City of Brookville

Design Criteria

Amended: November 2024

ChoiceOne Engineering

Contents

FORWARD

This manual has been prepared to aid engineers in the preparation of subdivision plans and/or improvement plans, and engineering design and to inform interested persons of the procedures and standards for the City of Brookville, Ohio. It is also intended to be used during reconstruction or replacement of existing facilities or utility construction within the City right-of-way. The rules, standards, specifications, criteria, etc. are to supplement the Zoning Regulations and Subdivision Regulations of the City of Brookville.

It is not the intent of this manual to take away from the designing engineer any responsibility for the technical adequacy of this design or freedom to use his engineering judgment and discretion. It is recognized that matters of engineering design cannot be set out in writing to cover all situations, however, the design standards as set out herein represent good engineering practice. Any design methods or criteria different than that listed will receive consideration for approval, provided the proposed variances and the reasons for their use are submitted to the City of Brookville.

The City of Brookville, at any time during design or construction, will have the authority to modify any engineering or construction detail, whenever required for the protection of the public's interest.

Though the City of Brookville has no jurisdiction in areas outside of the corporation limits, the City recommends that any subdivision constructed within close proximity of the City be designed and constructed to these standards. This will help ensure that, if the subdivision is incorporated into the City, the subdivision will be accepted by the City without additional upgrades. If a subdivision or residence is annexed, all streets and utilities must be brought up to City Standards at the developer's or homeowner's expense. Also, if a subdivision or residence outside of the corporation limits of the City will be connected to City utilities, the utilities will be constructed to City Standards and Specifications.

The City of Brookville, at their discretion, may request that infrastructure and utility facilities in any particular subdivision be installed to accommodate future expansion within the City. If this is requested, the City would pay the difference to oversize these particular items per the subdivision regulations of the City of Brookville.

REFERENCES

The City of Brookville Design Criteria and Construction Standards and Drawings are to be used to supplement the following references. Whenever there are differences in these references and the Design Criteria and Construction Standards and Drawings, the more restrictive or higher standard must apply as determined by the City of Brookville.

- Ohio Department of Transportation (ODOT), latest versions
    - Construction and Material Specifications
    - Location and Design Manuals
        - Volume 1 - Roadway Design
        - Volume 2 - Drainage Design
    - Standard Construction Drawings
    - Standard Design Drawings
    - Supplemental Specifications
    - Traffic Control for Uniform Control Devices
- American Association of State Highway and Transportation Officials (AASHTO), latest version
    - A Policy on Geometric Design of Highways and Streets
- Great Lakes Upper Mississippi River Board (GLUMRB) (Ten State Standards), latest version
    - Recommended Standards for Wastewater Facilities
    - Recommended Standards for Water Works

ARTICLE 1 GENERAL PROVISIONS

101 General

A. The Design Criteria and Construction Standards and Drawings along with 100% performance surety and 10% maintenance surety must apply to all public improvement construction projects that will eventually be taken over by the City of Brookville. The 100% performance surety and 10% maintenance surety must follow the regulations in the City of Brookville Subdivision Regulations even if a major subdivision is not applicable.

B. The Developer/Owner must design and construct improvements not less than the standards outlined in the City of Brookville Subdivision Regulations and this document. The work must be done under the City's supervision and must be completed within the time fixed or agreed upon by the City.

C. It is the responsibility of the Developer/Owner and his engineer to investigate local conditions that may require additional improvements.

D. In the event any conflicting standards are encountered, the most restrictive will always apply as determined by the City of Brookville.

E. Upon request of the Developer/Owner or his representative, the City will evaluate requests to provide open excavation of existing utilities to allow accurate elevation information.

102 Inspection Fees

A. An inspection fee of $100.00 per platted lot will be charged to cover the City of Brookville's expenses, construction drawing review, and general construction inspection.

B. A cashier's or certified check in the designated amount will be deposited with the City of Brookville. This deposit will be made in conjunction with the performance security.

103 Completion of Work

As required improvements are completed, approved, and accepted, the City of Brookville may reduce the amount of the security.

104 Acceptance

When the City of Brookville officials, following final inspection of a subdivision or improvement, certify to the City Council that all improvements have been constructed in accordance with City specifications, the City Council may proceed to accept the facilities for which the security was posted. Final dedication must be within (12) twelve months of acceptance. Deposit bonds will not be returned until dedicated.

105 Failure to Comply

In the event the improvements under these standards and specifications are not completed within twenty-four (24) months after the receipt of the security, or that in the opinion of the City of Brookville or it's representatives that the Subdivider is not constructing the improvements in accordance with the

City of Brookville Standards and Specifications, the City of Brookville must proceed with the work and hold the Subdivider and the Surety jointly responsible for the cost thereof.

106 Construction Procedures and Materials

A. Pre-Construction Meeting

A pre-construction meeting with the City is required. The Developer/Owner, contractor, engineer, and representatives from utility companies involved must be present at the meeting. It is the Developer/Owner's responsibility to arrange the preconstruction meeting. All meeting notes and the sign-in sheet will be provided by the developer and distributed to everyone in attendance. The City reserves the right to refuse issuance of a Zoning Certificate without completion of a pre-construction meeting.

B. Materials

All work and materials must conform to the Ohio Department of Transportation, (ODOT) Construction and Material Specifications, and the Construction Standards and Drawings of the City of Brookville, Ohio.

C. Inspections

1. Definition

Inspector/inspection is the visual observation or observation by instrument of construction to permit the City or its representative to render their professional opinion as to whether the contractor is performing the services in a manner indicating that, when completed, the services will be in accordance with the City of Brookville Subdivision Regulations, Construction Standards and Drawings, and Design Criteria. Such observations will not be relied upon in any part as acceptance of the services, nor will they relieve any party from fulfillment of customary and contractual responsibilities and obligations.

2. Periodic Inspection

Periodic inspection during the installation of improvements must be made by the City to ensure conformity with the approved plans and specifications as required by these and other regulations. The Developer/Owner must notify proper City officials at least twenty-four (24) hours before each phase of the improvements is ready for inspection. The presence and/or absence of an inspector during construction will not relieve the Developer/Owner and/or contractor from full responsibility of required improvements to the City of Brookville Construction Standards and Drawings and to the satisfaction of the City.

3. Inspections must be as follows:

a. Sanitary Sewer

i. Sanitary pipe and manhole installation

ii. Lateral location and inspection of all sewers

iii. Proper backfill installation

iv. Air test sanitary lines
v. Vacuum test manholes
vi. Deflection test on PVC sewers

b. Water Main
i. Pipe installation
ii. Hydrant installation
iii. Valve installation
iv. Service installation and location
v. Proper backfill installation
vi. Restraining glands and/or blocking installation
vii. Pressure test
viii. Disinfection

c. Storm Sewer
i. Manhole and catch basin installation
ii. Storm sewer pipe installation
iii. Field tile connections
iv. Proper backfill installation
v. Headwall installation
vi. Individual storm outlet location, if applicable
vii. Storm Water Pollution Prevention Plan (SWPPP) compliance

d. Roadway
i. Subgrade preparation
ii. Subgrade undercutting
iii. Subbase installation
iv. Street coring
v. Curbing installation
vi. Sidewalk and approach installation
vii. Prime/tack coat installation
viii. Asphalt installation

4. Weight and delivery tickets must be furnished to the City to substantiate the type, quantity, and size of material used.

D. Responsibility

All work must be under the control and supervision of the Developer/Owner until written final approval is given by the City.

E. Final Inspection

Upon completion of all the improvements, the Developer/Owner must request, in writing, a final inspection by the City. The final inspection must be performed by officials from the City with the Developer/Owner. The Developer/Owner's Engineer and the Developer/Owner's Contractor will be present.

F. Utility Coordination

Coordination of utility location/installation such as electric, gas, telephone, and cable television will be the responsibility of the Contractor, Developer, or Owner in accordance with plans approved by the City.

107 Subdivision Inspection

SUBDIVISION _____

DATE _____INSPECTOR _____

This list could vary depending upon the types of construction included in the project. This is a sample list (not all-inclusive) of items in which an inspector may utilize.

✓	DESCRIPTION	REMARKS
A.	**PRIOR TO INSPECTION**	
	Review plans, special provisions, construction & material manuals and specifications that apply to your assigned duties.	
	Discuss your responsibility & authority with the project engineer.	
	Discuss notification, changes, connections, delays, rejections, and tolerances.	
B.	**PRE-CONSTRUCTION CONFERENCE**	
	Attendees: City Representatives, Developer/Owner, Engineer, Contractor, Superintendent, Foreman, Utility Companies	
	Discuss phasing & schedules	
	Discuss materials	
	Discuss coordination	
	Discuss safety (public & job)	
	Discuss responsibilities	
C.	**SANITARY SEWER & LATERALS TO R/W**	
	Check pipe type & quality	
	Trench condition	
	Straight alignment & joints	
	Bedding	
	Proper initial backfill	
	Proper backfill	
	Prohibit groundwater from entering sanitary	
	Wye installation & location	
	Air test mainline & laterals	
	Mandrel test on PVC	
	Camera testing	

✓	DESCRIPTION	REMARKS
D.	**SANITARY MANHOLE**	
	Check type & condition	
	Steps condition & alignment	
	Cone type & condition	
	Risers precast/mastic	
	Casting - rim & lid	
	Proper pipe connection	
	Installation with O-rings	
	Installation on good base	
	Proper backfill, compacted granular under or near roadway	
	Exfiltration test	
	Rim & risers to proper finish grade	
	Chimney seal	
	Inflow dish installed	
E.	**WATER MAIN**	
	Type & condition	
	Valve type & condition	
	Hydrant type & condition	
	Trench condition	
	Pipe alignment & joints	
	Air release valves for testing	
	Isolation valve installation & location	
	Hydrant assembly installation & location	
	Restrained, as needed	
	Tracer wire	
	Bedding	
	Initial backfill, compacted granular	
	Proper backfill, compacted granular under or near roadway	
	Pressure test	
	Purification test	
	Valve & hydrant operation	
	Laterals: Corp stop Plastic Curb stop Meter set Compacted granular backfill Proper backflow prevention Backflow prevention devices	

