Owner will be required to establish a concrete benchmark at a reasonable location approved by the Township. A detail shall be included on the plan.
- f. Existing and proposed right-of-way of adjacent roads must be indicated.
- g. Road topography shall extend across the entire site with grades shown on both sides of the street for:
 - i. Property line;
 - ii. Ditch centerline and top of bank;
 - iii. Edge of shoulder;
 - iv. Edge of pavement or top of curb;
 - v. Crown or centerline.

C. UTILITIES (GENERAL)

1. GENERAL

- a. The location, size, and type of pipe of all existing and proposed utilities shall be shown in plan view.
- b. Proposed water main, sanitary sewer, and storm sewer shall extend across the property frontage(s) or to a property line.
- c. No new utilities shall be placed below or within a 1:1 influence of a building footprint. The limits of all removals and/or abandonment shall be shown on the plans. The following criteria shall apply for all existing utilities within the influence of a building foundation:
 - i. Utilities within five (5) feet or less below a footing shall be removed.
 - ii. Utilities greater than five (5) feet below a footing shall be grouted full using a standpipe to prevent air voids.
 - iii. Utilities that are to be abandoned and are not within the influence of a footing shall be bulkhead unless the utility is determined to be a hazard, nuisance or potential maintenance problem by the Township.
- d. A minimum ten (10) feet wide horizontal separation shall be required between all public utilities. In addition, utilities must be a minimum of ten (10) feet from buildings.
- e. No water main or sanitary sewer shall be within five (5) feet (measured horizontally) from the high water elevation of a detention, retention, and/or forebay basin.
- f. All utility crossings, including sanitary sewer leads, shall specify top and bottom of pipe elevations. An 18" minimum vertical clearance between water main and storm or sanitary sewer is required.
- g. A casing pipe shall be provided when utilities must cross retaining walls or when a bore is proposed under a roadway. The casing pipe must extend beyond the angle of repose of the retaining wall or roadway. The size, length and invert of the casing pipe shall be indicated. All bores under roadways shall meet the requirements of the Livingston County Road Commission.

D. WATER MAIN

1. GENERAL

- a. All proposed public (more than one user) water systems shall be designed to the meet the current standards of the Livingston Community Water Authority, except when the proposed system will tie-in to the City of Brighton's system, where it shall meet the current standards of the City at that time.
- b. A quantity list itemizing all proposed water main must appear on the first sheet of the plans.
- c. Public water main may be required for any new main servicing a fire hydrant, or where multiple users are serviced. Township approval will be required for private lines serving more than one building.
- d. New or existing sites may be required to connect into existing public water mains based on Township review.
- e. The applicant shall submit basis of design computations for residential development for analysis by the Township Engineer.
- f. The location, size, length and type of existing and proposed water main, water service leads, and water main appurtenances such as, though not limited to; valves, hydrants, vertical and horizontal bends, and tees shall be shown in plan and profile view. All water main, including appurtenances, shall meet the Livingston Community Water Authority standards (or in some cases the City of Brighton standards) and the Brighton Area Fire Department standards.
- g. Finished grade of hydrants and top of casting elevations shall be shown on plans.
- h. Internal Sprinkler Systems shall be in conformance with the Michigan Building and Plumbing Codes, latest edition.
- i. Water main shall be looped if practical/viable or if required by the Livingston Community Water Authority.
- j. If water main is not available, the location of existing and proposed well systems shall be shown on the plans. Documentation including the proper permits must be filed with the Livingston County Health Department (LCHD). Copies of all paperwork must be submitted prior to construction plan approval.
- k. No building permits will be issued above the foundation for any development prior to the required mains and hydrants being put into service. Adequate access for fire fighting equipment must also be provided. No occupancy will be allowed without the required mains, hydrants and sprinklers in active service.

2. METERS AND SERVICE LINES

- a. The provisions of Act 230 of the Public Acts of 1972 requires that the materials and methods indicated in the currently adopted Michigan Plumbing and Michigan Residential codes shall apply without local modification. The plumbing codes provisions apply to building sewers, storms and water services up to their connection with the public system.
- b. Domestic and fire protection services shall be allowed on 8" to 16" water main only. All water services must be connected directly to the water main.
- c. Taps for domestic water services from fire service leads and hydrant leads are not permitted.
- d. Service lines are to be sized in accordance with the latest version of the Michigan State Plumbing Code.
- e. Curb stops and boxes and valves and boxes shall not be placed within pavement areas, unless there is no alternative, or if otherwise required by the Township. Boxes located within pavement areas shall be centered within concrete.
- f. The Township Building Department must inspect all water service connections.
- g. All water services up to 2" diameter shall be Type K soft copper. All water services greater than 2" diameter shall be Class 54 ductile iron
- h. 1½-inch (or larger) meters shall be installed by a licensed plumber and inspected by a Township and/or LCWA representative, where applicable.

E. SEWERS (SANITARY/STORM)

1. GENERAL

- a. The following must be shown in plan view for sanitary and storm sewer.
 - i. Length, size, type, class, and slope of pipe between structures.
 - ii. Top of casting elevation at structures.
 - iii. Easement width (20' minimum for sanitary sewer, 12' minimum for storm sewer).
 - iv. Progressive numbering system for all structures.

- b. The following must be shown in profile view for sanitary and storm sewer:
 - i. Length, size, type, class, and slope of pipe between structures.
 - ii. Size and type of structure.
 - iii. Top of casting and sewer invert elevations at structures.
 - iv. Existing and proposed ground elevations.
 - v. Hydraulic grade line (storm sewer only).
 - vi. Utility crossings, including top and bottom of pipe elevations.
 - vii. Special backfill areas under or within pavement areas.
 - viii. Progressive numbering system for all structures.
 - ix. All existing sewer inverts must be field measured and so noted on the plans
 - x. Adjacent existing or proposed utilities plotted where parallel and may conflict with sewer leads.
 - xi. Provisions for infiltration testing (sanitary sewer only)

- c. Storm and sanitary sewer size, grade, and structure spacing table

	Std	Min	Max	Std	Max
	Grade	Grade	Grade	Run	Run
<u>Size</u>	<u>(%)</u>	<u>(%)</u>	<u>(%)</u>	<u>(ft)</u>	<u>(ft)</u>
8"	0.50	0.40	8.0	300	300
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

** minimum allowable storm sewer size is 12"

- d. All pipe connections at structures shall be separated by a minimum of one (1) foot between pipe walls and 40% of the structure circumference must remain intact. The design engineer shall provide details for all structures with multiple pipe connections not meeting the requirements below:

<u>Structure Inside Diameter</u>	<u>Max. Pipe Size for Straight – Through Installation</u>	<u>Max. Pipe Size For Right Angle Installation</u>
48"	24"	18"
60"	36"	24"
72"	42"	36"
96"	60"	42"

- e. Where Manning's equation is used to compute flow, a minimum value for "n", roughness coefficient shall be as follows:
- i. Concrete Pipe = 0.013
 - ii. HDPE pipe = 0.011
 - iii. CMP = 0.025
 - iv. Open Channel = 0.035

F. SANITARY SEWER

1. GENERAL

- a. When construction of sanitary sewer is proposed, the Township Sanitary Sewer Details must accompany the plans.
- b. Sanitary sewer shall be designed to serve the proposed development with gravity sewer. It is recognized that sanitary sewers and appurtenances to be constructed as part of a project may often need to be oversized in order to be properly integrated into the Township system. The Township shall not bear the costs of such oversizing. The proprietor shall bear all necessary costs and provide associated easements.
- c. Public sanitary sewers may be required when two or more new connections are made to, or are possible on, the same sewer. In most instances, including multiple unit developments, the sewer may have to be public even though the project has one Owner. Township approval will be required for private lines serving more than one building.
- d. A minimum 20' wide easement is required for all public sanitary sewers. Wider easements will be required for deeper sewer to maintain a 1:1 excavated side slope within the easement. The sanitary sewer shall be centered within the public easement.
- e. All pressure sewers shall be installed with tracer wire.
- f. 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 Township. The video shall be taken no less than 30 days after installation. A satisfactory review of the videotape by the Township Engineer and Owner shall be a condition of sewer acceptance.
- g. The Township Engineer will inspect all sanitary taps into existing Township structures.
- h. Downspouts, weep tile, footing drains, or any conduit that carries storm or groundwater shall not be allowed to discharge in the sanitary sewer system.
- i. If sanitary sewer is not available, a copy of LCDPH permit must be submitted prior to final approval of the construction plan drawings.
- j. Lift stations will not be permitted unless there is no other alternative for sewer service. If a lift station is required, the Design Engineer shall provide the Township with all design details and calculations, which shall be in accordance to all current local, County and State requirements. General design standards for lift stations in the Charter Township of Brighton are provided below. However, each lift station shall be evaluated for its long term purpose, and may require different specifications than those included in this document.

- k. No building permits will be issued above the foundation for any development prior to the required sanitary sewer being put into service. No occupancy will be allowed without the required sewer in active service.
- l. The testing requirements are as follows:
 - i. The contractor shall conduct a sanitary air test with the Township Engineer witnessing. Infiltration rates for all sanitary sewer shall not exceed 200 gallons per inch diameter per mile of pipe per 24 hours. Air tests shall comply with current testing standards and requirements. Air testing should not be used if the groundwater level is 2 feet or more above the top-of-pipe at the upstream end (reference ASTM F1417) or if the air pressure required for testing is greater than 11 psi.
 - ii. Mandrel testing shall take place to ensure flexible pipe has been properly bedded and back-filled. The deflection test must be conducted no less than 30 days after installation of the final backfill. The maximum allowable deflection is 5 percent. Installation shall conform to ASTM 2321-89. A nine-arm (point) mandrel shall be used. Cherne Fixed Steel Deflection or approved equal. Mandrel testing is not required for rigid pipe.
 - iii. A sanitary infiltration test complying with current standards is required when the water table is 2' or higher than the top-of-pipe.
 - iv. Additional testing requirements are outlined on the Sanitary Sewer Standard Details sheets.

2. DESIGN CRITERIA

- a. A quantity list and design data (on the cover sheet or first sheet of the plans) shall be provided and be in accordance with the current 10 States Standards.
- b. Sewer design flow computations shall be submitted to the Township Engineer for approval with a map of the area to be serviced. Developmental phases, present and future, with acreages and off-site areas contributing, shall be shown with the number of lots included. A permit application for a sanitary sewer construction permit as required by Part 41 of Act 451, Public Acts of 1994 (formerly Act 98) must be completed by the Design Engineer and submitted for review and approval by the Township Engineer. All design calculations and diagrams of service area shall be provided on the plan set.
- c. Sewer capacities shall be based upon the Recommended Standards for Wastewater Facilities (Ten States Standards, latest edition). The peak sanitary flows shall be designed using 240 gallons per capita per day, multiplied by the appropriate peaking factor.
- d. For residential developments of single homes, design population factor shall be at least 2.4 persons per prospective dwelling unit. In developments for housing of other types, and institutions, commercial, and industrial developments, refer to the Sanitary Sewer Unit Assignment Table provided in the Township's Sewer Ordinance.

- e. Minimum design velocity for sanitary sewers shall be 2 feet per second with pipe flowing full. The 0.8 depth flow line of sewers shall be matched at manholes when changing sizes of sewers.
- f. Compare flows with existing downstream sewer capacity to assure available capacity present for proposed development.
- g. Maximum design velocity for sanitary sewers shall be 10 feet per second with pipe flowing full.
- h. A 0.10 drop through manholes shall be required at all proposed structures.
- i. A 2-foot sump and temporary bulkhead shall be placed in the first manhole upstream of the connection to the existing sewer. A note to this effect shall be added to the profile. The sump shall be filled and bulkhead removed after successful testing.
- j. The provisions of Act 230 of the Public Acts of 1972, as amended, requires that the materials and methods indicated in the currently adopted Michigan Plumbing and Michigan Residential codes shall apply without local modification. The plumbing codes provisions apply to building sewers, storms and water services up to their connection with the public system.
- k. New or existing sites may be required to connect into existing public sanitary based on Township review and State of Michigan requirements.
- l. Hydrogen sulfide protection shall be provided where applicable. The Township and Township Engineer will determine the extent of the protection on a case-by-case basis.
- m. A minimum 10 feet separation must be maintained between the sanitary sewer and any permanent structures, such as a building.
- n. When there is a change in direction in a sewer at a manhole, an allowance of 0.10 feet in grade shall be made for a loss of head through the manhole.
- o. 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.
- p. Sanitary sewers shall be located so they provide unrestricted access for maintenance and inspection.
- q. Siphons shall only be allowed when specifically approved by the Township and Township Engineer.

3. DEPTH

- a. A minimum cover of 4' is required over all sanitary sewers, including leads.

- b. Maximum depth to invert of any sanitary sewer shall not exceed the depth recommended by the manufacturer for each size and class of pipe.
- c. Minimum depth of invert below finish grade of building to be served shall be deep enough to serve a standard depth basement by gravity. Deep setbacks or unusual conditions may require additional depth.
- d. Sanitary sewers that reach a depth greater than 20 feet shall be Ductile Iron Class 52.

4. LEADS

- a. The building lead location, size, type, and slope (minimum 6" diameter, SDR 23.5, and 1%) shall be provided. In order to verify the slope of the lead, invert elevations shall be provided at the finished grade of the building and at the connection to the mainline sanitary sewer.
- b. Private sanitary sewer leads of excessive length may require inspection and testing. Each site will be considered individually by the Township.
- c. In sanitary sewers where construction of building leads to the property line is not required, a wye branch (tees not allowed) shall be installed for each lot or potential building site.
- d. Clean-outs will be required for lead lengths in excess of 100 feet.
- e. Sanitary service leads shall be located five feet away from the water service lead.
- f. Leads shall not be connected to manholes unless specifically approved by the Township for connection to the last manhole or connection to deep sewer. A drop connection will be required at connections to manholes.