✓	DESCRIPTION	REMARKS
F.	**STORM SEWER**	
	Check pipe type, size, & quality	
	Check catch basin & grate type, size, & quality	
	Check manhole type, size, & quality	
	Trench condition	
	Straight alignment & joint sealing	
	Bedding	
	Proper initial backfill	
	Proper backfill, compacted granular under or near roadway	
	Proper connection to catch basin & manholes	
	C.B. set in good horizontal & vertical alignment with curbs	
	Slope & grade: review control stakes & adjacent terrain for drainage	
	Field tile & other pipes reconnected & noted on plans	
	Proper flow lines poured in bottom	
G.	**ROADWAY**	
	Subgrade:	
	All topsoil removed in roadway	
	Compacted granular or clay fill only	
	Proper cross slope	
	Proper elevation	
	Free of roots, large stones, & excess dust	
	Proper compaction	
	Proofroll or density test, if soft undercut and/or underdrains	
	Subbase:	
	Proper material	
	Compacted in appropriate layers	
	Density test, if soft	
	Protect subgrade from being rutted or damaged (back in over subbase & blade, if necessary)	
	Proofroll subbase before prime coat	
	Measure elevation & cross slope	
	Surface:	
	Appropriate moisture & temperature conditions	
	Visual inspection of material (be aware of acceptable temperature range of mix & compensation)	
	Proper distribution & roller	
	Proper prime coat if specified	
	Lay in proper layer	
	Watch joints & overlaps	
	Seal against concrete curb face, etc.	
	Measure elevation & cross slope	
	Keep traffic off for 24 hours, if possible	

✓	DESCRIPTION	REMARKS
H.	**FIXED STRUCTURES, CURBS, SIDEWALK, HEADWALL, ETC.**	
	Determine proper concrete mix	
	Appropriate moisture & temperature conditions	
	Check all underground portions	
	Check backfill, operation, & material	
	Check subgrade	
	Check subbase under curbs	
	Review requirements for reinforcing steel	
	Check all reinforcement	
	Check all dowels	
	Check for expansion joints	
	Be aware of time concrete was batched & allowable time for placement	
	Observe mix & placement	
	Observe finishing procedure	
	Observe reinforcement fibers	
	Needs curing material ASAP	
	If required, check cold weather protection	
	Needs saw joints ASAP	
	Note when forms are removed	
	Utility tap locations stamped in concrete	
I.	**MISCELLANEOUS**	
	Keep daily logs	
	Pre-mark all existing utilities	
	Reconnect all existing utilities	
	Mark ends of all laterals in field: Contractor's responsibility	
	Mark ends of all laterals on plans	
	Restoration	
	Grade to drain	
	Check trench settlement	
	Seeding & mulching	
	Erosion Control	
	Inlets	
	Outlets	
	Curb lines	
	Ditches	
	Basins	
	Final check for debris & flow	
	Sanitary sewer	
	Storm sewer, manhole, & catch basin	
	Curb lines	

108 Submission of Plans and Design Calculations

A. Design Calculations
    1. Storm Water Management Report containing all storm water detention and pipe sizing calculations.
    2. Traffic Impact Study if requested by the City. The Traffic Impact Study will follow ODOT standard design procedures. Additional information may be requested by the City. Additional information may include:
        a. Signal warrant analysis
        b. Signal timing study
        c. Signal coordination analysis
    3. Sight Distance Analysis Report if requested by the City
    4. Sanitary pump station calculations
        a. Wet well sizing
        b. Pump sizing
        c. Force main sizing
        d. Buoyancy calculations

B. Construction Drawings
    1. Construction plans for review must be submitted on 24”x36” bond paper, 11x17 paper and in pdf file format.
    2. Completed/final construction drawings on 24" x 36" bond paper, approved by a registered engineer must be made for all new streets, utilities, and other improvements to be constructed in any development in the City. In addition, the final construction drawings must be provided in pdf file format and also AutoCAD format. Said drawings are to be approved by the City before any construction may begin and before the plat of said subdivision may be recorded.
    3. Construction plans for review must be submitted on 24”x36” bond paper, 11x17 paper and in pdf file format.
    4. Submission of plans must comply with Planning Commission regulations and the City of Brookville’s Subdivision Regulations and Zoning Code.

C. Standard Title Block
    1. All plan sheets must display a standard title block containing the following:
        a. Name, address, telephone number, and email (logo optional) of developer/owner
        b. Name, address, telephone number, and email (logo optional) of design engineer
        c. Plan sheet number
        d. Development name
        e. Sheet title
        f. Date
        g. Revision block
        h. Drawn by
        i. Checked by

D. Required Plan Layout Order
    1. Title Sheet
    2. Final Plat
    3. Schematic Plan

4. Typical Sections
5. General Notes
6. General Details
7. Site Grading Plan and Erosion Control
8. Erosion Control Details
9. Storm Water Pollution Prevention Plan
10. Miscellaneous Details (example: Pump Station, Intersection Plan)
11. Plan and Profile (1” = 20’ horizontal, 1” = 5’ vertical*)
12. Cross-Sections (1” = 5’ horizontal, 1” = 5’ vertical*)
13. Detention Basin or Retention Pond Plan and Details
14. Off-site Utilities Plan and Profile (1" = 20' horizontal, 1 '' = 5' vertical*)
15. Street Light Layout

** Other scales may be used with prior approval.*

E. Plan Sheets
    1. Title Sheet
        a. Title of Project, City, County, Township, and State
        b. Index of sheets and sheet numbering
        c. Vicinity map with north arrow and project site call-out
        d. City standard drawings reference
        e. Underground utilities note (O.U.P.S.)
        f. Signature and stamp
        g. Date of finished plans
        h. Project description
        i. Approval plan signatures
        j. Name, address, telephone number, and email of firm that plans are prepared by
    2. Final Plat
        a. Copy of approved final plat with signatures
        b. See Subdivision Regulations for details
    3. Schematic Plan - Large Scale Layout of Site
        a. Shall be at a measurable scale to show the whole site on one sheet (maximum scale 1" = 100'). Other scales may be used with prior approval
        b. Show right-of-way, property lines and roadway, lot numbers, street names, and existing adjoining property lines and owners
        c. Show proposed utilities and numbering of sanitary and storm manholes and catch basins
        d. Stationing of intersections and streets
        e. Multi-baseline legend (sheet number, stationing, description, etc.)
        f. North arrow and scale
        g. Benchmarks and locations
        h. Centerline stationing
        i. Overall plan view of the development depicting the layout of the proposed sanitary sewer, water, and drainage network. Plans are to include all manholes, pipes, other structures, and the plan and profile sheet on which they are located
    4. Typical Sections
        a. Detailed labeling

b. Legend of pavement composition
c. Limiting stations for each section
d. Dimensioning, pavement, curb and gutter, curb lawn, sidewalk, right-of-way, and pavement slopes

5. General Notes
    a. All notes necessary for construction which are not defined clearly elsewhere within the plans
6. General Details
    a. All details necessary for construction which are not represented by City of Brookville Standard Drawings
    b. Modified City of Brookville Standard Drawings must be redrawn for approval
7. Site Grading Plan
    a. A final site grading plan must be included with the construction drawings and approved by the City
    b. Proposed 1 -foot contours showing all lots having proper drainage
    c. Proposed building pad elevation
    d. Show and label existing and proposed 1-foot contours.
    e. Proposed storm manholes, catch basins, pipes, etc., labeled and numbered
    f. Concentrated flows
    g. Emergency flood route
    h. Property lines, right-of-way, lot numbers, and owners
    i. Proposed/existing roadways
    j. Limits of grading
    k. Proposed storm sewer pipe flows and capacities
    l. Sediment basin location
    m. North arrow scale
    n. Must be at a measurable scale to show the entire site on one sheet (maximum scale 1"= 100')
8. Erosion Control Details
    a. Any details necessary for construction which are not represented by City of Brookville Standard Drawings
9. Storm Water Pollution Prevention Plan
    a. A Storm Water Pollution Prevention Plan must be included with the construction drawings and approved by the City. This plan must follow OEPA and NPDES permit requirements and be submitted to and approved by the OEPA prior to construction.
    b. Proposed diversions and erosion control (example: diversion ditches, fabric fence, sediment basin)
    c. Erosion control construction sequence list
    d. Past construction Best Management Practice (BMP) details

10. Miscellaneous Details (example: Pump Station, Intersection Plan, etc.)
    a. Plans must include a detailed drawing with all proper labeling and dimensions.
11. Plan and Profile
    a. General
        i. The plan and profile must be at a scale of 1" = 20' horizontal, 1"= 5’ vertical.
        ii. Plan and profile sheets must show all necessary data in sufficient detail for the complete construction of all work and improvements to be made in the plat.
        iii. All grade elevations must be based on U.S.G.S. and City of Brookville datum.
        iv. Plan and profile sheets will be required for all off-site utility extensions.
        v. More specifically, all plans and profile sheets must show and include the following items:
        vi. Plan View
            1. Show all proposed lots, streets, curbs, etc.
            2. Show all existing pavements, headwalls, piers, utilities, mailboxes, trees, etc. (existing infrastructure may be shown in lighter text and no less than 80% shading)
            3. Typical street and curb sections
            4. Construction notes
            5. Structural details
            6. North arrow (preferably up and to the right) and scale (horizontal and vertical)
            7. Street names
            8. Centerline stations and ticks every 100 feet (south to north and west to east where possible)
            9. Easements for utilities and storm drainage
            10. Lot numbers, dimensions, and frontage
            11. Curb radius at intersections with back of curb elevations at quarter points (if not covered in separate intersection detail)
            12. Curve data: radius, delta, chord length, chord bearing, arc length, station of PC, PT, PCC, PI, PRC
            13. Sheet reference
            14. Plat section lines (boundary lines) showing stations
            15. Dimension and station utility locations
            16. Centerline bearings and/or intersecting centerline angles
            17. Final monument box call-outs set at PC, PT, PCC, PI, PRC (in pavement) intersections
            18. Drive apron stationing and width call-outs
            19. Show all existing features within 50 feet of right-of-way.
            20. Proposed electric, telephone, gas, cable locations, and easements
            21. Proposed light pole layout and electric feed
            22. Match lines with stationing

23. Intersection elevation for proper storm water drainage
24. Benchmarks

vii. Profile View

1. Existing centerline and proposed centerline profile
2. Label proposed centerline grades (minimum grade 0.50%)
3. Show all mainline existing utilities
4. Existing and proposed grade elevations every 25 feet (existing elevation on bottom of sheet and proposed elevation on top of sheet. Note as to centerline or top of curb.)
5. Show and label all vertical curves (stations, elevations, and length)

b. Storm Sewer

i. Plan View

1. Show and label with station, with offsets, the proposed storm sewers: manholes, laterals, catch basins, headwalls, etc.
2. Label each pipe size and type
3. Number proposed storm manholes and catch basins

ii. Profile View

1. Show length of span, size, grade, and class and/or type of proposed pipe
2. Label existing pipe size and type
3. Existing and proposed storm
    i. Label existing and proposed mainline storm water manholes, junction boxes, catch basins, etc., and show centerline of streets and stations of each
    ii. Show invert elevations of all pipe at manholes, headwalls, junction boxes, catch basins, etc.
    iii. Show elevation on top of manhole or catch basin
    iv. Number proposed storm manholes and catch basins

c. Water

i. Plan View

1. Show and label with station with offsets the proposed waterline, laterals, deflection points, hydrants, valves, etc.
2. Label pipe size, tees, crosses, etc.
3. Proposed meter pit location
4. Indicate the testing requirements for fire protection and water services

ii. Profile View

1. Show length, size, depth, and class and/or type of pipe
2. Show deflection points
3. Show stations and any critical elevations for above items
4. Label minimum coverage of water main

d. Sanitary Sewer

i. Plan View

1. Show sanitary sewers, manholes, laterals, cleanouts, etc. with station and offset labeled
2. Label each pipe size
3. Number proposed sanitary manholes and cleanouts

ii. Profile View

1. Show length of span, size, grade, and class and/or type of proposed pipe
2. Show existing and proposed sanitary
3. Show invert elevation of all pipe at manholes
4. Show top elevations of manholes
5. Number proposed sanitary manholes and clean-outs

12. Cross-Sections
    a. The cross-sections must be at a scale of 1" = 5' horizontal, 1" = 5' vertical
    b. Cross-sections must be every 50 feet and at other critical areas
    c. Show all existing utilities with labels
    d. Show all proposed utilities with labels
    e. Show all proposed and existing roadway sections with existing and proposed centerline elevation
    f. Cross-sections at each drive and intersection roadway
13. Detention Basin or Retention Pond Plan and Details
    a. Detailed site plan including inlet and outlet elevations, top of bank elevations, and emergency overflow elevations
14. Off-Site Utilities Plan and Profile
    a. Refer to General Plan and Profile.
15. Street Light Layout
    a. Show all streetlight locations
    b. Show all electric service locations
    c. Show locations and size of conduit between lights

109 Subdivision Construction Plans Checklist

SUBDIVISION _____ DATE _____

✓	DESCRIPTION	REMARKS
A.	**REQUIRED PLAN LAYOUT ORDER**	
	Title Sheet	
	Final Plat	
	Schematic Plan	
	Typical Sections	
	General Notes	
	General Details	
	Site Grading Plan	
	Erosion Control Details	
	Storm Water Pollution Prevention Plan	
	Miscellaneous Details (e.g. pump station, intersection plan)	
	Plan and Profile (1"=20' horizontal, 1"=5' vertical)	
	Cross-Sections (1 "=5' horizontal, 1" = 5' vertical)	
	Detention Basin or Retention Pond Plan and Details	
	Off-Site Utilities Plan and Profile (1"=20' horizontal, 1" = 5' vertical)	
	Street Light Layout	
B.	**GENERAL**	
	Acceptable natural drainage and erosion control	
	Right-of-way widths meet minimum criteria	
	Pavement widths	
	Radius of curvature	
	Horizontal visibility	
	Vertical alignment and visibility	
	Grades	
	Cul-de-sacs	
	Turn around radius, right-of-way, and pavement	
	Dead-end streets	
	Alignment of intersection	
	Space of intersection relative to difference in road classifications	
	Avoidance of multiple intersection	
	Pavement and right-of-way of intersection	
	Streets for commercial subdivisions	
	Repair of pavements	
	Streets for industrial subdivision	
	Lengths of blocks meet minimum criteria	
	Crosswalks	
	Street monuments	
	Subgrade	

✓	DESCRIPTION	REMARKS
B.	**GENERAL (Continued)**	
	Base course	
	Surface course	
	Grading plan	
	Storm drainage system type	
	Manholes	
	Catch basins	
	Headwalls	
	Sufficient easements for utilities or open drainage	
	Other utilities	
	Underground utilities	
1.	**TITLE SHEET**	
	Title of Project, City, County, Township, State	
	Index of sheets and sheet numbering	
	Vicinity map with north arrow and project site callout	
	City Standard Drawings reference	
	Underground utilities note (O.U.P.S.)	
	Signature and stamp	
	Date of finished plans	
	Project description	
	Approval plan signatures	
	Name, address, telephone number, and email of firm that plans are prepared by	
2.	**FINAL PLAT**	
	Copy of approved final plat	
	See Subdivision Regulations for details	
3.	**SCHEMATIC PLAN - LARGE SCALE LAYOUT OF SITE**	
	At a measurable scale to show the whole site on one sheet (maximum scale 1" = 100')	
	Show right-of-way, property lines, roadway, lot numbers, street names, and existing adjoining property lines and owners	
	Show proposed utilities and numbering of sanitary and storm manholes and catch basins	
	Stationing of intersections and streets	
	Multi-baseline legend (sheet number, stationing, description, etc.)	
	North arrow and scale	
	Benchmarks and locations	
	Centerline stationing	
	Overall plan view of the development depicting the layout of the proposed sanitary sewer, water, and drainage network. Plans are to include all manholes, pipes, other structures, and the plan and profile sheet on which they are located.	

✓	DESCRIPTION	REMARKS
4.	**TYPICAL SECTION**	
	Detailed labeling	
	Legend of pavement composition	
	Limiting stations for each section	
	Dimensioning, pavement, curb and gutter, curb lawn, sidewalk, right-of-way, and pavement slopes	
5.	**GENERAL NOTES**	
	All notes necessary for construction which are not defined clearly elsewhere within the plans	
6.	**GENERAL DETAILS**	
	All details necessary for construction which are not represented by City of Brookville Standard Drawings	
	Modified City of Brookville Standard Drawings must be redrawn for approval	
7.	**SITE GRADING PLAN**	
	A final site grading plan must be included with the construction drawings and approved by the City	
	Proposed 1' contours showing all lots having proper drainage	
	Proposed building pad elevation	
	Show and label existing and proposed 1' contours	
	Proposed storm manholes, catch basins, pipes, etc., labeled and numbered	
	Concentrated flows	
	Property lines, right-of-way, lot numbers, and owners	
	Proposed/existing roadways	
	Limits of grading	
	Proposed storm sewer pipe flows and capacities	
	Sediment basin location	
	North arrow and scale	
	At a measurable scale to show the whole site on one sheet (maximum scale 1" = 100')	
8.	**EROSION CONTROL DETAILS**	
	Any details necessary for construction which are not represented by the City of Brookville Standard Drawings	
9.	**STORM WATER POLLUTION PREVENTION PLAN**	
	A Storm Water Pollution Prevention Plan will be required to be included with the construction drawings and approved by the City. This plan must follow the OEPA and NPDES permit requirements and be submitted to and approved by OEPA prior to construction	
	Proposed diversions and erosion control (e.g. diversion ditches, fabric fence, straw bales, sediment basins.)	
	Erosion control construction sequence list	
	Past construction Best Management Practice (BMP) details	

✓	DESCRIPTION	REMARKS
10.	**MISCELLANEOUS DETAILS (e.g. pump station, intersection plan etc.)**	
	Must include a detail drawing with all proper labeling and dimensioning	
11.	**PLAN AND PROFILE**	
	Use a scale of 1"= 20' horizontal, 1"=5' vertical	
	Show all necessary data in sufficient detail for the complete construction of all work and improvements to be made in the plat	
	All grade elevations must be based on U.S.G.S. and City of Brookville datum	
	Plan and profile sheets are required for all off-site utility extensions	
	PLAN VIEW	
	Show all proposed lots, streets, curbs, etc.	
	Show all existing pavements, headwalls, piers, utilities, mailboxes, trees, etc.	
	Typical street and curb sections	
	Construction notes	
	Structural details	
	North arrow (preferably up and to the right) and scale (horizontal and vertical)	
	Street names	
	Centerline stations and ticks every 100 feet (south to north and west to east where possible)	
	Easements for utilities and storm drainage	
	Pavements and right-of-way widths	
	Lot numbers, dimensions, and frontage	
	Curb radius and intersections with back of curb elevations at quarter points (if not covered in separate intersection detail)	
	Curve data: radius, delta, chord length, chord bearing, arc length, station of PC, PT, PCC, PI, PRC	
	Sheet reference	
	Plat section lines (boundary lines) showing stations	
	Dimension and station utility locations	
	Centerline bearings and/or intersecting centerline angles	
	Final monument box call-outs set at PC, PT, PCC, PI, PRC (in pavement) intersections	
	Drive apron stationing and width call-outs	
	Show all existing features within 50 feet of right-of- way	
	Proposed electric, telephone, gas, cable locations, and easements	
	Proposed light pole layout and electric feed	
	Match lines with stationing	
	Intersection elevation for proper storm water drainage	
	Benchmarks	