5. MANHOLES

- a. Minimum manhole size is 4 foot in diameter.
- b. All upstream dead-end sewers shall have a minimum last run grade of 1.0 percent.
- c. Manholes shall generally be placed at intervals of 400 feet, at every change of grade, direction, pipe size and at each junction of sewers. Manholes must be placed in locations accessible by sewer cleaning equipment.
- d. Sanitary manholes shall not be located in the influence of sidewalks or drive approaches.
- e. Flexible watertight joints are required for pipe connections to all manholes
- f. A manhole bench shall be provided on each side of the flow channel, per township details.

- g. The flow channel straight through a manhole should be made to conform as closely as possible in shape, and slope to that of the connecting sewers. The channel walls should be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection or flow in the sewers.
- h. A bench shall be provided on each side of any manhole channel when the pipe diameter (s) is less than the manhole diameter. The bench should be sloped no less than ½ inch per foot (4 percent). No lateral sewer, service connection, or drop manhole pipe shall discharge onto the surface of the bench.
- i. Structures deeper than 20-feet shall be six foot in diameter and wrapped with Infi-shield rubber, Elastomeric seal, or approved equal at every joint.

6. DROP CONNECTIONS

- a. External drop connections are required when there is an 24" vertical difference between inverts on the outlet and inlet pipes and shall be constructed according to the Standard Details.
- b. The Township must approve internal drop connections. The connection shall be based on field conditions and in accordance with standard details.

7. LIFT STATIONS:

- a. Shall be designed in accordance with "10-State Standards Recommended Standards for Wastewater Facilities."
- b. In general, the use of pump stations shall be avoided and will only be accepted where no other feasible alternative exists. Where allowed, the pump stations shall be Gorman-Rupp pump stations, designed per the recommendations of the Township Engineer.
- c. There will be a minimum of 2 pumps in a pumping station and minimum size of discharge lines shall provide adequate cleaning velocities and shall conform to Michigan Department of Environmental Quality requirements.
- d. Where only two units are provided, they shall be of the same size. Units shall have capacity such that, with any unit out of service, the remaining units will have capacity to handle the design peak hourly flow.
- e. All pumping station plans will be considered separately.
- f. Pipe for force mains shall be designed to withstand both internal pressures and external trench and live loads. Design computations shall be submitted by the Design Engineer for review and approval.

- g. Pumps handling raw wastewater shall be capable of passing spheres of at least three (3) inches (76 mm) in diameter. Pump suction and discharge openings shall be at least four (4) inches (102 mm) in diameter.
- h. Each pump shall have an individual intake. Wet well and intake design should be such as to avoid turbulence near the intake and to prevent vortex formation.
- i. Provisions shall be included for above-ground bypass pumping.
- j. Use submersible pumps in pump stations, installed on a non-sparking stainless steel guide rail system for easy retrieval during maintenance and repair. Lifting chains shall be stainless steel.
- k. All nuts, bolts, screws, etc. shall be stainless steel.
- l. Suitable shutoff and check valves shall be placed on the discharge line of each pump. The check valve shall be located between the shutoff valve and the pump. Check valves shall be suitable for the material being handled and shall be placed on the horizontal portion of discharge piping except for ball checks, which may be placed in the vertical run. Valves shall be capable of withstanding normal pressure and water hammer.
- m. Design wet well volume for a minimum of 10 minutes between pump starts at the average daily flow rate. Size wet well storage so that sewage is pumped out at least once every four (4) hours at the average daily flow rate.
- n. Pipe materials shall be ductile iron. Ductile iron Class 54 pipe shall be cement lined. Joints and fittings shall be equal to the requirements for pressure pipe used in the domestic water distribution system.
- o. Directional bores shall not be used without the written permission of the Brighton Township Utility Department.
- p. Hydrogen sulfide protection shall be provided on proposed wet wells as well as the first down stream discharge manhole. The extent of the protection will be determined by the Township Engineer on a case-by-case basis.
- q. Wastewater pumping station structures and electrical and mechanical equipment shall be protected from physical damage by the 100-year flood. Wastewater pumping stations should remain fully operational and accessible during the 25-year flood. Regulations of state and federal agencies regarding flood plain obstructions shall be considered.
- r. The pumping station shall be readily accessible by maintenance vehicles during all weather conditions. The facility should be located off the traffic way of streets and alleys. It is recommended that security fencing and access hatches with locks be provided.

- s. Where high groundwater conditions are anticipated, buoyancy of the wastewater pumping station structures shall be considered and, if necessary, adequate provisions shall be made for protection.
- t. Electrical systems and components shall be designed per section 42.35 of "Ten States, Recommended Standards for Wastewater Facilities."
- u. Provisions must be included for a permanent auxiliary power source and a telemetered alarm system compatible with the Township's system.
- v. Pump control panels shall include the following items:
 - i. UL listing;
 - ii. Type 304 stainless steel cabinet, NEMA 4X enclosure with dead front;
 - iii. Fully hinged inner door;
 - iv. HOA switch for manual and automatic operation;
 - v. Disconnect fuse;
 - vi. Circuit breaker;
 - vii. Motor contactors;
 - viii. Properly sized heaters;
 - ix. Automatic pump alternator switch;
 - x. Power company access and meter mounting location;
 - xi. Elapsed time meter, one per pump;
 - xii. Counter, one per pump;
 - xiii. Programmable timer;
 - xiv. Intrinsically safe relays, one per float switch;
 - xv. Low water/redundant off alarm;
 - xvi. Visual high water alarm shall be on a circuit independent of the pump. The visual alarm shall require internal shutoff.
 - xvii. Battery back-up for alarm system;
 - xviii. Four function emergency autodialer;
 - xix. Emergency generator connection meeting specifications of the Township Utility Department and Township Engineer;
 - xx. Load rated transfer switch;
 - xxi. Low voltage burnout protection for all motors and starters;
 - xxii. Motor Saver by SymCom, Inc.;
 - xxiii. Convenience outlet meeting specifications of the Township Utility Department and Township Engineer;
 - xxiv. Latch, padlock and two keys.

w. Lift Station Installation:

Excavate and place pre-cast concrete structure on sand subbase. Pour concrete around base of structure to counteract buoyant forces, if necessary. Backfill with sand compacted to a minimum of 95% of maximum unit weight.

- i. Make watertight connections for building sewer lead, pump discharge, electric power and controls.
- ii. Mount guide rails plumb and straight with half-inch (1/2") stainless steel expansion bolts.

- iii. Provide concrete grout fillets at the base of wetwells, sloped at 1:1.
 - iv. Install pumps on guide rails. Demonstrate free sliding action and proper seating of pumps against base flanges.
 - v. Install float switches and make electrical connections.
 - vi. Adjust float switches and demonstrate proper operation of the pumps with clean water.
 - vii. Place topsoil, seed and mulch so that cover of pump station is flush with surrounding grades. Slope grade away from hatch.
- x. Wastewater pumping stations and portable equipment shall be supplied with a complete set of operational instructions, including emergency procedures, maintenance schedules, tools, and such spare parts as may be necessary. The Township will determine the required detail of these items.
 - y. Copies of all equipment warranties, O&M Manuals, shop drawings and test reports shall be provided to the Township.
 - z. No construction or installation may take place between November 1 and April 15 without written consent of the Township.
8. BUILDING SEWERS:

a. Building Sewers included with Sewer Construction:

Unless otherwise approved due to exceptional circumstances, construction of the building sewer, from public sewer to property line for each fronting parcel which the sewer is designed to serve, shall be included with construction of each sanitary sewer. Building sewer shall extend a minimum of 10 feet beyond the property line.

b. Wyes, Tees and Risers:

Where cover over sanitary sewer to finished grade is more than 10 feet, risers shall be installed from wyes or tees to an elevation ten 10 feet below finished grade. Location of the wye or tee shall be marked from the downstream manhole on the record sewer plans prepared. Where the water table is high, the riser shall end at a depth of 1 foot above the water table.

When house leads are to be cut into an existing sanitary sewer, tap shall be made with the use of a saddle or other connections approved by the Township.

c. Size and Material of Building Sewers:

Ordinary house connections shall be 6 inch diameter up to the property line and shall be constructed of ABS plastic solid wall pipe ASTM D-2751, latest revisions, or PVC SDR 23.5 solid wall. Larger building sewers may be constructed of materials permitted for sanitary sewers under the same conditions.

Joints in building sewers, including fittings, and stoppers for wyes and tees, risers and building sewer leads, shall conform to the requirements of these specifications.

- d. Minimum grade of building sewers shall be 1 percent for 6-inch sewers.

9. FORCE MAINS:

- a. At design pumping rates, a cleansing velocity of at least 2 feet per second should be maintained. The minimum force main diameter for raw wastewater shall not be less than 4 inches.
- b. An air relief valve shall be placed at high points in the force main to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on force mains. The force main configuration and head conditions should be evaluated as to the need for and placement of vacuum relief valves.
- c. Force mains should enter the gravity sewer systems at a point not more than 2 feet above the flow line of the receiving manhole and discharge in the direction of flow.
- d. Pipe and joints shall be equal to water main strength materials suitable for design conditions. The force main, reaction blocking, and station piping shall be designed to withstand water hammer pressures and associated cyclic reversal of stresses that are expected with the cycling of wastewater lift stations. Surge protection chambers should be evaluated.

10. MATERIALS:

- a. Sewer Pipe and Fittings:

Sanitary sewer pipe shall conform to the current ASTM standards for the following materials:

- i. ASTM D2680- Truss Cement rubber gaskets (8"-15") (ABS or PVC truss pipe).
- ii. ASTM D3034 -SDR 26 (4"-15") pipe (heavy wall sewer)
- iii. ASTM F1803-97- (closed profile) gravity pipe and fittings based on controlled inside diameter D2321 (8"-60" pipe) or ASTM F949 PVC (A-2000) corrugated sewer pipe with a smooth interior and fittings (4"-36") pipe (A-2000). (18"-102")

PVC pipe and fittings shall conform to requirements of latest applicable ASTM standard. Deflection of pipe shall be limited to a maximum of 5 percent.

- b. Pipe Joints:

Pipe joints shall conform to the following requirements depending on the allowable type of pipe used:

- i. Joints for plastic pipe shall be push-on type or in special applications, solvent-cemented. Push-on type joints shall conform to ASTM Specifications D-3212 and F-477 latest revision. Solvent-cemented joints, where specified, shall conform to ASTM Specification D-2855, latest revision.
 - ii. Joints on truss pipe shall consist of ABS plastic couplings chemically cemented to the ends of the pipe being connected. Solvents and methods used in making the chemical bond shall be in accordance with manufacturer's printed instructions, and the installation technique shall conform to ASTM Specification: D-2321, or latest revision thereof.
 - iii. Joints for HDPE shall be fusible-type joints conforming to the latest ASTM specifications.
- c. Manholes:

Manholes shall be constructed of precast reinforced concrete sections in accordance with the Township's standard details.

- i. Precast reinforced concrete manhole sections shall conform to requirements of the American Society for Testing and Materials "Tentative Specifications for Precast Reinforced Concrete Manhole Risers and Tops" - ASTM Designation: C-478, latest revision.
- ii. Precast manhole joints shall be MGT with rubber gaskets.
- iii. Manhole steps shall be ASTM Specifications D 2146 reinforced polypropylene plastic or approved equal.
- iv. Where manholes are located outside of pavements and sidewalks, final grade adjustments shall be made with pre-manufactured adjustment plastic rings; for manholes in paved areas, final grade adjustments shall be made with pre-cast concrete rings. Brick adjustments will not be accepted. Grade rings shall be a minimum of 3 inches thick and reinforced with 2 full circles of 3/16 inches diameter steel reinforcing wire. Manhole casting frame and concrete adjustments rings shall be secured to precast cone section with a minimum of 4, 5/8 inches diameter cadmium coated threaded studs or bolts. All joints in the assembly shall be sealed with rubber "O" ring gaskets.
- v. Elastomeric seal or rubber wrap shall be placed around each manhole frame and cone section for water tightness.
- vi. Manhole covers and frame shall be East Jordan Iron Works #1040 with type "A" cover or approved equal. Covers shall be cast with the words, "BRIGHTON TOWNSHIP-SANITARY" in raised letters spaced in from the periphery of the cover.
- vii. Special approved wet area manholes with precast rubber gasket type pipe fittings and lockdown rubber gasket type manhole covers such as EJIW #1040 ZPT, or approved equal, shall be required in areas of high ground water table and where manholes are to be located in or adjacent to drainage ditches, low areas and floodplains.

G. STORM SEWER

1. GENERAL

- a. A drainage area map shall be provided. The drainage area map shall show the storm sewer system, sub-area boundaries and acreage contributing to each storm structure, and runoff coefficient for each sub area.
- b. When construction of storm sewer is proposed, the Charter Township of Brighton Standard Storm Detail sheets must accompany the plans.
- c. Storm water shall not be diverted onto adjoining properties nor shall storm water flow be impeded from its existing drainage path due to a proposed development. Detention may be required to meet County discharge rate requirements. See the Detention/Retention section of this document for requirements.
- d. Storm water discharge shall be per the Livingston County Drain Commissioner's requirements or the Livingston County Road Commission's requirements if discharging into the road right-of-way. If a conflict exists between the other agencies and Township standards, the stricter requirements shall govern.
- e. At no time shall storm water discharge exceed a rate of 0.2 cfs/acre.
- f. The location, size, type of pipe, slope, length, and invert elevations of all storm sewer, including culverts, shall be shown on the plans. Plan and profile drawings shall be provided for all storm sewer and culverts. Sewer and culvert requirements are further outlined in the design criteria of this section.
- g. The location, length and cross-section of all ditches shall be shown on the plans. The cross-sectional ditch requirements are further outlined in the design criteria of this section.
- h. Roof drainage and sump pump leads may be directed overland or connected to a storm sewer system. If connecting to a storm sewer system, the connection shall be made at a storm structure. The location, size, type and slope of the leads shall be included on the plans. Minimum size of these applications is 4 inches.
- i. Concrete headwalls and/or rip-rap may be required where storm sewers or culverts enter open ditches or county drains.
- j. Sufficient capacity shall be provided in the storm sewer system to handle upstream drainage areas. All upstream drainage must be accommodated onsite. Allowances for upstream area must be based on ultimate improvements and runoff.
- k. Composite runoff coefficient may be determined for each individual drainage area and calculations for each drainage area must be submitted as part of the design computations. Composite coefficient design is based on the sum of products of drainage areas and their respective runoff coefficients divided by the total tributary area.