✓	DESCRIPTION	REMARKS
	PROFILE VIEW	
	Existing centerline and proposed centerline profile	
	Label proposed centerline grades (minimum grade 0.50%)	
	Show all mainline existing utilities	
	Existing and proposed grade elevations every 25 feet (existing elevation on bottom of sheet and proposed elevation on top of sheet. Note as to centerline or top of curb.)	
	Show and label all vertical curves (stations, elevations, and length)	
	STORM SEWER PLAN VIEW	
	Show and station, with offsets, the proposed storm sewers: manholes, laterals, catch basins, headwalls, etc.	
	Label each pipe size and type	
	Number storm manholes and catch basins	
	STORM SEWER PROFILE VIEW	
	Show length of span, size, grade, and class and/or type of proposed pipe	
	Label existing pipe size and type	
	Label existing and proposed storm water manholes, junction boxes, catch basins, etc., and show centerline of streets and stations of each	
	Show invert elevations of all pipe at manholes, headwalls, junction boxes, catch basins, etc.	
	Show elevation on top of manhole or catch basin	
	Number proposed storm manholes and catch basins	
	WATER PLAN VIEW	
	Show and label with station, with offsets, the proposed waterline, laterals, deflection points, hydrants, valves, etc.	
	Label pipe size, tees, crosses, etc.	
	WATER PROFILE VIEW	
	Show length, size, depth, and class and/or type of pipe	
	Show deflection points	
	Show stations and any critical elevations for above items	
	Label minimum coverage of water main	

✓	DESCRIPTION	REMARKS
	SANITARY SEWER PLAN VIEW	
	Show sanitary sewers, manholes, laterals, cleanouts, etc. with station and offset labeled	
	Label each pipe size	
	Number proposed sanitary manholes and cleanouts	
	SANITARY SEWER PROFILE VIEW	
	Show length of span, size, grade, and class and/or type of proposed pipe	
	Show existing and proposed sanitary	
	Show invert elevation of all pipe at manholes	
	Show top elevations of manholes	
	Number proposed sanitary manholes and cleanouts	
11.	**CROSS-SECTIONS**	
	Cross-sections must be at a scale of 1"=5' horizontal, 1"=5' vertical	
	Cross-sections must be every 50 feet and at other critical areas	
	Show all existing utilities with labels	
	Show all proposed utilities with labels	
	Show all proposed and existing roadway sections with existing and proposed centerline elevations	
	Cross-section at each drive and intersection roadway	
12.	**DETENTION BASIN OR RETENTION POND**	
	Detailed site plan including inlet and outlet elevations, top of bank elevations, and emergency overflow elevations	
13.	**OFF-SITE**	
	Refer to Plan and Profile	
14.	**STREET LIGHT LAYOUT**	
	Show all streetlight locations	
	Show all electric service locations	
	Show locations and size of conduit between lights	

110 Record Drawing Requirements

A. At the completion of construction, the original tracings must be revised as necessary to provide Record Drawings. This work must be done by the Developer/Owner's engineer who was responsible for setting grades and staking for improvements. The Record Drawings must include the following information:
    1. Location of all water and sanitary services as well as storm outlets if provided
    2. Final elevations and locations of the following:
        a. Storm sewer inlets, outlets, and manholes with all inverts
        b. Drainage swales, detention basins including structures with all elevations, and capacity recalculated
        c. Sanitary sewer manholes, inverts, and lateral locations
        d. Curb, gutter, and centerline elevations at locations where the roadway ends and the potential for future roadway expansion exists
    3. Location of any changes in street, water, sanitary, or storm from design to completed construction
    4. The original tracings and any computer drawings will become the property of the City
B. Design calculations for storm sewer pipe, detention basin size and outlet control
C. Design calculations for lift stations including forcemain sizing, wet well sizing, and buoyancy
D. Project material submittals: including supplier cut sheets, precast submittals and shop drawings
E. Maintenance Surety will not be released until satisfactory Record Drawings (As-Builts) are delivered to the City
F. All Record Drawing files are to be supplied on a flash drive in pdf format

ARTICLE 2 DEFINITIONS

201 Interpretation of Terms or Words

Regardless of capitalization, definitions are standard for the intent of these Design Criteria.

202 Definitions

AASHTO

American Association of State Highway and Transportation Officials

ANSI

American National Standards Institute

ASCE

American Society of Civil Engineers

ASTM

American Society for Testing Materials

AVERAGE DAILY FLOW

The total quantity of liquid tributary to a point divided by the number of days of flow measurement.

AWWA

American Water Works Association

BEDDING

The earth or other materials on which a pipe or conduit is supported.

BUILDING SEWER

A pipe conveying wastewater from a single building to a common sewer or point of immediate disposal.

CATCH BASIN

A structure intended to collect surface runoff and direct it into the storm sewer system.

COLLECTOR SEWER

A sewer normally less than 15 inches in diameter that receives wastewater from the sanitary laterals and transports it to the interceptor sewer.

COMBINED SEWER

A sewer intended to receive both wastewater and storm or surface water.

CROSS-CONNECTION

A. A physical connection through which a supply of potable water could be contaminated or polluted.

B. A connection between a supervised potable water supply and an unsupervised supply of unknown portability.

CUL-DE-SAC

A street closed at one end.

CULVERT

A structure which allows surface runoff to flow through a roadway fill or similar obstruction of open flow. Culverts may be corrugated metal pipe, reinforced concrete, etc.

CURB INLET

A specialized catch basin (see Catch Basin) designed to collect runoff from pavement with curbing.

DESIGN STORM

The expected frequency of the storm for which the capacity of a structure will be equaled or exceeded. The capacity of a storm sewer designed for a 10-year design storm has a 1 in 10 chance of being equaled or exceeded in any given year.

DETENTION/RETENTION

The term detention/retention basin refers to the use of a storm water storage facility which will store storm water and release it at a given rate. The objective of a detention/retention facility is to regulate the rate of runoff and control the peak discharges to reduce the impact on the downstream drainage system.

A. Type of Storm Water Storage Facilities:
    1. Detention Basin or Dry Basin - Dry basins are surface storage areas created by constructing a typical excavated or embankment basin.
    2. Retention Basins or Ponds - Retention basins are permanent ponds where additional storage capacity is provided above the normal water level.
    3. Parking Lot Storage - Parking lot storage is a surface storage facility where an inlet is undersized causing shallow ponding to occur in specific graded areas of the parking lot.
    4. Subsurface Storage - Subsurface storage is a structure constructed below grade for the specific purpose of detaining storm water runoff.

DISCHARGE

The amount of flow carried by a culvert or storm sewer, normally measured in cubic feet per second.

DRAINAGE AREA

The area, in acres, which drains to a particular catch basin, culvert, or similar structure.

DROP MANHOLE

A manhole installed in a sewer where the elevation of the incoming sewer considerably exceeds that of the outgoing sewer; a vertical waterway outside the manhole is provided to divert the wastewater from the upper to the lower level so that it does not fall freely into the manhole except at peak rate of flow.

EARTH-DISTURBING ACTIVITY

Any grading, excavating, filling or other alteration of the earth's surface where natural or manmade ground cover is destroyed, and which may result in or contribute to erosion and sediment pollution.

ENERGY GRADIENT

The slope of the energy line of a body of flowing water with reference to a datum plane.

ENERGY GRADIENT LINE

The line representing the gradient which joins the elevation of the energy head.

ENERGY HEAD

The height of the hydraulic grade line above the centerline of a conduit plus the velocity head of the mean velocity of the water in that section.

ENERGY LINE

A line joining the elevation of the energy heads; a line drawn above the hydraulic grade line by a distance equivalent to the velocity head of the flowing water at each section along a stream, channel, or conduit.

EROSION

A. The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.
B. Detachment and movement of soil or rock fragments by wind, water, ice, or gravity.
C. Erosion includes:
    1. Accelerated erosion: Erosion much more rapid than normal, natural or geologic erosion, primarily as a result of the influence of the activities of man.
    2. Floodplain erosion: Abrading and wearing away of the nearly level land situated on either side of a channel due to overflow flooding.
    3. Gully erosion: The erosion process whereby water accumulates in narrow channels during and immediately after rainfall or snow or ice melt and actively removes the soil from this narrow area to considerable depths such that the channel would not be obliterated by normal smoothing or tillage operations.
    4. Natural erosion (geological erosion): Wearing away of the earth's surface by water, ice, or other natural environmental conditions of climate, vegetation, etc., undisturbed by man.
    5. Normal erosion: The gradual erosion of land used by man which does not greatly exceed natural erosion.
    6. Rill erosion: An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed soils.
    7. Sheet erosion: The removal of a fairly uniform layer of soil from the land surface by wind or runoff water.

EXFILTRATION

The quantity of wastewater which leaks to the surrounding ground through unintentional openings in a sewer. Also, the process whereby this leaking occurs.

FIRE HYDRANT

A fixture installed throughout water distribution systems to provide water for fire-fighting needs.

FREEBOARD

The distance between the top of normal water and top of embankment in a storm detention basin.

FLOOD-ROUTING

Path of travel for flood water once initial storm water conveyance and detention systems are full.

GRASSED WATERWAY

A broad or shallow natural course or constructed channel covered with erosion-resistant grasses or similar vegetative cover and used to conduct surface water.

HEADWALL

A structure placed at the ends of a culvert to prevent movement of the culvert and reduce erosion.

HEADWATER

The vertical distance from a culvert invert at the entrance to the water surface upstream from the culvert.

HOUSE CONNECTION

The pipe carrying the wastewater from the building to a common sewer. Also called building sewer, house sewer, or sanitary lateral. The house connection begins at the outer face of the building wall.

HOUSE SEWER

A pipe conveying wastewater from a single building to a common sewer or point of immediate disposal. See House Connection.

INFILTRATION

The discharge of ground waters into sewers through defects in pipe lines, joints, manholes, or other sewer structures.

INFILTRATION/INFLOW

A combination of inflow wastewater volumes in sewer lines with no way to distinguish either of the two basic sources, and with the same effect as surcharging capacities of sewer systems and other sewer system facilities.

INFLOW

The discharge of any kind of water into sewer lines from such sources as roof leaders, cellars, sump pumps and yard-area drains, foundation drains, commercial and industrial so-called "clean water"

discharges, drains from springs and swampy areas, etc. It does not "infiltrate" the system and is distinguished from such wastewater discharge, as previously defined.

INLET CONTROL

A situation where the discharge capacity of a culvert is controlled at the culvert entrance by the depth of headwater and the entrance geometry, including the area, shape, and type of inlet edge.

INTERCEPTOR SEWER

A sewer which receives the flow from collector sewers and conveys the wastewater to treatment facilities.

JOINTS

The means of connecting sectional lengths of storm sewer pipe into a continuous sewer line using various types of jointing materials with various types of pipe formation.