- I. The owner/developer shall be responsible for cleaning and maintaining all storm sewer, storm structures, sediment forebays, filter berms, detention basins, and detention basin outlets. These storm water management systems shall be cleaned at the time of final completion. A note indicating this as well as the a description of the mechanism for which the owner/developer plans to establish in order to provide for long term maintenance should be included on the plans.

2. DESIGN CRITERIA

- a. Enclosed storm sewer design calculations shall be submitted with the plans using the Rational Method, $Q = CIA$. The following shall be considered:
 - i. 10-year storm, $I = 175/(T+25)$ with initial $T=15$ minutes. Time (T) shall be based on the actual time of flow from the most distant point of flow measurement.

- ii. Typical surface runoff coefficients shall be:

<u>Surface</u>	<u>C</u>
Pavement (Asphalt, Concrete, Brick)	0.90
Roofs	0.90
Open Water	1.00
Aggregate	0.65
Greenbelt (Lawns, Vegetation)	0.20

Note: Surface area of detention, retention, and forebay areas shall be considered open water unless a naturally vegetative basin is provided.

- b. Velocity: Minimum = 2.5 ft/s; Maximum = 10.0 ft/s. Velocities exceeding 5.0 ft/s will require erosion protection as directed by the Township Engineer.
- c. Manning's formula shall be used to calculate pipes flowing full to verify the capacity of the storm sewer system:

$$Q = (1.49/n) AR^{2/3}S^{1/2}$$

- d. The storm sewer system shall be designed, if possible, so that the hydraulic grade line (HGL) is within the pipe. When discharging storm sewer into an existing or proposed detention basin, the 10-year storm elevation or bankfull elevation shall be considered when calculating the HGL of the proposed system. When discharging into an existing storm sewer system, the 8/10 point of the nearest existing downstream pipe or existing HDL, whichever is greater, shall be considered when calculating the HGL of the proposed system.
- e. Typically, the hydraulic gradient shall be maintained within the pipe. However, the gradient must always be maintained a minimum 1-foot below the top of all structures.

- f. Pipes shall be free flowing and no portion of a storm drainage system shall be permanently submerged.
- g. The provisions of Act 230 of the Public Acts of 1972, as amended, requires that the materials and methods indicating in the currently adopted Michigan Plumbing and Michigan Residential codes shall apply without local modification. The plumbing codes provisions apply to building sewers, storms and water services up to their connection with the public system.
- h. Sewer and structure requirements
 - i. All storm sewer shall be in accordance with Section V., Sewers (Sanitary/Storm).
 - ii. The minimum size storm sewer shall be 12" diameter.
 - iii. The Township Engineer must approve direct taps for storm sewer. Direct taps shall only be permitted if the storm sewer that is to be tapped is significantly larger than the tapping pipe. A KOR-N-TEE and boot connection shall be required for allowable taps. A detail shall be included on the plans.
 - iv. The sump leads and roof drain leads connecting to a storm sewer system shall be a minimum of 4" diameter and shall be SDR 35, non-perforated, solid wall, PVC pipe.
 - v. Storm sewer, unless otherwise approved by the Township Engineer, shall be reinforced concrete pipe (RCP) and shall meet the following requirements:
 - (i) Class IV for a depth up to 14 feet
 - (ii) Class V for depth 14 feet to 24 feet
 - (iii) Class III may be allowed in greenbelt areas for a depth up to 14 feet. At no time shall Class III be allowed under or within the influence of pavement areas
 - (iv) All RCP shall be meet ASTM C76 requirements
 - vi. RCP elliptical storm sewer may be allowed and must be approved by the Township Engineer. Elliptical storm sewer shall meet ASTM C507 requirements.
 - vii. Plastic storm sewer pipe may be allowed in greenbelt areas, where approved the Township Engineer, per the following requirements:
 - (i) Maximum 18" diameter
 - (ii) Smooth interior
 - (iii) PVC pipe shall meet ASTM F949 requirements
 - (iv) HDPE pipe shall meet ASTM M294 requirements
 - viii. Plastic storm sewer pipe may be allowed within the influence of paved areas, where approved the Township Engineer, per the standards of the MDOT Standard Specifications for Construction, latest revision. Additionally, plastic pipe will be allowed per the specifications outlined in the Qualification for Class B Plastic Pipe, as outlined by the MDOT.
 - ix. End sections shall be RCP, with a bar grate and 8" to 15" rip rap at the outlet.

- x. Manholes and catch basins shall be a minimum of 48" diameter. A detail of a typical manhole and catch basin shall be included on the plans. The type of casting for each structure shall be indicated in either plan or profile view and on the detail.
 - xi. Inlets shall be a minimum of 24" diameter. Inlets shall only be permitted at a structure that is the first (upstream) structure in a series and 12" diameter pipe serves as the discharge.
 - xii. A minimum cover of 3'-0" is required. MDOT "lowhead" or "flat top" structures are required instead of a cone/corbel section if there is less than 4' of cover over the pipe. Both plan and profile shall specify "low head" where necessary. A detail of the "lowhead" structure should be included on the plans.
 - xiii. A maximum depth to invert of any storm sewer shall not exceed the depth recommended by the manufacturer for each size and class of pipe.
 - xiv. A two (2) foot sump is required for any structure receiving surface runoff, with the exception of inlet structures.
 - xv. Structures (manholes and catch basins) shall generally be placed at intervals of 400 feet, at every change in grade, alignment, direction, pipe size, and at all junctions. A 0.10-foot drop should also be placed at all changes in horizontal alignment. Maximum distance between manholes shall be 325 feet for sewers 36 inches in diameter and smaller. Sewer larger than 36 inches in diameter will be considered individually.
 - xvi. Catch basins shall be placed at all low points in the gutter lines and not over 500 feet from a high point. Multiple catch basins may be required at a low point based upon the drainage area (catch basins at low points shall not receive drainage from an area larger than one acre for a paved surface). Catch basins shall be placed at rear lot lines as directed by the Township Engineer to provide proper site drainage.
 - xvii. All storm sewer shall be premium joint (rubber gasket). A note indicating this shall be included on the plans.
 - xviii. Trench drains shall only be permitted within truck wells. A trench drain detail shall be included in the plans.
 - xix. All storm water runoff within a truck well or discharging into a wetland shall be pre-treated with an oil and gas separator. A detail of the treatment structure, including the type and model number, shall be included on the plans.
- i. Where an underground storm sewer system is present, sump pump discharge (footing drains, roof drains, etc.) must be directed into the storm sewer via an enclosed system. The minimum size for these applications is 3 inches and taps must occur at a structure.
 - j. Where underground storm sewer is not present on a project, sump pump discharge shall be directed overland to a natural drainage course, such as a swale or wetlands.
 - k. All connections to storm sewer must be made at a structure. Blind taps are not allowed.
 - l. Storm structures shall not be located in sidewalks or drive approaches.

- m. Culvert calculations shall be submitted for inlet headwater control or outlet tailwater control with proper “K” factors used to determine culvert sizes. All culverts shall be sized for a 10-year storm event.
- n. Culvert requirements
 - i. The minimum size culvert shall be 12” diameter
 - ii. Culverts 48” diameter and greater shall require sloped paving at the inlet.
 - iii. Culverts shall be either corrugated metal pipe (CMP) or reinforced concrete pipe (RCP) and shall meet the following requirements:
 - (i) 12” – 24” CMP shall be 16 gauge
 - (ii) 30” – 36” CMP shall be 14 gauge
 - (iii) 42” – 54” CMP shall be 12 gauge
 - (iv) 60” – 72” CMP shall be 10 gauge
 - (v) All RCP shall be a minimum of Class IV
- o. Open ditch calculations shall be submitted and shall be sized for a 10- year storm event using Manning’s formula: $Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$. A one (1) foot freeboard shall be required.
- p. Open ditch requirements:
 - i. Minimum flat bottom width: 2’
 - ii. Minimum flat bottom depth: 2’ (measured from shoulder hinge point).
 - iii. Transverse slopes: 1.0% - 5.0%; ditch slopes exceeding 3% shall be sodded to a point one (1) foot above the ditch flow line.
 - iv. Maximum side slopes 3:1
 - v. Culverts sized for a 10-year storm elevation
 - vi. Flow through an open ditch system shall not exceed eight (8) cfs with a minimum flow velocity of 1.5 f/s and maximum velocity of 4.0 f/s
 - vii. No more than six (6) acres of tributary area may be conveyed through an open ditch system. An enclosed storm sewer system is required for all tributary areas exceeding six (6) acres.
 - viii. A ditch cross-section, which clearly indicates the dimensions outlined above shall be included on the plans.

3. EASEMENTS

- a. All public storm sewers must be located in a public right-of-way or an easement. The easement size will vary individually as required for maintenance and access based upon sewer depth.
- b. All private storm sewers must be located in a private easement. The easement size will vary individually as required for maintenance and access based upon sewer depth.
- c. Public storm sewer easements shall be dedicated to the LCDC office, and shall conform to the easement requirements of LCDC which are based on sewer depth.

- d. Private storm sewer easements shall be dedicated to the organization or association responsible for maintenance of the storm sewer system.
- e. Dedication of the easement will be required prior to the acceptance of the development.

4. MATERIALS

- a. Storm sewer pipe will conform to the ASTM "Tentative Specifications for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe," ASTM C-76 for circular pipe, latest revision or C-507 for horizontal elliptical pipe, latest revision. If other materials are proposed for use, the Owner will furnish the load carrying design analysis for the pipe for the proposed depth conditions. Plastic storm sewer pipe may be allowed in green belt areas only depending on the depth of the pipe. Type of plastic pipe will be reviewed by the Township on a case-by-case basis.
- b. Pipe joints will conform to one of the following requirements:
 - i. Modified Grooved Tongue (MGT) pipe will have a rubber gasket snapped into a groove cast into the tongue. The modified groove or bell end of the pipe will be made smooth and will have not over a 3.5 degree slope for sizes 10 to 24 inches, or a 2 degree slope for sizes 27 inches to 108 inches, tapered to fit the rubber gasket to tolerances as determined by the gasket manufacturer. MGT joints will be lubricated and coupled according to the pipe manufacturer's printed instructions.
 - ii. Rubber gasket joints will follow the Tentative Specification for "Joints for Circular Concrete Sewer and Culvert Pipe, Using Flexible, Watertight, Rubber Type Gaskets," ASTM Designation: C-443, latest revision. Rubber gasket joints will be lubricated and coupled according to the pipe manufacturer's printed instructions.
 - iii. Flexible, watertight, rubber gasket joints will be required for plastic storm sewer pipe. Rubber gasket joints will be lubricated and coupled according to the pipe manufacturer's printed instructions
- c. Manholes:
 - i. Manholes will be constructed of concrete block or precast reinforced concrete sections according to the Charter Township of Brighton standard details.
 - ii. Precast reinforced concrete manhole sections will follow the requirements of the ASTM "Tentative Specifications for Precast Reinforced Concrete Manhole Risers and Tops," ASTM Designation C-478, latest revision. Wall thicknesses will depend on depth and will be subject to the approval of the Township Engineer.

- iii. Final grade adjustments for structures shall be made with pre-cast concrete rings. Brick adjustments shall not be accepted. Grade rings shall be a minimum of 3 inches thick and reinforced with 2 full circles of 3/16 inches diameter steel reinforcing wire. Manhole casting frame and concrete adjustments rings shall be secured to precast cone section with a minimum of 4, 5/8 inches diameter cadmium coated threaded studs or bolts. All joints in the assembly shall be sealed with rubber "O" ring gaskets.
 - iv. Precast manhole joints will be as described in Section J, Item 3 of this chapter.
 - v. Manhole covers and frames shall be EJIW #1040 with Type "C" cover or approved equal.
- d. Catch basins:
- i. Catch basins shall be precast reinforced concrete manhole sections, according to the Charter Township of Brighton standard details.
 - ii. Catch basin and inlet frame and covers will be EJIW No. 5080 Type M1 cover or approved equal when in pavement edge or gutter line.
 - iii. If accepted by the Township, catch basin and inlet frame and covers can be EJIW No. 1010 Type M cover, or approved equal when in paved areas other than edge gutter line.
 - iv. Catch basin and inlet frame and covers will be EJIW M.D.O.T. beehive with Type "N" cover or equivalent when in yard areas.

H. DETENTION/RETENTION

1. GENERAL

- a. The location of the detention, standpipe riser structure, retention, forebay, forebay filter berms, and rain garden areas shall be shown in plan view.
- b. Storm water management systems, proposed as private systems or under the jurisdiction of the Drain Commissioner, shall be located on common-owned property, not on privately owned lots.
- c. Storm water management systems proposed as private shall meet the requirements of the Livingston County Drain Commissioner and the standards outlined below. If a conflict exists between the Drain Commission and Township standards, the stricter requirements shall govern.
- d. Detention must accommodate all onsite drainage and any runoff entering the site from neighboring properties.
- e. In some cases, a project will be establishing a Drainage District through the Livingston County Drain Commissioner's office, or discharging to an already established Drainage District. In these cases, the Drainage District to which the site discharges shall be indicated on the plans.
- f. Discharge rates shall not exceed 0.2 cfs/acre. More restrictive discharge rates may be required based on site conditions, the conditions downstream of the discharge, and if applicable, the drainage district to which the site discharges. The Township Engineer and/or the Livingston County Drain Commissioner shall determine if a more restrictive discharge rate is required. It is in the Applicant's best interest to involve both the Township Engineer and LCDC when such an issue needs to be resolved.
- g. Detention basins may be dry basins, wet basins, or storm water marsh systems.
- h. Storm water management system incorporating pumps shall not be permitted in developments with multiple owners. Variances from this requirement will only be considered if it is demonstrated that no other alternative is feasible, and it is demonstrated that a power failure will not adversely affect onsite drainage.
- i. The use of underground detention/retention is prohibited. Variance from this requirement will only be considered if it is demonstrated that no other alternative is feasible. These systems shall meet the requirements below.

2. DETENTION/RETENTION/FOREBAY DESIGN

- a. Calculations for sizing the detention basin, retention basin, and forebay shall be submitted and included on the plans.

b. All detention basin sizing shall be per the Drain Commissioner's "Simple Method of Detention Basin Design" for a 100-year storm event and have a minimum freeboard of one (1) foot. Drainage calculations shall include the following:

- i. Tributary area in acres
- ii. C-factor
- iii. Discharge rate
- iv. Volume of storage required
- v. Volume of storage provided
- vi. Volume of the permanent wet area, which shall be based on the following equation:

$$4537.5 * \text{runoff coefficient} * \text{site drainage area (cf)}$$

vii. Bankfull volume. This volume shall be based on a 1.5-year, 24-hour storm event and the following equation:

$$5160 * \text{tributary area acreage} * \text{C-factor}$$

viii. The bankfull volume shall be stored not less than 24-hours and not more than 40 hours.

ix. First flush volume. This volume represents the first 0.5 inch of runoff and shall be calculated using the following equation:

$$1815 * \text{tributary area acreage} * \text{C-factor}$$

x. Standpipe-type riser structures are required for all detention basins. The size of the riser pipe and calculations showing the size and number of infiltration holes within the riser pipe shall be included. Riser pipes shall be a minimum of 36" diameter for a height up to four (4) feet and a minimum of 48" diameter for a height exceeding four (4) feet. Infiltration holes shall be set at the bottom of the riser pipe and at the first flush and bankfull elevations. A standpipe detail shall be included on the plans.

xi. The outlet pipe and/or emergency overflow spillway shall be sized for a 10-year storm event.

c. If connecting into an existing detention basin, calculations showing the total volume of the existing basin, the design criteria used to size the existing basin, the amount of storage volume provided for the site, and the amount of storage volume required for the site shall be provided on the plans.

- d. Calculations for sizing a retention basin shall be submitted and included on the plans. Retention basins shall be sized to accommodate two inches of rainfall over the entire tributary area. However, based on the soil boring data and/or overflow assessment, additional storage may be required up to that of two consecutive 100-year storm events. The applicant must submit a minimum of two soil boring logs taken from within the basin bottom area to a depth of 20 feet below the proposed bottom elevation. An overflow assessment should be provided showing the features and elevations of the surrounding areas, including nearby homes that would be impacted in the event of an overflow. A minimum three (3) foot freeboard shall be required. Calculations shall include all requirements for detention basins shown in sections 2.a.i.-v. above and 2.d. below.
- e. Calculations for sizing the sediment forebay(s) shall be included on the plans. The capacity of the forebay shall be equivalent to 5% of the 100-year storm volume based on the area tributary to the inlet. Forebays shall be separated from the detention basin using either gabions or compacted earthen filter berms. A detail of the separation method shall be included on the plans.
- f. The bottom of the basin must be sodded. Minimum grade on the bottom of a detention basin will be 1 percent when sodded. If paved swales in detention basins are desired, the minimum will be 0.5 percent. Infiltration galleries are recommended in retention basins to promote year round function of the basin. All basins must be permanently stabilized with maintainable densely rooted turf.
- g. When sizing detention basins, any volume of water provided below the invert of the gravity outlet will not be considered as storage volume.
- h. Rip-rap must be provided around the inlet and outlet pipes.
- i. Maintenance:
 - i. Subdivisions and Residential Sites: The Owner must provide for continued maintenance of detention basins, through acceptance of ownership and maintenance responsibility by the Livingston County Drain Commissioner or when allowed, an acceptable private system maintained by the developments homeowner's association will be accepted.
 - ii. Commercial, Industrial and Office Sites: The Owner shall maintain the detention basins in proper working order at all times.
 - iii. The Township will not accept the responsibility for the maintenance of any basin or other site drainage feature.
- j. In cases of retro-fitting an existing system, redevelopment, or underground storage, or where a sediment forebay will not be constructed, a storm water treatment device will be required prior to discharge to the storage area, or discharge from the site. New developments will be reviewed on an individual basis. A detail of the system must be provided on the plan drawings.

- k. Basin side slopes, regardless of the type shall be no flatter than 20:1 and no steeper than 3:1. For drains proposed to be under the jurisdiction of the Drain Commissioner, slopes steeper than 5:1 must have a four (4) foot high decorative fence with a twelve (12) foot wide access gate. The fence shall completely surround the basin.
- l. Fencing around basins not under jurisdiction of the Drain Commissioner shall meet the requirements of the Township Ordinances.

3. RAIN GARDEN

- a. Located a minimum distance of 10' from any building structure or parking area.
- b. Maximum contributing acreage shall be five (5) acres. Contributing acreage of one (1) acre or less is preferred.
- c. The size of the rain garden shall be indicated on the plans. Sizing shall be based on contributing drainage area, amount of imperviousness, and soil type. The calculations using following formula shall be included on the plans:

$$A = \text{Drainage area} * 5\% * R_v$$

$$R_v = 0.05 + (\% \text{ impervious})$$

- d. A cross-section of the rain garden shall be included on the plans and shall meet the following requirements:
 - i. Soil mixes shall consist of 50%-60% sand, 20%-30% topsoil and 20%-30% compost.
 - ii. Water depth shall be based on the ground slope of the surrounding area.
 - (i) Depth = 4" – 5" for slopes ≤ 4
 - (ii) Depth = 6" – 7" for slopes 5%-7%
 - (iii) Depth = 8" for slopes 8% - 12%

Water depth shall not exceed 8" and ground slopes should not exceed 12% within 30 feet from the rain garden.

- iii. A minimum 4" mulch layer shall be placed between the water storage area and planting soil bed. The mulch specified shall be appropriate for water quality gardens. Coarse, fibrous, shredded wood chip mulch is preferred.
- iv. (If necessary) Type and size of underdrain shall be specified. All underdrain shall be surrounded by pea gravel with 12" minimum layer of class II sand.
- v. Water depth shall be based on the ground slope of the surrounding area.
- e. The number and type of plants should be included. The plants shall be water tolerant and the one (1) plant for every square foot of rain garden area is required.

I. FLOODPLAIN DEVELOPMENT

1. GENERAL

- a. An MDEQ permit is required for work within the floodplain.
- b. An equivalent volume of excavation must compensate for all fill within floodplain in order to maintain water storage volume.
- c. The 100-year floodplain boundary must be shown on the plans.
- d. Where available, the community flood insurance study shall be used. In areas where no flood insurance study has been conducted, the applicant may be required to conduct a study to determine the limits of the floodplain.

J. SITE GRADING

1. GENERAL

- a. Sufficient proposed grades must be indicated to ensure the following:
 - i. Drainage is adequately discharged offsite with proper detention or retention.
 - ii. No upstream drainage is restricted.
 - iii. Paving slopes are adequate.
 - iv. The site generally drains without standing water.
 - v. Site grading merges with grading on neighboring sites.
 - vi. Sight lines are not obstructed.
- b. The finished grade elevation for all proposed and existing buildings on site or on neighborhood properties must be provided.
- c. The maximum slope to an abutting property line is 1:4.
- d. A slope of 1:3 may be approved based on Township review. A slope greater than 1:4 shall be restored using an approved "erosion blanket". This shall be identified on the plans.
- e. Grading plans shall take into account the natural features of the land as much as possible.
- f. A grading easement from an adjacent property owner will be required for any offsite grading and for any retaining wall footing or where it appears that "normal" (1 on 1 side slope) excavation to the bottom of the footing encroaches the adjacent property.
- g. Single-family lots shall be graded to drain away from the house. To ensure proper drainage, swales may have to be constructed along the lot lines. If so, swales shall discharge to a catch basin or other approved drainage course and be contained within a drainage easement.
- h. Walls or berms, as required by Zoning, must be shown in cross-section.
- i. No filling will be allowed within the floodplain of a river, stream, creek, or lake unless under the terms of a permit granted by the MDEQ.
- j. The Owner or Owner's representative shall certify that the as-built site grading and building setbacks conform to the Township approved site and engineering drawings at the completion of the improvements. This certification shall be prepared by and bear the seal of a professional land surveyor or engineer licensed in the State of Michigan. The certification shall be submitted as directed on forms provided by the Township (see Appendix VII). The following conditions shall be noted:
 - i. No certificate of occupancy will be granted until grading certificates are received and approved for each lot.

- ii. After a grading certificate is submitted, funds may be pulled from the inspection escrow to have the Township Engineer spot-check and verify grades at the Township's discretion. The detention pond grades may be verified at this time as well.

2. REQUIREMENTS FOR RESIDENTIAL DEVELOPMENT:

- a. All single family lots shall be graded for rear to front drainage per the Standard Lot Grading-Detail A provided in Appendix III. The Standard Lot Grading-Detail B (front to rear drainage) will be allowed, but only where, due to existing topography, rear to front drainage would be very difficult to achieve or not feasible. Large acreage lots will be reviewed on an individual basis.
- b. Where front to rear drainage is permitted, the longitudinal slope along a rear yard drainage easement shall be not less than 1.0% or more than 3.0%. Maximum distance from a high point to a drain outlet shall not exceed 250 ft..
- c. Where front to rear drainage is used, private easements for drainage shall be dedicated and recorded. For perimeter lots, easement width shall be 12 feet minimum (or as required), and for abutting lots with a common rear yard lot line, easement width shall be at least 6 feet on each lot (or as required).
- d. All grade point elevations shall be shown for each lot per Detail A or B, illustrated in Appendix III.
- e. The general direction of overland drainage in the rear yard shall be indicated on each lot with arrow.
- f. High and low street grade points, slope direction (by arrow) and the location of all catch basins inlets and drainage ditches shall be shown on the grading plan.
- g. A maximum slope of 4 feet horizontal to 1 foot vertical shall not be exceeded for all terracing. The toe of slope shall be located outside of the rear and/or side lot line drainage easements.
- h. Complete site grading plans shall be drawn to a maximum scale of 1" = 100' (e.g. 1" = 200' will not be accepted).
- i. Grading plans shall include details of typical lot grading and drainage patterns intended to be used.
- j. The grading plans shall show the existing elevation topography by contour lines. Topography on abutting property within 100 feet of the site boundary shall be shown.
- k. All elevations shall be to N.A.V.D. 88 datum (see Topography Section for specific details).

- l. Drainage patterns, other than those shown in Details A and B, may be used and will be acceptable for review. A detail of the typical lot drainage pattern shall be shown on the grading plan with all grade control points identified.
- m. In general, for streets with ditches and no curbs, elevation of the front lot line shall be at least 6 inches above the centerline of the road. If other grading methods are preferred, justification should be provided for approval.
- n. All non-conforming lots with drainage patterns other than those in Standard Details A or B shall be noted on the grading plan.
- o. Catch basins shall be placed in rear yard swales at low points where front to rear grading is used.
- p. Gravel filters or other acceptable temporary measures shall be provided at rear yard catch basins to prevent sedimentation of storm sewers. The Owner shall be responsible for maintaining temporary erosion control devices.

3. RETAINING WALLS

Generally, the review will be based on the following information, however additional data, calculations, and information may be requested to provide for a more extensive review, depending on specific site conditions and wall proposed.

- a. Walls with a grade differential of 4-feet or greater are considered a retaining wall and require a structural engineering design and review. The Design Engineer must supply a cross-sectional detail on the plans and computations (sealed by a registered engineer) with the plan submittal. The cost of all retaining walls must be included in the engineering cost estimate.
- b. A signed and sealed letter from the design engineer shall be provided, certifying that structures have been designed in accordance with applicable structural design codes with the codes identified; that all applicable safety factors, standards and codes (identify safety factors) have been met or exceeded; and that the soil conditions have been reviewed by a qualified geotechnical engineer.
- c. Top and bottom of wall elevations and dimensions above and below grade and from the property line shall be shown on the plans.
- d. The face of a retaining wall shall be a minimum of 2' from the property line.
- e. Edge drain shall be provided along the base of all retaining walls. Edge drain shall be a minimum of 6" diameter. The type of pipe should be included in the cross-sectional detail. Alternative methods of drainage will be reviewed on a case-by-case basis.
- f. The developer shall provide appropriate material testing at his/her cost during construction.

- g. Protective railing is required for all walls within 2' of parking, driving, pedestrian walkways and/or when the height of the wall is 30" or greater.
- h. Type of walls allowed and specifications:
 - i. Concrete Walls/Structures
 - (i) Clearly identified location of structure in site (plan view) with a location map (200 scale or equivalent)
 - (ii) Top and bottom of wall elevation (plan view)
 - (iii) Finished grades adjacent to the structure
 - (iv) Grading plan corresponds to proposed structure
 - (v) Minimum and maximum wall height (cross section)
 - (vi) Notes identifying or referencing material types and specifications
 - (vii) Design loads including vehicular impact and surcharge loadings where applicable
 - (viii) Structural dimensions and footing depth
 - (ix) Wall and footing thickness
 - (x) Steel (reinforcing) grade, cover, spacing, quantity, overlap (2" minimum clearance for reinforcing steel from any formwork)
 - (xi) Bearing pressures (noted or referenced) and soil bearing capacities
 - (xii) Openings in walls
 - (xiii) Protective guard requirements (required within two feet of pedestrians)
 - (xiv) Drainage requirements
 - (xv) Filter wrapped drain tile and outlets specified
 - (xvi) Utility conflicts – noted with owner contact information
 - (xvii) Soil boring information & Geotechnical analysis
 - ii. Block & Timber Retaining Walls
 - (i) All of the above except steel reinforcing data
 - (ii) Segmental wall dimensions and soil reinforcing (if applicable)
 - (iii) Manufacturer specifications (Block only) – compare to plans
 - (iv) Geo-grid length noted, dimensioned and labeled on plans
 - (v) Embedment depth
- i. Inspection items (for developer's engineer):
 - i. Concrete walls
 - (i) Formwork dimensions for the base
 - (ii) No vibration of concrete occurs inside the form during placement.
 - (iii) Concrete cylinders, slump, air entrainment tests performed by developer's testing firm are acceptable.
 - (iv) Concrete mix shall not be over watered at the job site.
 - (v) Copies of the delivery tickets are obtained.

ii. Pre-cast walls

- (i) Certification shall be obtained from the manufacturer (inspection only).
- (ii) Wall base placement, material, size, thickness, and compaction.
- (iii) Embedment and batter are per the manufacturer's recommendations.

iii. Wood walls

- (i) Certificates of treatment level for wood materials.
- (ii) Connection details and fasteners (i.e. nails, bolts, etc.)
- (iii) Proper length and embedment of "dead men".

iv. Boulder walls

- (i) Maximum height: 4 feet.
- (ii) Boulder size shall range from 24" to 30" and embedment shall be a minimum of 8" into the ground.