JURISDICTION

Any governmental entity, such as a town, city, county, sewer district, sanitary district or authority, or other multi-community agency which is responsible for and operates sewer systems, pumping facilities, regulator-overflow structures, and wastewater treatment works.

MAIN

The large water-carrying pipe to which individual user services are connected. Mains are normally connected to each other in a grid type system.

MANHOLE

An opening in a sewer provided for the purpose of permitting a person to enter or have access to the sewer.

MANNING ROUGHNESS COEFFICIENT

The roughness coefficient in the Manning Formula for determination of the discharge coefficient in the Chezy Formula. Roughness coefficient (n) of a channel is based on actual tests typically provided in standard tables.

METER

The flow-measuring device installed at each service on a distribution system to measure the amount of water consumed by users at that service.

NORMAL DEPTH

The depth at which water will flow in a pipe or channel by virtue of its slope and roughness, based on the Manning Formula.

OEPA

Ohio Environmental Protection Agency.

OUTLET CONTROL

A situation where the discharge capacity of a culvert is controlled by the barrel of the culvert, rather than the inlet.

OVERFLOW

A pipe line or conduit device, together with an outlet pipe, which provides for the discharge of a portion of sewer flow into receiving water or other points of disposal.

PEAK

The maximum quantity that occurs over a relatively short period of time. Also called peak demand or peak load.

RAINFALL INTENSITY

The amount of rain falling over a specified period of time. Rainfall intensity is usually measured in inches per hour.

RATIONAL FORMULA

The method used to determine the amount of runoff from a specified area of known surface characteristics.

RUNOFF COEFFICIENT

A coefficient used in the Rational Formula to express the ratio of runoff to rainfall.

SANITARY WASTEWATER

A. Domestic wastewater with storm and surface water excluded.
B. Wastewater discharging from the sanitary conveniences of dwellings (including apartment houses and hotels), office buildings, industrial plants, or institutions.
C. The water supply of a community after it has been used and discharged into a sewer.

SEDIMENT

Solid material both mineral and organic that is in suspension, is being transported, or has been moved from its site of origin by wind, water, gravity, or ice, and has come to rest on the earth's surface above or below sea level.

SEDIMENT BASIN

Barrier, dam, or other suitable detention facility built across an area of water flow to settle and retain sediment carried by runoff waters.

SEDIMENT CONTROL PLAN

A written description, acceptable to the approving agency, of methods for controlling sediment pollution from accelerated erosion on a development area of 5 or more contiguous acres or from erosion caused by accelerated runoff from a development area of 5 or more contiguous acres.

SEDIMENT POLLUTION

Failure to use management or conservation practices to abate wind or water erosion of the soil or the degradation of the waters of the state by soil sediment in conjunction with land grading, excavating, filling, or other soil disturbing activities on land used or being developed for commercial, industrial, residential, or other purposes.

SERVICE

The pipe carrying water to individual houses or other users on a distribution system.

TAILWATER

The vertical distance from a culvert invert at the outlet to the water surface downstream from the culvert.

TIME OF CONCENTRATION

The time required for water to flow from the hydrologically remote point of a basin to the outlet or collection point being analyzed. The time of concentration is the maximum time for water to travel through the watershed, which is not always the maximum distance from the outlet to any point in the watershed. The time of concentration for all drainage design for areas larger than 20 acres should be computed using the TR-55 method. For smaller areas, Roughness Coefficient for TR-55 sheet flow may be used.

WATER RESOURCE

Any natural or unnatural body of water, swale, ditch, conduit, pond, lake, etc. that receives or transports storm water runoff.

ARTICLE 3 Roadways

301 General

All street design and layout must follow the City of Brookville Construction Standards and Drawings; ODOT Location and Design Manual, Volume One, Roadway Design, latest version; and AASHTO. The most restrictive must apply as determined by a City representative. These criteria cover design factors and provide guidelines for evaluations of plans and specifications by the City. The design must be consistent with the requirements of AASHTO and ODOT.

302 Driveways

A. The following data is recommended for the uniform design of driveways and must be used in conformance with the standard drawings for driveways and driveway approaches.

B. The key elements of driveway configuration include the following:

    1. Width - must be measured at the right-of-way line
    2. Radii - connecting the driveway edges to the street curb or edge of pavement
    3. Angle - as related to the street line
    4. Directional flow - in, out or two-way
    5. Spacing - from nearest intersection, from property corners, and between adjacent driveways.

C. In general, as driveway widths and radii (on the entering side) are made larger, a more rapid and efficient entry flow can be expected. Thus, in most areas, generous widths and radii are desirable. Particularly good design is needed for high-volume driveways at shopping centers and factory parking lots.

303 Horizontal Alignment and Vertical Alignment

A. Alignment of all streets are required to follow the Ohio Department of Transportation's Location and Design Manual, Volume One, Roadway Design, and AASHTO.

304 Cul-de-Sacs and Dead-End Streets

A. Cul-de-sacs and dead-end streets are local streets terminated or closed at one end. Cul-de-sacs are used frequently in housing developments.

    There are several advantages in dead ending a street. Normally a street, no matter how unimportant, is used by some traffic not destined for or originating in a particular block. Such traffic is largely eliminated on a dead-end street increasing the street value for residential purposes because of decreased noise, odor and increased safety. Where the street is industrial in nature, dead ending has the advantage of converting the street, normally used for some through traffic, into an almost private loading street for the industries served.

    Where an existing street is commercial in character, there are objections to dead ending in that commercial establishments are not readily accessible. For example, in the case of a gasoline service station, dead ending can have a depressing effect on business. Thus, commercial streets are rarely dead ended.

Damages can occur as a result from terminating streets, and an element of extra cost to the arterial highway may be involved. In such cases consideration should be given to possibilities for connecting two or more adjacent streets as an alternate to their dead ending to avoid possible damages and improve local circulation.

A temporary dead end street can be made simply by providing a barricade across the street, possibly with a curb in front of it, supplemented by adequate warning signs and markers. All temporary dead end streets are operated two-ways and a turnaround must be provided at the end. No permanent dead end streets will be permitted.

In most cases cul-de-sacs need to be large enough to accommodate passenger vehicles, delivery trucks, fire trucks, and school buses. On industrial streets the cul-de-sacs must accommodate most medium-size semi-trailer combinations.

All cul-de-sacs and or dead-end streets must be designed per the latest City of Brookville Standard Construction Drawings.

B. Traffic Control Devices

The need for traffic control devices is required to be determined by an engineering study made in conjunction with the geometric design of the street or highway. The "Manual on Uniform Traffic Control Devices" is required to be used to ensure standard design and uniform application of the various traffic control devices.

ARTICLE 6 STORM DRAINAGE

601 General

The following Design Criteria are detailed herein to establish practical uniform design of storm sewers for the City of Brookville. These criteria cover design factors and provide guidelines for evaluation of plans and specifications by the City department having jurisdiction over the review of plans and specifications. These Design Criteria are also intended to conform to the standard drawings for storm sewers. Storm sewer design are required to follow these criteria and Ohio Department of Transportation Location and Design, Volume Two, Drainage Design.

602 Adequate Drainage Outlet

Surface water runoff from a development must be drained offsite in accordance with the City of Brookville Design Criteria and Construction Standards and Drawings to an adequate outlet(s). The City must approve the location of the outlet(s). The outlet(s) may consist of a ditch, stream, storm sewer, excluding a field tile, or approved detention basin having sufficient capacity to accommodate the surface water runoff in a reasonable manner that does not cause erosion or degradation of existing facilities.

The Developer must submit in writing evidence indicating the adequacy of the outlet(s) to at least and through the first drainage structure offsite of the proposed improvement. The City will review and determine the adequacy of the drainage outlet and reserves the right to require the outlet(s) to be cleaned, reconstructed, and/or replaced as deemed necessary.

An adequate outlet is defined as an outlet functioning as designed and able to carry the existing flows as well as the proposed flows in the post development condition.

603 Storm Sewer and Inlet Grate Design

An adequate storm drainage system must be constructed for all proposed developments. Natural drainage areas should be closely followed.

Outlets for the storm water runoff for development upstream of the proposed development must be provided. All storm sewer calculations must be submitted to the City before any approvals will be given.

Storm runoff from urban areas may constitute a large volume of flow. The rational method is the preferred method for estimating storm runoff for areas less than or equal to 200 acres. Once the runoff is determined, the Manning Formula is the preferred method to calculate the capacity of the storm sewer pipes. Storm sewer must be designed based on the full flow capacity of all pipes being able to carry at least the runoff from a 10-year storm event.

Also, the Hydraulic Grade Line (HGL) should be checked to ensure that a 25-year storm event will not cause ponding water at catch basins and manholes.

The Rational Formula used to compute the runoff that reaches a storm sewer inlet consists of the following:

$$Q=CiA$$

Q = Peak rate of runoff in cubic feet per second (cfs)
C = A coefficient expressing the ratio of runoff to the average rainfall rate during the time of concentration
i = Intensity of rainfall, in inches per hour
A = Drainage area, in acres

The drainage area(s) (watershed area) must be determined by a review of, but not limited to, the sources listed below. Watershed area(s) are subject to the approval of a City representative. Existing watershed boundaries must be maintained.

A. Contour Map: U.S. Geological Survey quadrangle (7.5 minute series) maps or other topographic contour map
B. Field investigation
C. Soil Survey of Montgomery County, Ohio, USDA
D. Others approved for use by a City representative

Other methods for determination of peak runoff rates may be used upon approval from or by request of the City.

604 Table – Runoff Coefficient – C

Lists values of "C" for several land uses and surface characteristics. If more than one land use is present in a particular drainage area, a composite "C" value should be computed to represent the site.