K. PAVING AND ROADS

1. GENERAL

- a. All public roads shall meet the requirements of the Livingston County Road Commission and the Charter Township of Brighton Zoning Ordinance.
- b. All private roads shall meet the requirements of the Charter Township of Brighton Zoning Ordinance and the standards outlined below.
- c. Any road improvements in the MDOT right-of-way are subject to review and approval of MDOT. A permit must be secured from MDOT for construction.
- d. Any road improvements in the LCRC right-of-way are subject to review and approval of LCRC. A permit must be secured from LCRC for construction.
- e. Any connection, public or private, to an existing County road, shall meet the then current requirements of the Livingston County Road Commission.
- f. Soil borings must be taken and analyzed by a professional engineering firm qualified to do such work at the locations of all proposed roads. It is recommended that a soils investigation be done and a report prepared for all areas of proposed pavement in addition to roads.
- g. The type of surface proposed for roadways, parking areas, driveways, sidewalks, pathways, loading zones, and dumpster pads shall be shown on the plans and shall be in accordance with the requirements outlined in the Zoning Ordinance.
- h. All applicable pavement and/or gravel cross-sections shall be included on the plans for roadways, parking areas, driveways, sidewalks, pathways, and dumpster pads. Curb and gutter cross-sections shall be included on the plans, if applicable.
- i. Roadway cross-sections shall conform to the Zoning Ordinance and the following criteria. Alternate cross-sections may be considered if the alternate section has been demonstrated to have equivalency to the required section via the AASHTO Guide for the Design of Pavement Structures. Geotechnical analysis may be required to be supplied by a geotechnical engineer for review and approval by the Township Engineer:
 - i. The pavement shall have transverse slope (crown) of 2% each way of the pavement center-line. Superelevated sections are prohibited in any development having a proposed operating speed of less than fifty-five (55) miles per hour. Where the design speed for a proposed street or road is less than fifty-five (55) mph and super elevation would otherwise be required as determined in the latest edition of the AASHTO Policy on Geometric Design for Streets and Highways, the horizontal curve shall be designed with a radius long enough to counter the need for superelevation.

- ii. Edge drain is required on all streets with curb and gutter. The trench must be filled with Class II sand to the level of the sand base material, and the pipe wrapped with geotextile fabric. This requirement may be lessened to areas with poor draining soils and low points by providing evidence of existing well-draining soils.
- iii. Proposed sections utilizing an open ditch section shall have a ditch depth of not less than two (2) feet relative to the shoulder hinge point and two (2) feet wide rounded at the bottom. The depth shall be increased if warranted by drainage discharge calculations.
- iv. The maximum slope within the proposed right-of-way shall be 1:4 (rise/distance). The use of slopes steeper than 1:4 outside of the proposed right-of-way draining toward the roadway should be avoided.
- v. Driveway slopes or lot access areas shall have a slope not greater than 1:10 within the right-of-way or easement. Driveways beyond the right-of-way should generally not exceed 12% slope without significant topographical limitations.
- vi. All driveways are required to meet sight distance requirements. In some instances, a clear vision easement will be required outside of the road right-of-way or easement.
- vii. Cross-sections of all proposed pavement improvements must be shown on the plans with the thicknesses and materials clearly indicated.
- viii. Pavement sections for residential driveways (sections in ROW or easement) shall meet the following:
 - (i) Gravel – six (6) inches of MDOT 21AA limestone or MDOT 23A.
 - (ii) Asphalt – three (3) inches of bituminous surface over six (6) inches of MDOT 21AA limestone.
 - (iii) Concrete – six (6) inches of concrete over four (4) inches of MDOT Class II sand.
- ix. Pavement sections for commercial or industrial driveways (sections in ROW or easement) shall meet the following:
 - (i) Gravel drives will not be permitted.
 - (ii) Asphalt – four (4) inches of bituminous surface over eight (8) inches of MDOT 21AA limestone. For development with significant truck traffic, asphalt approaches will not be permitted.
 - (iii) Concrete – eight (8) inches of concrete over four (4) inches of MDOT Class II.
- j. Horizontal alignment shall conform to the Township Zoning Ordinance and the following guidelines or those of the LCRC, whichever is more restrictive. All horizontal alignment and intersection design shall follow the latest edition of the AASHTO Policy on Geometric Design for Streets and Highways. The design speed shall be thirty-five (35) mph for interior subdivision streets unless otherwise directed by the Township or Road Commission.
 - i. Intersection radii shall be a minimum of thirty-five (35) feet for residential streets and a minimum of forty-five (45) feet for commercial and industrial streets.

- ii. Intersections shall be designed such that the first sixty-five (65) feet in any direction shall be straight line sections.
 - iii. Boulevard intersections or entrances shall have concrete curb and gutter around the island.
 - iv. MDOT Detail M openings shall be used for all commercial or industrial drives or approaches. All commercial or industrial approaches shall be curbed regardless of the road cross section.
 - v. Commercial and industrial drive approaches shall have a minimum forty-five (45) foot radius.
 - vi. Drive approaches shall be contained within the property lines, including radii and any acceleration/deceleration tapers, if required.
- k. Vertical alignment shall conform to the following guidelines or those of the LCRC, whichever is more restrictive. All vertical alignment design shall follow the latest edition of the AASHTO Policy on Geometric Design for Streets and Highways. The design speed shall be thirty-five (35) mph for interior subdivision streets unless otherwise directed by the Township or Road Commission.
- i. A vertical curve shall be required where the algebraic difference in slopes of the tangent sections exceeds 1.0%. The minimum length of the vertical curve shall be 100'.
 - ii. Road grades within 100' of an intersection shall not exceed a slope of three (3) percent regardless of the surface type.
- l. A drainage system to adequately collect and discharge tributary roadway runoff is required. Either an open ditch or enclosed storm sewer system per the Township requirements is acceptable. The drainage system shall be designed to drain to a storage area, as required by these Engineering Standards.
- i. All paved roads with curb and gutter shall have an enclosed storm sewer system unless otherwise approved by the Township.
 - ii. The maximum allowable storm water runoff tributary area conveyed overland in drainage ditches shall no be more than six (6) acres. When the tributary area is more than six (6) acres or the amount of flow in the ditch exceeds 8.0 cfs an enclosed storm sewer system and curb and gutter will be required.
 - iii. The percent of grade in an open ditch shall not be less than 1.0% or greater than 5.0%
 - iv. Any open ditch that exceeds 3.0% shall have a sodded ditch bottom. Sod in these areas shall extend from the ditch bottom up either side of the ditch to a point one foot above the flow line of the ditch.
- m. Roadway signage shall meet the requirements of the Livingston County Road Commission and the Michigan Department of Transportation's Manual of Uniform Traffic Control Devices.

2. PARKING LOT REQUIREMENTS

- a. A striping and traffic control plan for parking areas shall be included. The location of all traffic control, regulatory, street, and subdivision signs shall be shown on the plans.

- b. Cross-section of parking lots shall be three (3) inches of bituminous surface place in two courses (no course or lift shall exceed 2 inches), with eight (8) inches of 21AA aggregate base.
- c. Minimum general paving slopes are 1.0% for asphalt-paved areas and 0.4% for concrete-paved areas.
- d. Minimum drive widths and parking dimensions shall be in accordance with the Charter Township of Brighton Zoning Ordinance.
- e. Adequate space must be provided to allow for turning movements of vehicles, including WB-50 trucks and fire engines.
- f. Concrete curb and gutter shall be provided for the perimeter of the parking area and for all island areas within the parking area. An appropriate detail for the curb and gutter shall be provided.
- g. Minimum drive widths and parking dimensions shall be in accordance with the Charter Township of Brighton Zoning Ordinance.

3. PRIVATE DEVELOPMENTS

- a. Loading zones and dumpster pads: 8" concrete on 6" 21 AA limestone aggregate.
- b. Minimum drive widths and parking dimensions shall be in accordance with the Charter Township of Brighton Zoning Ordinance.

4. PATHWAYS AND SIDEWALKS

- a. Pathways and Sidewalks shall be located in the right of way and one (1) foot from the ultimate right-of-way line.
- b. Cross-sections of pathways and sidewalks shall meet the requirements of the Township Zoning Ordinance and the Brighton Township Pathways Plan.
- c. Proposed grades must be shown along the property line, driveways, and intermittent locations along the length of the path or walk.
- d. Any structures, hydrants, poles, etc., which exist along the alignment of the path or walk, must be adjusted or relocated at the expense and coordination of the developer.
- e. All pathway and sidewalk construction shall be in accordance with public Act No. 8, 1973, and the new MDOT standards for ADA ramps with detectable warning domes.

CONSTRUCTION PROCEDURES AND REQUIREMENTS

VI. PERMIT REQUIREMENTS

A. BUILDING PERMIT

Before any building/structure construction can begin, a building permit must be obtained from the Charter Township of Brighton. This permit will not be issued until all fees have been paid (including utility fees) and the Township Planner, the Township Engineer, and the Fire Department have approved of the construction plans.

B. SOIL EROSION AND SEDIMENT CONTROL PERMIT:

This permit is required prior to the start of any site improvements. Applications are available through the LCDC. A bond will likely be required in accordance with LCDC standards.

C. MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY, (WATER MAIN):

Construction of public water main requires a construction permit from the Michigan Department of Environmental Quality (MDEQ) as well as the approval of the Charter Township of Brighton. Upon request of the Township Engineer, the Owner shall submit 5 sets of plans and specifications, signed and sealed by a Design Engineer licensed in the State of Michigan. In addition, a tabulation of water mains consisting of their size, location, type and length shall be prepared by the Design Engineer and submitted to the Township. The Township Engineer will transmit the plans to the Livingston Community Water Authority and request approval for an MDEQ permit.

D. MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY (SANITARY):

Construction of public sanitary sewer requires a construction permit from the MDEQ (as required under Part 41 of Act 451, Public Acts of 1994) as well as the approval of the Charter Township of Brighton. Upon request of the Township Engineer, the Owner shall submit 5 sets of plans and specifications, signed and sealed by a Design Engineer licensed in the State of Michigan. In addition, a permit application, design flow computations for the proposed sewers, and a tabulation of the capacities of the proposed sewers and the existing outfall sewer shall be submitted by the Design Engineer. The Township Engineer will transmit the plans to the MDEQ for permitting.

E. LIVINGSTON COUNTY ROAD COMMISSION (ROADS):

All work in the road right-of-way under the jurisdiction of Livingston County requires a permit from the Livingston County Road Commission.

F. LIVINGSTON COUNTY DRAIN COMMISSIONER'S OFFICE (STORM DRAINAGE):

A Livingston County construction permit is required for any connection to a county drain.

G. MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY (Wetlands, Inland Lakes and Streams):

It is the Owner's responsibility to obtain MDEQ permits as required under the Wetlands Protection Act 203 and the Inland Lakes and Streams Act 346.

H. OTHER PERMITS:

Other agencies from which the Owner may need a permit will be designated on the approved plan. These permits are generally the Contractor's responsibility and will generally be required prior to construction.

Michigan Department of Transportation
Michigan Water Resources Commission
Livingston County Health Department
United States Army Corps of Engineers

I. It is the Owner's responsibility to obtain MDEQ permits as required under the Wetlands Protection Act 203 and the Inland Lakes and Streams Act 346.

VII. FEES

Prior to the Pre-construction meeting, the contractor shall provide an inspection escrow to the Township. Proof of payment should be forwarded to the Township Engineer. The final approval letter from the Township Engineer will detail the amounts and basis of the escrow based upon the fee schedule below.

- A. The inspection fee deposit shall be based upon the approved engineer's estimate of costs all water main, sanitary sewer, paving, grading, soil erosion control and drainage improvements, and shall be in the amount indicated in Appendix V.
- B. The escrow account will cover costs associated with required inspections, scheduling of inspectors, construction engineering review and site visits, processing/administration of construction related documents/matters, attending required preconstruction meetings and associated work by the Township Engineer.
- C. Unused observation and administration escrow funds will be eligible for return as described in the final approval letter.
- D. The Township shall monitor the observation escrow and may require additional deposits. This shall be dependent on the contractor's rate of progress and the difficulty in completing the project.
- E. Failure to keep the observation escrow current may result in withholding construction observation, and therefore possibly delaying construction.

VIII. INSURANCE

- A. Prior to construction, the Contractor shall procure and maintain, during the term of the project, public liability and property damage insurance with a responsible insurance company, which meets the approval of Charter Township of Brighton, in such amounts as will be adequate to protect the public, Charter Township of Brighton interests, and shall not be less than the limits set forth herein.

Type of Insurance:

1. Workmen's Compensation Insurance and Employer's Liability

- a. Limit: As required by laws of State of Michigan

2. Public Liability & Property Damage:

a. Bodily Injury:	Each Occurrence:	\$1,000,000
	Aggregate:	\$2,000,000
b. Property Damage:	Each Occurrence:	\$1,000,000
	Aggregate:	\$2,000,000

3. Owner's and Contractor's Protective Liability & Property Damage:

a. Bodily Injury:	Each Occurrence:	\$1,000,000
	Aggregate:	\$2,000,000
b. Property Damage:	Each Occurrence:	\$1,000,000
	Aggregate:	\$2,000,000

4. Motor Vehicle (including Owner, Hired and Non-Owned Vehicles):

a. Bodily Injury:	Each Occurrence:	\$1,000,000
b. Property Damage:	Each Occurrence:	\$1,000,000
c. Combined single limit:		\$2,000,000

5. Policies shall be made available to Charter Township of Brighton and the Township Engineer for examination as to their validity and any undesirable exclusions deemed improper by legal opinion rendered to the Township regarding same. Underground construction, where applicable, shall be specified in the coverage. Certificates of coverage signed by the insurance carriers shall include a guarantee that 30 days written notice shall be given by the insurance carrier to Charter Township of Brighton prior to cancellation of, or any change in the respective policies. In the event that the insurance is canceled, operations shall cease prior to the cancellation date and shall not resume until evidence is provided that proper insurance is again in effect. Additional Named Insured under Owners and Contractors Protective Public Liability and Property Damage Insurance shall include Charter Township of Brighton, the Township Engineer (specifically by name) and members of staff, employees and agents for the Township.

6. The name of the proposed development must be included on the insurance documents.

IX. FINANCIAL SECURITIES

The amount of financial securities collected by the Township will be based on the signed and sealed Design Engineer's estimate for the work approved by the Township Engineer. Financial securities will be accepted in the form of cash, certified checks, bonds, or letters of credit.

Prior to setting a pre-construction meeting, the following guarantees will need to be submitted:

- A. Performance Guarantee
100% of the cost for improvements, including the cost for public utilities.
- B. Monuments & Corner Markers Guarantee
\$25 per monument and \$10 per corner marker.
- C. Other guarantees may be required for specific purposes

Prior to Final Acceptance, the applicant will post a two-year Maintenance and Guarantee Security with the Township in an amount equal to the full cost for the public improvements.

X. PRE-CONSTRUCTION MEETING

- A. Upon final plan approval and receipt of all permits, but prior to commencing construction, a Pre-construction meeting shall be held. The Developer or the Developer's Authorized Representative shall contact the Township Engineer to schedule the Pre-construction meeting.
- B. All fees, bonds, escrows, and connection costs (e.g. benefit charges, tap fees, transport and treatment fees, inspection fees, pathway fund deposits, etc.) must be paid prior to scheduling the preconstruction meeting.
- C. Preconstruction meeting requests shall be made at least 10 business days prior to the date of the proposed meeting.
- D. Attendees shall include: Township representatives, Township Engineer, Developer or Developer's Authorized Representative, Design Engineer, Underground and Paving Contractors, any interested regulatory agency, and applicable utility companies.
- E. At the Pre-construction meeting, the following information shall be provided:
 - 1. Proof of insurance in accordance with the Insurance section of this document.
 - 2. All permits from other agencies (MDOT, MDEQ, LCRC, LCDC, etc.).
 - 3. Approximate schedule for construction.

XI. GENERAL CONSTRUCTION REQUIREMENTS

- A. Initially and/or after a significant delay in construction, the Township Engineer shall have a minimum 72 hours notice (not including weekends or holidays) prior to the start of any construction requiring observation to ensure the presence of the Township Engineer during construction.
- B. All public improvements must be field staked under the supervision of the Design Engineer that prepared the plans. Staking must be in accordance with the approved plans.
- C. The Contractor and construction operations must comply with current OSHA, MIOSHA, and confined space regulations.
- D. The Owner through their Design Engineer or an independent testing company shall provide all density testing. Reports shall verify that the materials are constructed in accordance with the compaction requirements indicated on the approved plans and specifications. The reports shall be signed and sealed by a registered professional engineer licensed in the State of Michigan, and shall be submitted to the Township Engineer.
- E. Shop drawings are required to be reviewed and approved by the developer's engineer prior to the start of construction. Shop drawings shall be furnished to the Township Engineer for all special fabricated structural and mechanical parts of the system as determined by the Township Engineer. Operation manuals shall be furnished for all water booster stations, sanitary lift stations, and similar installations.

XII. INSPECTION

Charter Township of Brighton or their designated representative will provide observation on all proposed public utilities and improvements, as well as limited construction observation of private improvements, according to the following criteria. The criteria may be adjusted for large or phased developments, at the discretion of the Township. The Township's Engineer may inspect all other operations requested by the Township. Any facilities installed without Township provided observation may not be accepted by the Township, and therefore may be required to be re-installed. The requirements and procedures for Construction Observation shall be as follows:

- A. Mass grading – The Township's Engineer will not review the site grading for compliance with the plans unless specifically directed to do so by the Township. Responsibility for adhering to the approved grading plan shall fall upon the developer or their engineer/surveyor. Any irregularities observed by the Township's Engineer while out performing other inspections will be brought to the Township's and developer's attention. A grading certificate as described under project closeout requirements shall be required.

- B. Soil erosion control - All inspections related to soil erosion control will be handled by the permitting agency, LCDC. Any problems observed by the Township's engineer while on site performing other inspections will be brought to the Township's, LCDC's, and developer's attention.
- C. Water system improvements – Full time inspection will be provided by the Township's Engineer.
- D. Sanitary system improvements – Full time inspection will be provided by the Township's Engineer.
- E. Storm system improvements (private sewers) – Construction of the private storm sewer system shall be inspected full-time by a qualified professional. The developer may elect to hire his/her own professional, or elect to have the Township Engineer perform the inspections. The developer or developer's engineer shall be responsible for certifying the storm system prior to project acceptance. Copies of testing reports and all certifications shall be provided to the Township. Any problems observed by the Township's Engineer while on site performing other inspections will be brought to the Township's and developer's attention.
- F. Storm system improvements (public sewers) – Full time inspection will be provided by the Township's Engineer. Any problems observed by the Township's Engineer while on site performing inspections will be brought to the Township's, LCDC's, and developer's attention.
- G. Private road improvements – The Township's Engineer will perform inspections at critical junctions of the road construction process. Critical junctions will be defined as:
 1. Witnessing the proof-roll of the sub-grade (Permit to place sub-base)
 2. Verification of sub-base construction (Permit to place base)
 3. Verification of base construction (Permit to place pavement material)
 4. One (1) inspection during the placing of the bituminous leveling course and/or concrete pavement to verify general compliance with the plans and specifications.

The developer or developer's engineer shall be responsible for certifying the road system prior to project acceptance. Copies of testing reports and all certifications shall be provided to the Township.
- H. Public road improvements - Full time inspection will be provided by the Township's Engineer. Any problems observed by the Township's Engineer while on site performing inspections will be brought to the Township's, LCRC's, and developer's attention.

Generally, one inspector will be assigned to a particular project and will be responsible for that project until its completion. The Contractor and the inspector may make arrangements for day-to-day inspection. Any interruption or moratorium on the flow of

work may result in a reassignment of that inspector to another project and require the normal 72 hour notice.

In the event that an inspection escrow account becomes depleted, an additional deposit will be required. The Township may choose to withhold additional inspections on the site until the inspection escrow is brought current.

XIII. CONDITIONAL COMPLETION

A. Residential Projects

1. When utility construction is complete, the necessary tests must be completed and passed, and preliminary punchlists addressed. Any portions of the work found to be unacceptable shall be repaired or replaced prior to issuance of Conditional Completion.
2. All roads shall have been constructed in accordance with the plans, except for the top course of pavement, when using asphalt, prior to issuance of Conditional Completion.
3. All common areas, buildings, pathways, or any other items outlined in PUD Agreements or the Master Deed shall have been constructed prior to issuance of Conditional Completion.
4. When Conditional Completion is issued, the Township will allow 50% of building permits to be issued.
5. Upon acceptance of field improvements, the Developer's Engineer will be provided with a copy of the Inspector's Daily Reports (IDR), any applicable lead reports, red-lined plans, and a blank "Record Drawing Requirement Checklist" in order to provide record drawings to the Township's Engineer for review and approval.
6. A grading certificate will be required at this time. This form (provided by the Township and found in Appendix VII) will also need to be signed and sealed by the Developer's Engineer and then submitted to the Township's Engineer along with the record drawings.
7. Easements for public utilities based on "As-Built" conditions requires a sketch and legal description to be submitted by the Developer's Engineer to the Township's Engineer for review and approval along with the record drawings. Once easement documents are approved, the Township's Engineer will mail the Developer/Township the easements to be recorded with the County Register of Deeds. Once the easements are recorded with liber and page number, recorded copies will need to be forwarded to the Township and the Township's Engineer.

8. Once the record drawings are approved by the Township's Engineer, the Developer's Engineer shall submit:
 - a. Three (3) sets of plans
 - b. Two (2) CD-ROM in accordance with the technical specifications found in Appendix IX.
9. All required items shall be submitted and approved prior to issuance of the first Certificate of Occupancy. When the project reaches 50% build-out, the project can move to Substantial Completion.

B. Commercial Projects

1. When utility and hardscape construction is complete, the necessary tests must be completed and passed, and preliminary punchlists addressed. Any portions of the work found to be unacceptable shall be repaired or replaced prior to issuance of Conditional Completion.
2. When Conditional Completion is issued, the Township will allow the appropriate building permits to be issued.
3. At the time of Conditional Completion, record drawings will be requested. The drawings shall be prepared and certified by a design engineer registered in the State of Michigan and submitted to the Township for review by the Township Engineer. The as-built drawings shall be in accordance with the requirements outlined earlier in the document, and Appendix VIII.
4. A completed grading certificate, all applicable easements, and the digital record drawings shall be submitted to the Township for review by the Township Engineer.
5. All required items shall be submitted and approved prior to the issuance of the first Certificate of Occupancy. After that point, the project can move to Final Completion.

XIV. SUBSTANTIAL COMPLETION

A. Residential Projects

1. When the project has reached 50% build out, and all items related to Conditional Completion have been addressed, the Township will issue Substantial Completion.
2. When Substantial Completion is issued, the Township will allow another 30% of building permits to be issued.
3. At this time, a post punchlist will be developed which shall be addressed and approved prior to issuance. Any portions of the work found to be unacceptable shall be repaired or replaced prior to issuance of Substantial Completion.
4. When all required items have been addressed and approved, the project can move to Final Completion.

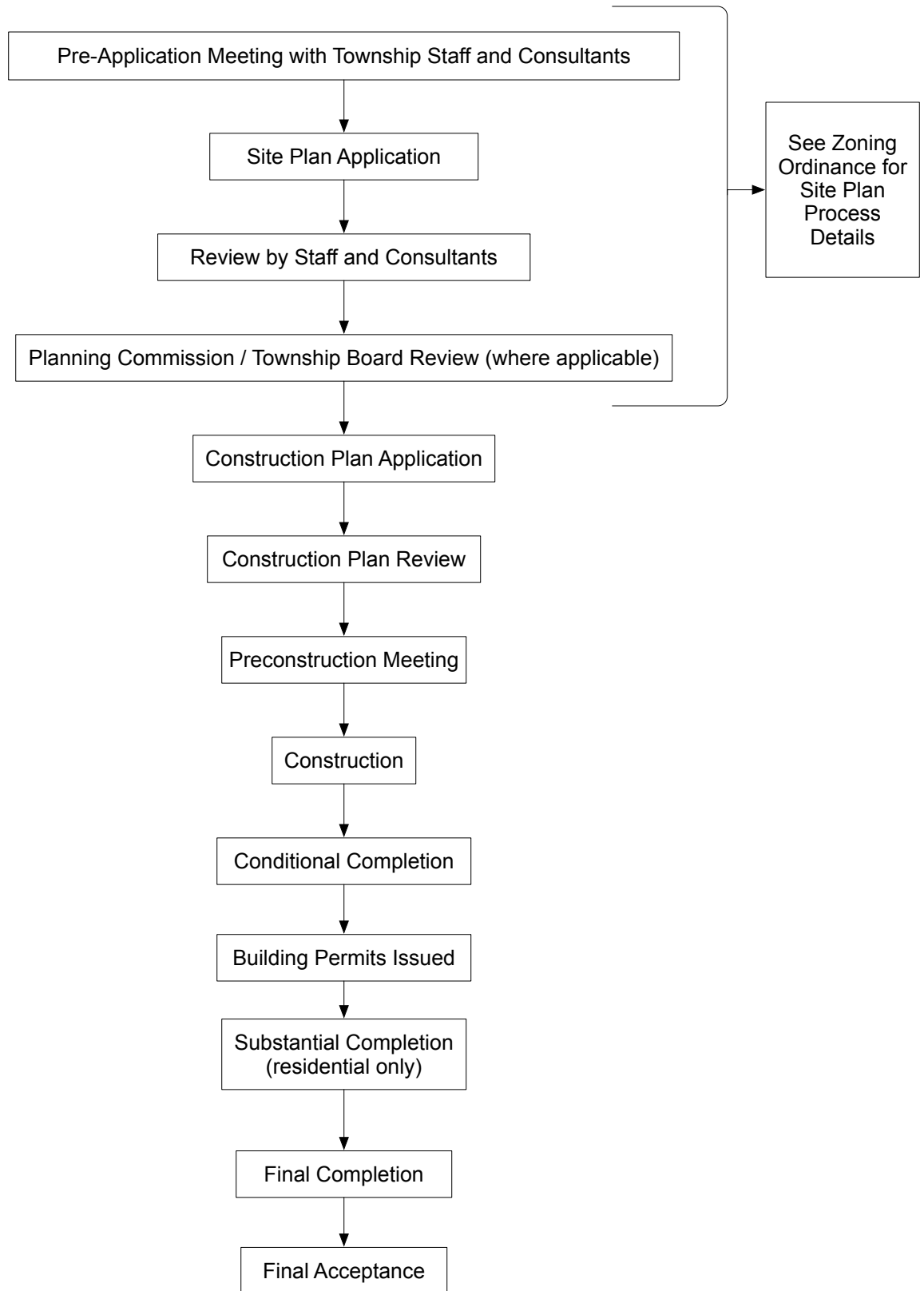
XV. FINAL COMPLETION

- A. When the project has reached 80% build out, and all items related to Substantial Completion have been addressed, the Township will issue Final Completion.
- B. The Township Engineer will generate a final punchlist. Once the items have been addressed, the Township and the Township's Engineer will conduct a final site inspection.
- C. At the time of final inspection, the Owner or his Contractor shall provide all labor and equipment necessary to allow the Township to inspect the system.
- D. All punchlist items must be addressed.
- E. All fees and escrows must be paid in full.
- F. A Maintenance and Guarantee bond should be provided to the Township. The bond should be 100% of the engineer's estimate for public improvements. The Township will keep the bond for two years from the date of Final Acceptance.
- G. Record drawings and related documents shall have been provided to the Township.