Predominant Land Use	
Business:	
Downtown Area	.80
Neighborhood Area	.70
Residential:	
Single-Family Areas	.40
Multi-Family Areas	.60
Industrial:	
Light Areas	.70
Heavy Areas	.80
Parks, Cemeteries	.30
Playgrounds	.35
Railroad Yard Areas	.35
Row Crops or Open Land	.25
Surface Characteristics	
Street:	
Asphalt	.90
Concrete	.90
Drives and Walks	.90
Roofs	.85
Lawns	
Flat – 2% or less	.25
Average – 2% to 7%	.35
Steep – 7% or greater	.40

605 Table – Intensity – Duration – Frequency

Methodology for converting I-D-F data points to an equation of the general form:

$$i=a/(t+b)^c$$

i = rainfall intensity (inches/hour)
t = time of concentration (minutes)
a = constant
b = constant
c = constant

Frequency (Years)	Constant "a"	Constant "b"	Constant "c"
2	56.299	10.000	0.876
5	67.933	11.000	0.869
10	84.550	13.000	0.882
25	95.736	14.000	0.871
50	96.783	14.000	0.850
100	80.436	11.500	0.794

Source: ODOT L&D Manual, Volume 2, Figure 1101-2 and 1101-3

This can be used to determine values of "i" for several storm frequencies.

The Manning Formula, used to compute flow in open conduits, consists of the following:

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

Q = Flow in cubic feet per second (cfs)
n = Coefficient of conduit roughness (n = 0.013)
R = Hydraulic radius, ratio of flow area to wetted perimeter in feet
S = Channel or pipe slope, in feet per feet
A = Area of cross-section of flow in square feet

The design of storm sewers in the City of Brookville must be performed as follows:

A. Prepare a contour map of the drainage area including the surrounding area, drainage limits, and direction of surface flow.

B. Divide the area into the subarea's tributary to the proposed sewer inlets. These inlets should be located at reversals of road grade from negative to positive and at street intersections. A maximum distance of 300 feet between catch basins will be allowed along long street grades.

C. Determine the acreage and imperviousness of each area.

D. Calculate the required capacity of each inlet using the appropriate time of concentration, the tributary area and the rational method.

E. Beginning at the highest elevation, compute the flow to be carried by each line. The time of concentration for each line other than the first in a series is the sum of the time of concentration to the inlet next upstream and the flow time in the connecting pipe. Where more than two lines meet, the time of concentration to be used for the succeeding line is the longest

time in the lines meeting. Each line will thus require calculation of time of concentration, tributary area (all upstream areas), and flow.

F. Select tentative pipe sizes and grades using the Manning Formula. Each line must be selected in order since the time of concentration for subsequent lines will be dependent upon the time of flow in all upstream lines.

G. Minimum cover requirements specified by ASTM specifications must be met.

H. 606 Figure - Computation for Storm Sewer Design, may be used for storm sewer calculation. Other methods including ODOT CDSS, Hydraflow, and other computer programs are acceptable methods as long as they follow the same methodology described above.

I. Regardless of the format, the supplied calculations are to include the 10-year design capacity and 25-year Hydraulic Grade Line Calculations.

606 Figure – Computation for Storm Sewer Design

COMPUTATION FOR STROM SEWER DESIGN																
Manning Formula: n_____ Project: _____ Date: _____ Sheet: _____																
Manhole No.	Begin/ End Sta.	Δ "A"	"C"	Δ "CA"	Sum "CA"	Δ "T"	Sum "T"	"I" __YR	"Q" Disch __YR	"Q" Disch __YR	"L" Ft.	Slope Ft./Ft.	Pipe Dia. In.	"V" FPS	CAP CFS	Flow Line Elev. Inlet/ Outlet

* If this sheet is used, additional calculations must be provided to confirm the 25-year hydraulic grade line is accomplished.

607 Minimum Diameter

The minimum diameter of storm sewer pipe must be 12 inches. The diameter must be increased as necessary according to the design analysis.

608 Minimum Cover

The minimum cover over storm sewer pipe must be 2 feet unless otherwise approved by a City representative. Cover is measured from the top of pipe to the finished grade directly above the pipe. Required cover may be greater for plastic pipe due to floating. Follow manufacturer's recommendations for required pipe depth based on size when using plastic pipe.

609 Minimum Slope

The minimum recommended slope for storm sewers must be 0.10 foot per 100 feet, unless a greater slope is required to obtain the minimum mean velocity. Culverts may be installed on flatter grades as approved by a City representative.

610 Minimum Velocity

The absolute minimum mean velocity for all storm sewers must be 2.0 feet per second when flowing full based on Manning's Formula using an "n" value of 0.013. Use of other "n" values will be considered if deemed justifiable on the basis of extensive field data. The desirable minimum velocity is 3.0 feet per second based on the same criteria.

611 Maximum Velocity

The maximum velocity of all storm sewers must be 10 feet per second. If the velocity is greater than 10 feet per second, provisions should be made to protect against displacement and erosion of the pipe.

612 Maximum Headwater

The maximum allowable headwater depth for culverts must be 2 feet below pavement surfaces and/or finish floor elevations for culverts draining greater than 1,000 acres. Maximum allowable depth must be 1 foot below pavement for culverts draining less than 1,000 acres.

613 Manholes

Manholes must be installed at the end of each line, at all changes in grade, size, alignment, and at all pipe intersections. Manholes must be installed at distances not greater than 400 feet. Intervals of more than 400 feet may be approved in sewers 42 inches and larger.

Manholes may be either poured in place or precast concrete. Concrete construction must conform to ASTM C-478.

The flow channel through manholes are required to be made to conform in shape, slope, and smoothness to that of the sewers.

All manhole covers must be adjusted to grade by the use of no more than 12 inches of precast adjusting collars.

Manholes must be consistent with those shown in the standard drawings.

614 Manhole Minimum Diameter

Manholes must be constructed large enough to allow access to all sewers. The minimum diameter of manholes must be 48 inches. Where large sewers require the use of manholes diameters greater than 48 inches, the manhole must be returned to the 48-inch diameter as soon as practical above the sewer crown. Manhole openings of 24 inches or larger are recommended for easy access with safety equipment and to facilitate maintenance.

615 Catch Basins

Curb inlets must be placed at all low points, points of change to a flatter street grade, the dead end of descending streets, and at the Point of Curvature and Point of Tangency of all intersection radius curves where the street grade descends toward the radius curve and at all intersections. The basis for the design and spacing of curb inlets must conform to the most recent version of the Location and Design manual, Volume 2, Drainage Design.

Under normal conditions, curb inlets must be placed on both sides of the street at intervals indicated by the street grade. Approximate spacing ranges from 150 feet to 300 feet maximum under normal conditions for the spread of flow-in gutters.

Catch basins not placed in the street must be selected and placed so that they blend with the surrounding and not appear unsightly.

Curb inlets must be placed on the property lines if at all possible.

Catch basin types must be consistent with the types shown in the standard drawings.

Maximum catch basin depth to be 5’ unless otherwise approved.

616 Basis of Culvert Design

The basis of design for street and roadway culverts must be the Ohio Department of Transportation's Location and Design Manual, Volume Two, Drainage Design.

Hydraulic analysis of culverts may also be performed utilizing Hydraulic Design Series No. 5, Hydraulic Design of Highway Culverts, Federal Highway Administration and Computer Program HY-8 or similar program.

Design must be based on a 25-year storm for full flow capacity and an overtopping capacity of at least a 100-year storm.

Culvert flow type must be determined for each culvert design. There are two types of culvert flow: Inlet Control and Outlet Control. This must be determined to help ensure proper culvert design.

Maximum allowable headwater must be 2 feet below the low edge of the pavement for culverts draining greater than 1,000 acres. Maximum allowable headwater must be 1 foot below when draining less than 1,000 acres. However, the designer should generally limit the maximum 100-year headwater depth to twice the diameter or rise of the culvert.

Tailwater conditions must also be analyzed for all culverts. In some locations, a high tailwater will control the operation of the culvert. This condition can greatly affect the capacity and headwater of the culvert and must be checked to help determine upstream design storm and storm water elevations.

617 Open Drainage Ditches

The basis of design for drainage ditches shall be the Manning Formula, as defined in Section 605. Table 618 may be used to determine the value of "n," Manning's Roughness Coefficient, to be used in the calculations. These calculations of open ditch capacity should be provided to the reviewing agency along with the construction drawings.

618 Table – Channel Material

Channel Material	**n**
Vitrified clay	0.014
Cast iron pipe	0.015
Smooth earth	0.018
Firm gravel	0.023
Corrugated metal pipe	0.022
Natural channels in good condition	0.025
Natural channels with stones and weeds	0.035
Very poor natural channels	0.060

619 Channel Protection

Channel protection material must be placed at pipe outlets and other areas of high velocity flow to prevent erosion. The type, location, and depth of the protective material must be reviewed and approved by the City.

620 Storm Water Detention Basin/Retention Pond Size Requirements

It is recognized that the outlets for storm water runoff in the City are very limited. These outlets do not have the capacity to receive and convey the increased runoff resulting from rapid development around the City.

Developers/Owners must participate in providing detention storage to eliminate the excessive runoff during heavy storm periods. Where impervious areas are planned or contemplated, it is the intent that detention be provided as required by the provisions hereinafter set forth. It is proposed that well maintained landscaped areas would be provided to act jointly as detention reservoirs and recreation facilities as aesthetic focal points in new developments. Other control methods to regulate the rate of storm water discharge that may be acceptable include detention on parking lots, streets, lawns, underground storage, oversized storm sewers with restricted outlets, etc. However, these methods must be approved by City officials.

It is recognized that in order to better serve the long-range interests of the City and the surrounding area, comprehensive basin-wide planning for runoff control is required to be formulated, adopted, and implemented. Comprehensive planning is far more beneficial than small, on-site detention areas, although on-site detention does provide protection and is acceptable for compliance.

Detention of storm water must be required for all developments and proposed development which would alter storm runoff as to flow, velocity or time of concentration. The City reserves the option to require more stringent detention requirements than what is listed below based upon the estimated capacity of the existing storm sewers. All calculations must be submitted to the City for approval.

Calculations must include a profile of the existing storm sewer from the proposed connection point to a point 500 feet downstream or the first outfall structure nearest to or beyond the required 500 feet.

The calculated full flow capacity of the existing storm water outfall must also be provided.