XVI. FINAL ACCEPTANCE

- A. When the project has addressed all items outlined above and obtained all necessary approvals and permit releases from all other agencies with interest in the project, the Township will issue Final Acceptance of the project.

Guide for Land Development in Brighton Township



**CHARTER TOWNSHIP OF BRIGHTON
APPLICATION FOR CONSTRUCTION PLAN REVIEW**

DATE: _____

BTSP#: _____

NAME OF DEVELOPMENT: _____

DEVELOPER'S NAME(S): _____

CONTACT PERSON: _____

ADDRESS: _____

PHONE: _____

FAX: _____

E-MAIL: _____

PROPOSED TOTAL PROJECT COST: _____

PROPOSED CONSTRUCTION PLAN REVIEW FEE: _____
(SEE REVERSE)

SIGNATURE: _____

I have received this project cost estimate and believe this is a reasonable estimate of the costs of this project, and approve this engineering fee.

Township Engineer's Signature: _____ Date: _____

APPLICANT:

Please submit this signed form with a check made out to The Charter Township of Brighton. Submit in person or by mail to The Charter Township of Brighton Treasurer.

Checks will not be accepted without this form signed by the Township Engineer.

Charter Township of Brighton, 4363 Buno Road, Brighton, MI 48114

THE CHARTER TOWNSHIP OF BRIGHTON

CONSTRUCTION PLAN REVIEW FEES

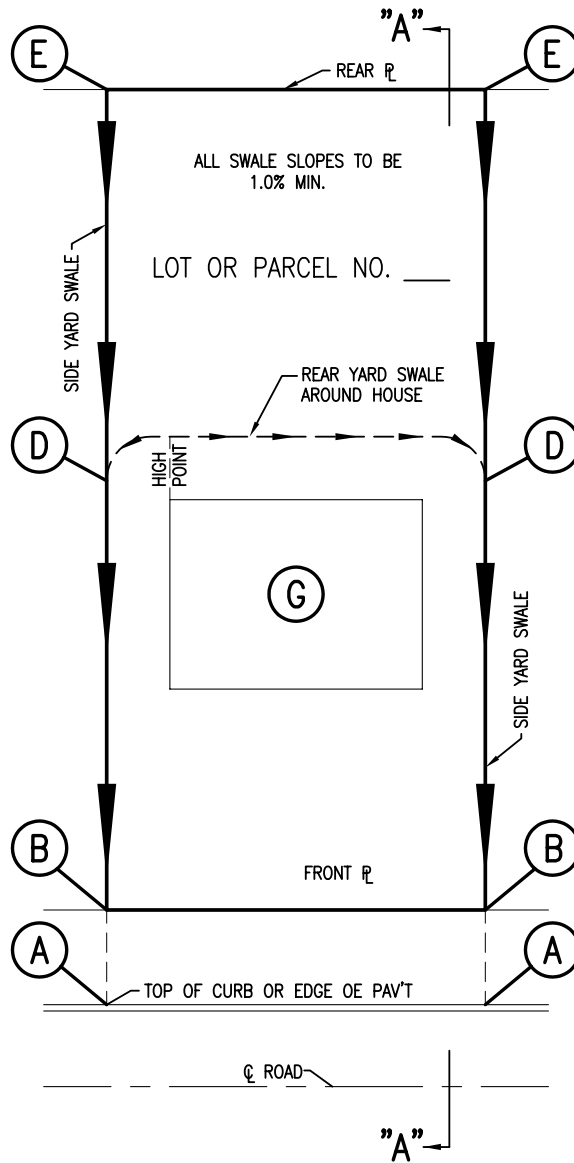
At the time of submittal of detailed construction plans, specifications, and detailed estimates of total costs of the proposed construction and improvements, the applicant shall pay to the Township Treasurer a fee for review equal to the below fee schedule. The fees shall be based on the engineer's estimate of costs provided by the applicant, and verified by the Township engineer, with the Township engineer retaining final authority to determine the total costs upon which the percentage shall be based. The fee shall be paid prior to the Township engineer's review of any part of the construction plans. In the event engineering review fees exceed the amount of the fee paid (above), additional hours shall be billed at the actual costs.

Engineer's Estimate of Costs	Fee Percentage
\$0 - \$100,000	2.00% (min, fee \$1,200.00)
\$100,001 - \$2,000,000	1.50%
\$2,000,001 and above	0.75%

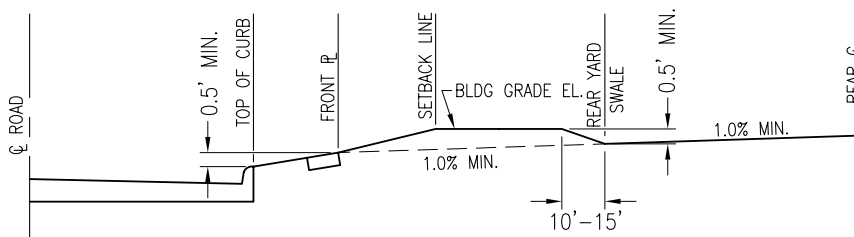
The percentage fee covers two reviews. The third review and beyond shall be hourly according to the Township engineer's approved hourly rate schedule

Appendix III : Standard Lot Grading Details

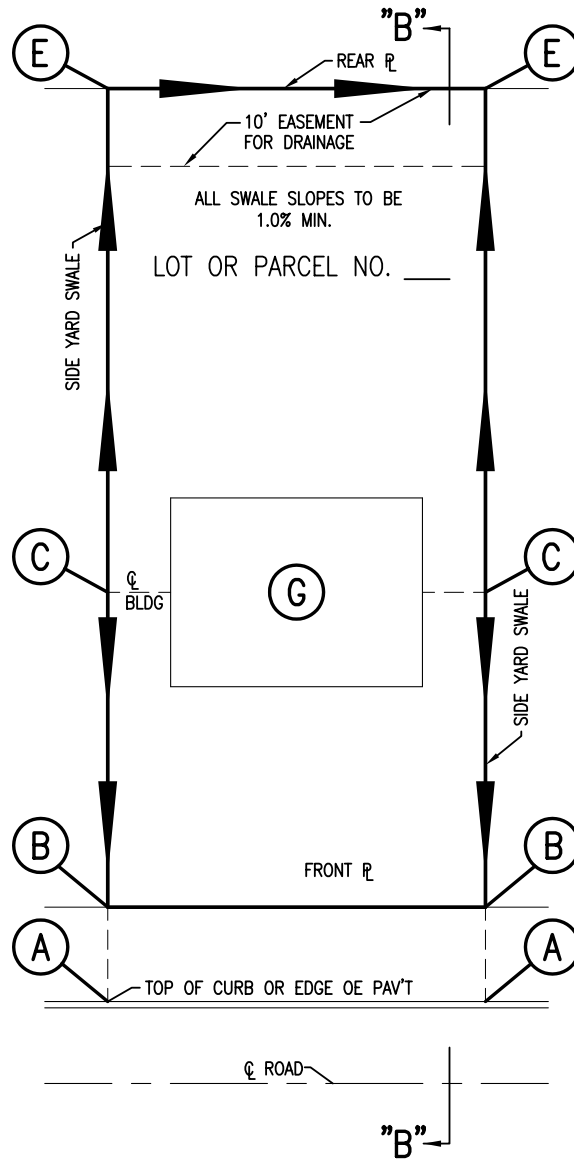
STANDARD LOT GRADING—DETAIL A



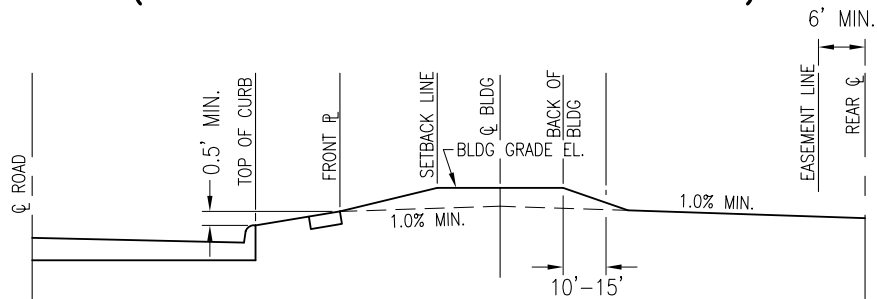
REAR TO FRONT DRAINAGE (REAR SWALE CONTROL AT HIGH SIDE OF HOUSE)



STANDARD LOT GRADING-DETAIL B



FRONT TO REAR DRAINAGE (WITH NO REAR SWALE AROUND HOUSE)



**Qualification Procedure
For
Class B Plastic Pipe**

1. Scope

- 1.1 This document describes the procedure to be followed by plastic pipe manufacturers who wish to have 12-inch to 24-inch diameter sewer and culvert pipe evaluated for addition to the Qualified Products List (QPL) for Class B installations for a qualification period of five years.

2. Submittal Procedure

- 2.1 Request for Product Design Calculations Review – A written request for product design calculations review must be submitted to the following address:

Flexible Pipe Specialist
Municipal Utilities Unit
Utilities, Drainage & Roadside Section
Design Support Area
425 W. Ottawa
Lansing, MI 48933
Telephone: (517) 373-7596

- 2.2 Product Information – Include all material specifications and design drawings including pipe geometry. Provide approved third party verification for the idealized wall profile geometry for each diameter of pipe. **Pipe must already be listed on the QPL for *Watertight Joint Systems for Sewers and Culverts* in order to be considered for review under this qualification procedure.**
- 2.3 Load-and-Resistance Factor Design (LRFD) Calculations – Include product design calculations prepared in accordance with Section 12 of the current *American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specifications*. Demonstrate, through the calculations, adequate strength and service for depths of cover from 10- to 16-feet. Assumed values for factors and other parameters shall be conservative and indicative of a typical embankment installation in Michigan. Provide an explanation for the selection of factors and parameters if they differ from the values listed below. Submit calculations in either Microsoft Excel or Mathsoft Mathcad format.
- 2.4 Factor and Parameter Values – Use the following factors and parameters in the Section 12 equations. Follow the LRFD specifications and commentary for factors and parameters not listed below.

γ_{EV} = 1.95	Load Factor for permanent load
γ_{LL} = 1.75	Load Factor for vehicular live load
γ_{WA} = 1.3	Load Factor for hydrostatic pressure
Φ = 1.00	Resistance Factor for flexure and minimum wall area and buckling
Φ_s = 0.90	Resistance Factor for soil stiffness
η_{EV} = 1.0	Load Modifier applied to vertical earth loads
P_{SP} = 0.120 kcf	Geostatic earth pressure
h_w = 8.0 feet	Height of water surface above top of pipe
γ_w = 0.0624 kcf	Unit weight of water
Δ = 5%	Allowable deflection of pipe
Soil type	S_n
90%	Degree of Compaction - standard Proctor backfill density (MDOT follows the suggested practice of the AASHTO LRFD Bridge Specification's Commentary to design for a standard Proctor backfill density 5 percent less than specified by the contract documents.)

3. Evaluation

- 3.1 The submitted calculations will be reviewed for conformance with Section 12 of the current *AASHTO LRFD Bridge Design Specifications*.

4. Disqualification

- 4.1 A product may be immediately removed from the QPL should any problems develop related to installation or performance. A product may also be removed due to specification changes made by either MDOT or the product manufacturer. Removal from the QPL will result in immediate loss of approved status on all active and proposed projects. If a product is removed from the QPL, it will not be approved for use on a state or federally-funded project until the manufacturer has demonstrated, to the satisfaction of the Municipal Utilities Unit, the material has been redesigned and shown to meet all applicable specifications and requirements.

5. Requalification

- 5.1 A product that has been disqualified and removed from the QPL will be considered for re-evaluation only after submittal of a written request along with acceptable evidence that the problems causing the disqualification have been corrected. The requirements for qualification, as specified in this document, also apply for requalification of the product at the expiration of the qualification period.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
CULVERT CLASSES TABLE 401-1

DES:PGF

1 of 1

C&T:APPR:RDT:DBP:02-22-06

FHWA:APPR:03-01-06

Delete Table 401-1, Pipe Alternates for Culvert Classes, on page 184 of the Standard Specifications for Construction, and replace with the following:

Table 401-1 Pipe Alternates for Culvert Classes

Type of Pipe Depth of Cover in feet (a)	Class A Culvert 0 to 10 (l)	Class B Culvert >10 to 16	Class C Culvert >16 to 23	Class D Culvert >23 to 33 (i)	Class E Culvert 0 to 3 (b)	Class F Drive Culvert (c)
Reinforced Concrete Pipe (d)	II	III	IV	V	IV	II
Nonreinforced Concrete Pipe (e)	1	3	No	No	No	1,3 (f)
Corrugated and Spiral Ribbed Al-Alloy Pipe (j)	Yes	Yes	Yes	Yes	No	Yes
Corrugated and Spiral Ribbed Steel Pipe (j)	Yes	Yes	Yes	Yes	No	Yes
Smooth-Lined Corrugated Plastic Pipe (CPE) (g)(j)	Yes (h)	Yes (k)	No	No	No	Yes (h)

- a. Cover, including the pavement structure is defined as the height of fill above the top of the pipe.
- b. Class E culvert applies when the culvert is beneath the influence of proposed pavement and the depth of cover is 3 feet or less.
- c. Class F culvert applies for driveway culverts (residential and commercial).
- d. Roman numerals refer to class of reinforced concrete pipe, AASHTO M 170.
- e. Arabic numerals refer to the class of nonreinforced concrete pipe, AASHTO M 86.
- f. Nonreinforced concrete pipe Class 1 is allowed for Class F culverts with a depth of cover up to 10 feet. Nonreinforced concrete pipe Class 3 is allowed for Class F culverts with a depth of cover greater than 10 feet, but less than or equal to 16 feet.
- g. CPE must conform to AASHTO M 294, Type S polyethylene pipe.
- h. Permitted only for 36-inch diameter pipe and under for CPE pipes.
- i. Special design is required for depths of cover greater than 33 feet.
- j. Minimum cover 2 feet when the culvert is outside the influence of proposed pavement (measured from top of pipe to final grade).
- k. Permitted only for 12 to 24-inch diameter CPE pipes. Refer to the Class B Plastic Pipe Qualified Products List for approved manufacturers and products.
- l. Class A culvert applies when the culvert is outside the influence of proposed pavement or is beneath the influence of proposed pavement and the depth of cover is greater than 3 feet, but less than or equal to 10 feet.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
STORM SEWER CLASSES TABLE 402-1