Design of storm water detention facilities must be based on the following:

A. Any increase in the volume of site surface drainage water resulting from accelerated runoff caused by site development must be controlled so that the post development peak discharge rate does not exceed that of the pre-development peak discharge rate, for all 24-hour storms between a one-year frequency and the critical storm frequency as determined below. The method by which an applicant must determine changes in rates and volumes of runoff is presented in the US Department of Agriculture, Engineering Division of the Soil Conservation Service, Urban Hydrology for Small Watersheds, Technical Release No. 55, June 1986 or most current edition. To find the critical storm frequency for which additional control will be needed, the applicant must:

    1. Determine the percent increase in runoff volume for a one-year frequency, 24-hour storm occurring on the development area.

    2. Determine the critical storm frequency for which additional control is needed by using the percent increase in runoff volume; see 621 Table.

    3. Control the post development storms of a frequency between one year and the critical storm determined in (2), so as to be equal to or less than the pre-development peak runoff rate for a 24-hour one-year frequency storm.

B. Storms of less frequent occurrence (longer return periods) than the critical storm up to the one-hundred-year storm have peak runoff rates no greater than the peak runoff rates from equivalent size storms under pre-development conditions. Consideration of the one, two, five, ten, twenty-five, fifty, and one hundred-year storms must be considered adequate in designing and developing to meet this standard. It must also be considered when out letting into an existing storm system what the capacity of the downstream system.

Critical Year Storm Calculations:

$$\frac{(1\ year\ Post - 1\ year\ Pre)}{1\ year\ Pre} \text{ x } 100\%$$

621 Table – Critical Storm

Determining Storm Frequency for Which Control is Needed		
Percent Increase in Runoff Volume From a 1 Year Frequency 24 Hour Storm		
Equal or greater than (percent)	Less than (percent)	Storm Frequency (years)
-	10	1
10	20	2
20	50	5
50	100	10
100	250	25
250	500	50
500	-	100

All post-construction stormwater management systems must be designed in accordance with OEPA Permit OH000005, or most recent version, post-construction storm water management requirements to take into account water quality volume and draw down requirements.

The post construction requirements of the OEPA Construction Permit, OHC000005 must be made part of these regulations. The City of Brookville must be responsible for reviewing the current permit. In subsequent construction parts of the reissued or revised permit must take precedence. Any revision in the plan needs to be reviewed by the City.

An emergency overflow from the basin to a major storm system must be provided to protect the facility and adjacent properties. The designer should investigate the capacity of the downstream drainage facilities to determine if they will be adequate to handle the design flow from this particular development. If the downstream facilities are inadequate, it may be necessary to provide additional on-site retention or ponding basins to limit the flow to an amount which the downstream system can accept.

Emergency overflow weir must be sized to be able to outlet the 100-year post site runoff amount.

There must be 1' of free board provided from the 100-year water surface elevation to top of basin elevation.

622 Detention Basin/Retention Pond Guidelines

A. Recommendations for Dry Detention Basins

1. Where water quality during dry weather periods in a small basin would be a potential problem due to lack of adequate dry weather flow, direct pollution from surface water runoff, or high nutrients in the flow; the basin should be designed to remain dry except when in flood use.
2. Dry detention basins must be designed to minimize the wetness of the bottom so that water does not remain standing in the bottom; thereby harboring insects and limiting the potential use of the basin. If possible, 2% slope across bottom of detention basin must be maintained from inlet to outlet. If 2% is not possible, 1% minimum slope must be used.
3. The detention basin should be designed to have a multi-purpose function. Recreational facilities, aesthetic qualities, etc., as well as flood water storage should be considered in planning the basin.
4. Side slopes must be 3 to 1 or flatter.
5. There must be a minimum of a 3-foot berm at 2 percent between right-of-way and top basin slopes.

B. Recommendations for Basins Containing Permanent Water

1. In order to provide better management for water quality, retention basins containing permanent lakes should have a water area of at least one-half acre. The lake area should be an average depth of 5 feet to inhibit weed and insect growth and should have no extensive shallow areas. A system to augment storm flows into the lake with water from other sources should be provide to enhance the water quality, if necessary. These systems would include the use of public water supplies or wells on site.

2. In excavated lakes, the underwater side slopes in the lake should be stable.

3. A safety ledge 4 to 6 feet in width is recommended and should be installed in all lakes approximately 18 to 24 inches below the permanent water level to provide a footing if people fall into the water. In addition, there must be a minimum of a 5-foot berm at 2 percent slope beginning at least 1 foot above normal pond elevation. The slope between two ledges should be stable and of a material which will prevent erosion due to wave action (see Figure 623). Walkways consisting of a non-erosive material should be provided in areas where extensive population use tramples growth. One area in particular would be along the shoreline of a heavily fished lake. Side slopes above the berm must be 3 to 1 or flatter.

4. See Figure 623 for side slope requirements.

5. To obtain additional recreational benefits from developed water areas and provide for insect control, ponds may be stocked with fish. For best results, stocking should follow recommendations for warm water sport fishing by the Ohio Department of Natural Resources, Division of Fisheries, or similar organizations.

6. Periodic maintenance will be required in lakes to control weed and larval growth. The basin should also be designed to provide for the easy removal of sediment which will accumulate in the lake during periods of basin operation. A means of maintaining the designed water level of the lake during prolonged periods of dry weather is also recommended. One suggested method is to have a water hydrant near the pond site.

7. Rubble or construction refuse may not be disposed of at any time.

8. No pond with a permanent water elevation must be placed within one mile of a runway approach or landing approach to an airport.

C. Recommendations Common to Either Dry Detention Basins or Retention Basins with Permanent Water

1. A 20-foot-wide City easement must be provided for access to all storm water storage ponds.

2. All basins must have an emergency overflow weir sized to discharge the 100-year post inflow from the site.

3. All excavated spoils should be spread so as to provide for aesthetic and recreational features such as sledding hills, sports fields, etc. Slopes of 6 horizontal to 1 vertical are recommended except where recreation uses call for steeper slopes. Even these features should have a slope no greater than 3 horizontal to 12 vertical for safety, minimal erosion, stability, and ease of maintenance.

4. When conduits are used for the outlet of the reservoir they must be protected by bar screens as approved by the City or other suitable provisions so that debris or similar trash will not interfere with the operation of the basin.

5. Safety screens should also be provided for any pipe or opening to prevent children or large animals from crawling into the structures. For safety, a suggested maximum opening is 6 inches.

6. Grass or other suitable vegetative cover should be maintained throughout the entire reservoir area. Grass should be cut regularly no less than five times a year or in accordance with the appropriate City ordinance, whichever is stricter.
7. Debris and trash removal and other necessary maintenance should be performed after each storm to assure continued operation in conformance to the design.

D. Detention Basin Ownership

1. Detention basin maintenance and ownership must remain private unless the City accepts ownership through approval by the City Council.
2. Owners will be responsible for routine maintenance of the any of the development's detention basin located on their individual lots. Grass mowing, ornamental landscaping, and fencing are considered routine maintenance. No activity which will interrupt the operation of the detention basin will be allowed. No accessory buildings or gardens will be permitted. The City will be responsible for major erosion control and fixed structures such as piping, manholes, and inlets. This statement shall be added to each deed of transfer.

E. Inspection of Basins

1. Record drawings will be required for all basins to assure compliance with all applicable requirements.
2. The City may inspect all private detention basins and if problems exist, and report these to the owner. The owner shall be given a reasonable amount of time to correct the problem, weather permitting.
3. The City shall perform such work as it deems necessary and charge the owner if the owner fails to correct the problem.

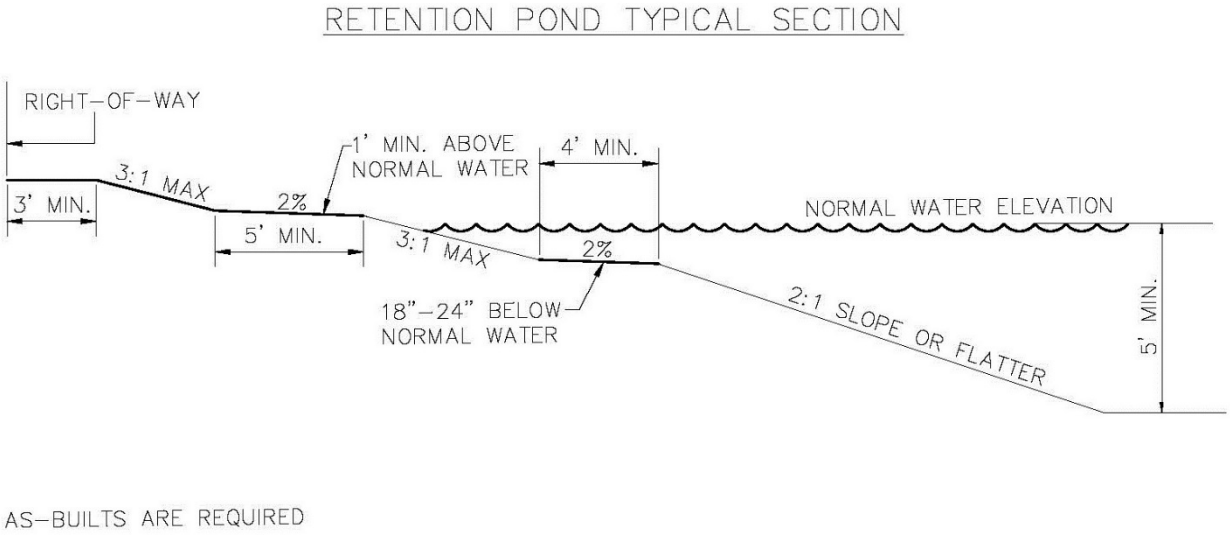
F. Submerged Outlets

Submerged outlets may be permitted provided a manhole is constructed between the outlet at the retention pond and the main storm system. This manhole must also be after the last pavement crossing. The invert elevation of the pipe into this manhole will be at least 1 foot above the normal pool elevation. The slope of the basin at the outlet shall be no flatter than 2:1 to avoid siltation at the outlet. The manhole shall have a grated casting or, in some cases, may require being a manhole with a catch basin with windows frame and top.