DES:PGF

1 of 1

C&T:APPR:RDT:DBP:02-22-06
FHWA:APPR:03-01-06

Delete Table 402-1, Pipe Alternates for Storm Sewer Classes, on page 196 of the Standard Specifications for Construction, and replace with the following:

Table 402-1 Pipe Alternates for Storm Sewer Classes

Type of Pipe Depth of Cover in feet (a)	Class A Sewer 0 to 10 (l)	Class B Sewer >10 to 16	Class C Sewer >16 to 23	Class D Sewer >23 to 33 (m)	Class E Sewer 0 to 3 (b)
Reinforced Concrete Pipe (c)	II	III	IV	V	IV
Nonreinforced Concrete Pipe (d)	1	3	No	No	No
Corrugated and Spiral Ribbed Al-Alloy Pipe (e)	Yes	Yes	Yes	Yes	No
Corrugated and Spiral Ribbed Steel Pipe (f) (k)	Yes	Yes	Yes	Yes	No
Smooth-Lined Corrugated Plastic Pipe (CPE) (g)	Yes (h)	Yes (i)	No	No	No
Corrugated Polyvinyl Chloride Pipe (CPV) (j)	Yes (h)	Yes (i)	No	No	No

- a. Cover, including the pavement structure is defined as the height of fill above the top of the pipe.
- b. Class E sewer applies when the sewer is beneath the influence of proposed pavement and the depth of cover is 3 feet or less (measured from top of pipe to final grade).
- c. Roman numerals refer to class of reinforced concrete pipe, AASHTO M 170.
- d. Arabic numerals refer to the class of nonreinforced concrete pipe, AASHTO M 86.
- e. Permitted for 12 to 66-inch spiral ribbed and 12 to 18-inch helically corrugated 2 2/3 x 1/2-inch aluminum alloy pipe only. Minimum cover 3 feet (measured from top of pipe to final grade).
- f. Permitted for 12 to 84-inch spiral ribbed and 12 to 18-inch helically corrugated 2 2/3 x 1/2-inch steel pipe only. Minimum cover 3 feet (measured from top of pipe to final grade).
- g. CPE must conform to AASHTO M 294, Type S polyethylene pipe.
- h. Permitted only for 36-inch diameter pipe and under for CPE and CPV pipes. Minimum cover 3 feet (measured from top of pipe to final grade).
- i. Permitted only for 12 to 24-inch diameter CPE and CPV pipes. Refer to the Class B Plastic Pipe Qualified Products List for approved manufacturers and products.
- j. CPV must conform to AASHTO M 304.
- k. Refer to Frequently Used Special Provision 03SP402(A).
- l. Class A sewer applies when the sewer is outside the influence of proposed pavement or is beneath the influence of proposed pavement and the depth of cover is greater than 3 feet, but less than or equal to 10 feet.
- m. Special design is required for depths of cover greater than 33 feet.

Inspection Escrow Schedule

<u>Estimate Amount:</u>	<u>Amount to Deposit:</u>
0 to \$25,000	10%
\$25,000 to \$100,000	\$2,500 + 7% of amount over \$25,000
\$100,000 to \$250,000	\$7,750 + 5% of amount over \$100,000
Over \$250,000	\$14,500 + 4% of amount over \$250,000

PRECONSTRUCTION MEETING CHECKLIST

Date: _____

Brighton Township Building Official
4363 Buno Road
Brighton, MI 48114

Site Name: _____

Site Plan #: _____

Lot #: _____

Owner: _____

Design Engineer: _____

Firm Name: _____

Address: _____

Phone: _____ Fax: _____

Email: _____

Developer: _____

Address: _____

Phone: _____ Fax: _____

Email: _____

GENERAL

Engineering approval of construction plans	YES / NO
Building Department approval of construction plans	YES / NO
Insurance submitted per Township requirements?	YES / NO

FEES	REQUIRED?	PAID?
Outstanding review fees	YES / NO	YES / NO
Water Taps	YES / NO	YES / NO
Sewer Taps	YES / NO	YES / NO
Performance Guarantee \$ _____		YES / NO
M & I Guarantee \$ _____		YES / NO
Other Guarantee \$ _____		YES / NO
Pathway Fund \$ _____		YES / NO
Inspection Escrow \$ _____		YES / NO

PERMITS	REQUIRED?	OBTAINED?
MDEQ Water Main	YES / NO	YES / NO
MDEQ Sanitary Sewer	YES / NO	YES / NO
LCRC ROW Permit	YES / NO	YES / NO
LCDC SESC Permit	YES / NO	YES / NO
LCDPH Well	YES / NO	YES / NO
LCDPH Septic	YES / NO	YES / NO
NPDES	YES / NO	YES / NO
MDOT	YES / NO	YES / NO

READY FOR PRECONSTRUCTION MEETING? YES / NO

GRADING / SETBACK CERTIFICATION

Date: _____

Brighton Township Building Official
4363 Buno Road
Brighton, MI 48114

Site Name: _____

Site Plan #: _____

Lot #: _____

Design Engineer: _____

Firm Name: _____

Address: _____

Phone: _____ Fax: _____

Owner: _____

Address: _____

Phone: _____ Fax: _____

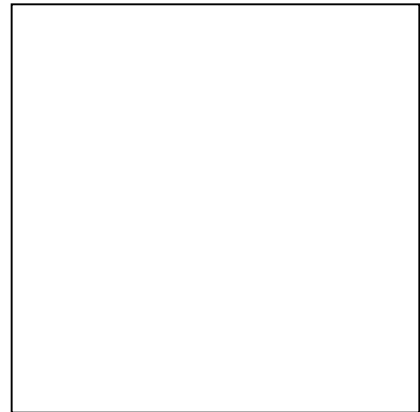
I hereby certify that I have checked the distances from the side, rear, and front lot lines of the building(s), as well as building elevations and site grades for the above-referenced project and find that the construction conforms with the plans approved by the Township Engineer, dated _____, except as noted below. I also certify that all improvements will not adversely impact drainage flows and all utility rim elevations have been verified with cover over public utility lines checked against Township standards.

Sincerely,

Printed Name of Professional Engineer

Signature

Engineer's Seal



CHARTER TOWNSHIP OF BRIGHTON RECORD DRAWING REQUIREMENT CHECKLIST

4363 Buno Road, Brighton, MI 48114, P: 810-229-0550, F: 819-299-1778

JOB NAME: _____ REVIEWED BY: _____

JOB NUMBER: _____ DATE REVIEWED: _____

NOTE: Tie down measurements and top of casting elevations to all utility structures or building corners will also be the responsibility of the engineer providing the record drawings. The use of coordinates alone to locate structures is not acceptable.

The Brighton Township and Township Engineer project numbers must be printed in the lower right-hand corner of all plan sheets.

COVER SHEET			COMMENTS
A.	[NEED]	[O.K.]	Type & class of pipe & joint for all utilities
B.	[NEED]	[O.K.]	Permit numbers (County & MDEQ)
C.	[NEED]	[O.K.]	Manufacturer of pipe
D.	[NEED]	[O.K.]	Manufacturer of manhole
E.	[NEED]	[O.K.]	Manufacturer of hydrant
F.	[NEED]	[O.K.]	Basis of Design for Sewer Demands
G.	[NEED]	[O.K.]	Basis of Design for Water Demands

SANITARY SEWER			COMMENTS
I. PLAN VIEW			
<i>OHM USE ONLY</i>			
A.	[NEED]	[O.K.]	Lengths between manholes
B.	[NEED]	[O.K.]	Size of pipe
C.	[NEED]	[O.K.]	Lengths of casing pipe
D.	[NEED]	[O.K.]	Ties to manholes
E.	[NEED]	[O.K.]	Wye locations
F.	[NEED]	[O.K.]	Manhole numbering (sequential)
G.	[NEED]	[O.K.]	Show all sanitary sewer easements on plans
H.	[NEED]	[O.K.]	Provide sketch and legal description of sanitary sewer easements

II. PROFILE VIEW			
<i>OHM USE ONLY</i>			
A.	[NEED]	[O.K.]	Lengths between manholes
B.	[NEED]	[O.K.]	Size of pipe
C.	[NEED]	[O.K.]	Lengths of casing pipe
D.	[NEED]	[O.K.]	Depth of wye & riser
E.	[NEED]	[O.K.]	Invert grades
F.	[NEED]	[O.K.]	T/casting grades
G.	[NEED]	[O.K.]	Wye locations
H.	[NEED]	[O.K.]	Percent slope between manholes
I.	[NEED]	[O.K.]	Manhole numbering (sequential)
J.	[NEED]	[O.K.]	All utility crossings
K.	[NEED]	[O.K.]	Backfill areas graphically shown

STORM SEWER**COMMENTS****I. PLAN VIEW***OHM USE ONLY*

- | | | | |
|----|--------|--------|--|
| A. | [NEED] | [O.K.] | Lengths between manholes/catch basins/inlets |
| B. | [NEED] | [O.K.] | Size of pipe |
| C. | [NEED] | [O.K.] | Ties to manholes/catch basins/inlets |
| D. | [NEED] | [O.K.] | T/casting grades |
| E. | [NEED] | [O.K.] | Structure numbering (sequential) |
| F. | [NEED] | [O.K.] | Special structures (low head, 5' dia., 6' dia., 2' sump, etc.) |
| G. | [NEED] | [O.K.] | Show all easements for storm sewer |
| H. | [NEED] | [O.K.] | Provide sketch and legal description of storm sewer easements |

II. PROFILE VIEW*OHM USE ONLY*

- | | | | |
|----|--------|--------|---|
| A. | [NEED] | [O.K.] | Lengths between manholes |
| B. | [NEED] | [O.K.] | Size of pipe |
| C. | [NEED] | [O.K.] | Invert grades |
| D. | [NEED] | [O.K.] | T/casting grades |
| E. | [NEED] | [O.K.] | Structure numbering (sequential) |
| F. | [NEED] | [O.K.] | Percent slope between manholes (as-built) |
| G. | [NEED] | [O.K.] | All utility crossings |
| H. | [NEED] | [O.K.] | Special backfill areas graphically shown |

III. DETENTION BASIN

- | | | | |
|----|--------|--------|--------------------------------------|
| A. | [NEED] | [O.K.] | Constructed Contours |
| B. | [NEED] | [O.K.] | Outlet Control Structure Information |
| C. | [NEED] | [O.K.] | Detention Calculations |

WATER MAIN**COMMENTS****I. PLAN VIEW***OHM USE ONLY*

- | | | | |
|----|--------|--------|--|
| A. | [NEED] | [O.K.] | Lengths between gate valve & wells, hydrants and fittings |
| B. | [NEED] | [O.K.] | Size of pipe |
| C. | [NEED] | [O.K.] | Ties to gate valve & wells, |
| D. | [NEED] | [O.K.] | Ties to stop boxes |
| E. | [NEED] | [O.K.] | Ties to building or offsets to pipe |
| F. | [NEED] | [O.K.] | Location of thrust blocks & types of restraints |
| G. | [NEED] | [O.K.] | Sequentially numbered G.V. & wells |
| H. | [NEED] | [O.K.] | Show all water main easements on plan |
| I. | [NEED] | [O.K.] | Provide sketch and legal description of water main easements |

WATER MAIN**COMMENTS****II. PROFILE VIEW (REQUIRED FOR PIPE 12" & LARGER)***OHM USE ONLY*

- | | | | |
|----|--------|--------|---|
| A. | [NEED] | [O.K.] | Lengths between grade changes |
| B. | [NEED] | [O.K.] | Size of pipe |
| C. | [NEED] | [O.K.] | Type and class of pipe |
| D. | [NEED] | [O.K.] | G.V. & well location |
| E. | [NEED] | [O.K.] | Hydrant location (identify special structures such as blow off) |
| F. | [NEED] | [O.K.] | Air relief valves/blow off valve locations |
| G. | [NEED] | [O.K.] | Vertical bend locations |
| H. | [NEED] | [O.K.] | T/Casting grades |
| I. | [NEED] | [O.K.] | All utility crossings |
| J. | [NEED] | [O.K.] | Special backfill areas graphically shown |

 Revisions Needed No Revisions Needed

Charter Township of Brighton

Standards for Digital As-Built Drawings

The following digital submission specifications are being provided as minimum requirements and guidelines for consultants and developers reference. At the request of a developer, the Township will have the Township Engineer prepare the digital as-builts, at the developers expense. Should you have any questions or comments, please contact the Township Manager or Engineer.

A. Digital format of CAD files

The acceptable digital format for as-built drawing files shall be in AutoCAD format according to the following specifications:

- AutoCAD version 12.0 or later
- DWG or DXF formats as defined in AutoCAD
- All polygons must be closed
- Lines shall not be unnecessarily segmented
- Intersecting lines segments must have common end points
- No external document references

B. Coordinate System

All drawings shall contain adequate geodetic reference to Michigan South State Plane NAD 83. Units must be described as being international feet.

Drawings will conform to having one of the following references:

- A drawing will reference a section corner/quarter-corner with distance and bearing data relating this point to the site plan.
- A minimum of two (2) drawing locations will be identified with NAD83 coordinates established by field survey techniques (i.e., GPS or total station). Geographic coordinates shall appear in the drawing as text of a readable size and shall be in either Michigan South State Plane NAD83 or Geographic coordinates of sufficient resolution to derive state-plane coordinates within 1/10 of a foot.

C. Media for delivery

File transfer media shall be one of three options:

- CDROM or CD-R
- IOMEGA Zip 100 disks
- Electronic (Internet) file transfer