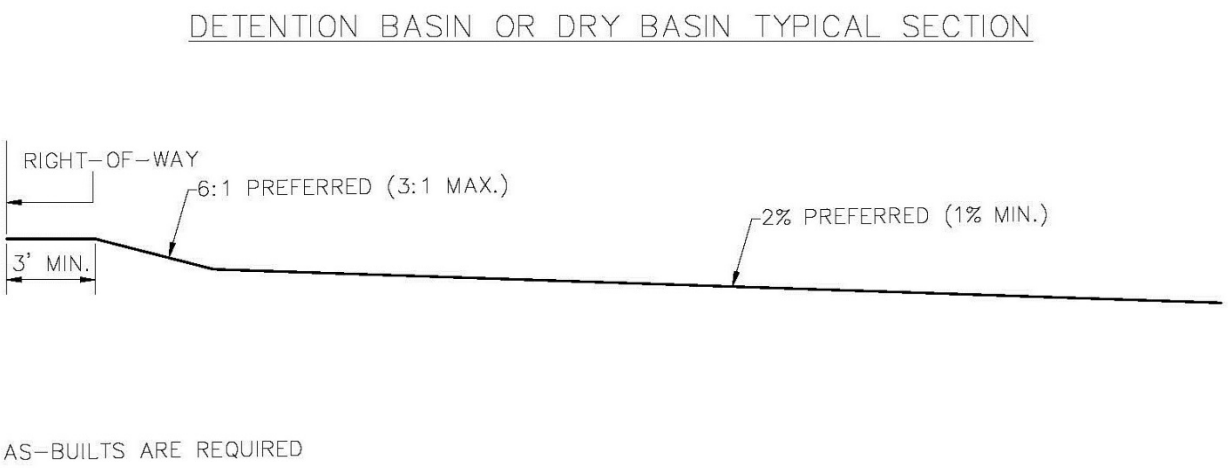
G. Outlet Material

Outlet structure materials shall be reinforced concrete and/or RCP pipe. Stainless steel plates shall be used if orifice size is smaller than available RCP sizes.

623 Figure - Retention Pond



624 Figure - Detention Basin or Dry Basin



625 Flood Routing Path

A. Capacity

The flood routing path is that part of the major storm drainage system that carries the runoff that exceeds the capacity of the designed drainage facilities. The major storm drainage system shall have the capacity to carry runoff from a storm with a return period of not less than 100 years without causing significant threat to property or public safety.

B. Surface Flood Routing Paths

Generally, it is not economically feasible to size a storm sewer system to collect and convey more than the frequent storm runoff. Essentially, the complete drainage system of an urban area contains two separate drainage elements. While the storm sewers belong to the initial system, surface drainage ways must be provided for the major flow from more intense storms.

C. Intent in Providing Flood Routing Paths

The intent of planning for the major drainage element is to ensure storm water runoff which exceeds the capacity of the initial drainage system has a route to follow which will not cause a major loss of property or any loss of life. It should be remembered that the major drainage system exists even when it is not planned for and whether or not development exists in respect to it.

D. Street Rights-Of-Way

Street rights-of-way are common choice for conveying major drainage flows. Such use must be anticipated when the street layout is established. Side and rear lot lines offer one alternative to the street. The problem with this alternative is the possibility of individual property owners encroaching on the major drainage easement. Rarely is the problem recognized until the frequent rainstorm occurs and the major system fails to operate properly.

Where the street is designated as the major drainage way, the depth of flow must not exceed 12 inches at the gutter line for local and collector streets and the crown for arterial streets. The same maximum depth criteria will apply where a major drainage way crosses the street. Where a major drainage way is located outside a street right-of-way, easements must be provided. All major storm routing easements must be shown on the grading plan.

E. Multi-Purpose Flood Routing Paths

In order to protect the integrity of the non-street drainage rights-of-way, the owner/developer's engineer is encouraged to design flood routing paths for multi-purpose functions. Pedestrian and bicycle paths lend themselves naturally to this application. Linear parks aligned along the major drainage corridor are also very effective, but usually require greater width than would normally be necessary for drainage purposes.

F. Major Storm Runoff

The major storm runoff is routed through the drainage system to determine if the combined capacity of the flood routing path and storm sewer system is sufficient.

626 Site Grading

A. Site Grading Plan

Site grading plans must be prepared with 1 foot existing and proposed contours showing all lots or lots having proper drainage. Site grading plans for developments must also have proposed building pad elevations to ensure proper drainage of the development. Individual site plans within a development must conform to the subdivision drainage site plan.

B. Cuts and Fills

No land must be graded, cut, or filled so as to create a slope exceeding a vertical rise of 1 foot for each 2 ½ feet of horizontal distance between abutting lots, unless a retaining wall of sufficient height and thickness is provided to retain the graded bank. Major cuts, excavation, grading, and filling, where the same material changes the site and its relationship with surrounding areas, must not be permitted as such excavation, grading, and filling will result in a slope exceeding a vertical rise of 1 foot for each 2 ½ feet of horizontal distance between abutting lots or between adjoining tracts of land, except where adequate provision is made to prevent slides and erosion by cribbing and retain walls.

C. Compaction of Fill

All fill must be compacted to a dry density of 98% standard proctor or greater. Inspection of fill must be conducted by a City representative. The City may require the developer, at the developer's cost, to have the fill material tested by an approved testing laboratory.

D. Retaining Walls

Retaining walls may be required whenever topographic conditions warrant or where necessary to retain fill or cut slopes within the right-of-way. Such improvements require the approval of the City.

E. Filling of Existing Areas

No existing area must be filled or graded to adversely affect adjoining properties as determined by a City representative.

627 Responsibility for Maintenance of Private Storm Water Facilities and Drainage on Private Property

A. Any owner or possessor of private property upon which storm water drainage facilities, whether man-made or natural, exist for the purpose of collecting, conveying, retaining, or detaining storm water within that property and which are not public facilities, must be responsible for the maintenance of these facilities to ensure proper operation.

B. The City must not be responsible for resolving drainage problems on private property where such problems pose a nuisance, do not impact the operation of the overall storm water management system of the City, or do not involve the function of public facilities. Private property owners bear the responsibility to remedy these types of problems.

C. The City may cooperate with private property owners to extend public facilities of the storm water management system to the private property, to enable the resolution of these drainage problems if the City Council decides that suitable resources are available, the project can be accommodated within the context of the City's overall Capital Improvement Plan, and the City determines that the City's storm water management system is capable of handling any additional flows that may be placed in the system as a result of implementing the proposed solution.

628 Runoff from Upstream Drainage Areas

The runoff from drainage areas upstream of the proposed development or improvement must be provided with an unobstructed outlet and an emergency overflow. The outlet should provide the capacity needed to carry the runoff from a 10-year storm in its existing land use condition.

629 Runoff onto Contiguous Properties

All site drainage must be contained on-site. No land altering activity must disperse runoff into areas adjacent to the area experiencing development.

630 Soil Sediment Pollution Control Regulations

All items below must be in accordance with OEPA Stormwater construction general permit No. OHC000005, or most up-to-date permit. If any discrepancies are seen between this section and OEPA permit, the OEPA permit governs.

The purpose of the regulation is to prevent the undue polluting of public waters by sediment from accelerated soil erosion and accelerated storm water runoff caused by earth-disturbing urban areas. Control of such pollution will promote and maintain the health, safety and general well-being of all life and inhabitants in the City.

A. Scope

This must apply to earth-disturbing activities on areas of land used or being developed for commercial, industrial, residential, recreational, public service, or other non-farm purposes that are within the City unless otherwise excluded within or unless expressly excluded by state law.

B. Disclaimer of Liability

Neither submission of a plan under provisions of this article nor compliance with provisions of these regulations must relieve any person from responsibility for damage to any person or property otherwise imposed by law, nor imposed any liability upon the City or its appointed representative for damage to any person or property.

C. Severability

If any clause, section, or provision of this resolution is declared invalid or unconstitutional by a court of competent jurisdiction, validity of the remainder must not be affected thereby.

D. Requirements

No person will cause or allow earth-disturbing activities on a development area except in compliance with the standards and criteria and the applicable item listed below:

1. When a proposed development area consists of one or more acres and earth- disturbing activities are proposed for the whole area or any part thereof, the responsible person must develop and submit for approval a Storm Water Pollution Prevention Plan (SWPPP) prior to any earth-disturbing activity. Such a plan must contain sediment pollution control practices and must comply with and adhere to OEPA construction general permit No. OHC000005 or most up-to-date permit.
2. When a proposed development area involves less than 1 acre, it is not necessary to submit a SWPPP. All earth-disturbing activities must be subject to surveillance and site investigation to determine compliance with the standards and regulations.

E. Standards and Criteria

In order to control sediment pollution of water resources, the owner or person responsible for the development area must use conservation planning and practices to maintain the level of conservation established by one or more of the following standards:

1. Timing of Sediment-Trapping Practices - Sediment control practices must be functional throughout earth-disturbing activity. Settling facilities, perimeter controls, and other practices intended to trap sediment must be implemented as the first step of grading and within seven (7) days from the start of earth disturbing activities. They must continue to function until the upslope developed area is restabilized.
2. Stabilization of Denuded Areas - Denuded areas must have soil stabilization applied within seven (7) days if they are to remain dormant for more than forty-five (45) days. Permanent or temporary soil stabilization must be applied to denuded areas within seven (7) days after final grade is reached on any portion of the site, and must also be

applied within seven (7) days to denuded areas which may not be final grade, but will remain dormant (undisturbed) for longer than forty-five (45) days.

3. Settling Facilities - Concentrated storm water runoff from denuded areas must pass through a sediment-settling facility. The facility's storage capacity must be 67 cubic yards per acre of drainage area.
4. Sediment Barriers - Sheet flow runoff from denuded areas must be filtered or diverted to a settling facility. Sediment barriers such as sediment fence or diversions to settling facilities must protect adjacent properties and water resources from sediment transported by sheet flow.
5. Storm Sewer Inlet Protection - All storm sewer inlets which accept water runoff from the development must be protected so that sediment-laden water from soils that are not permanently stabilized will not enter the storm sewer system without first being filtered or otherwise treated to remove sediment, unless the storm sewer system drains to a settling facility.
6. Working in Crossing Streams
    a. Streams including bed and banks must be restabilized immediately after in-channel work is completed, interrupted, or stopped. To the extent practicable, construction vehicles must be kept out of streams. Where in-channel work is necessary, precautions must be taken to stabilize the work area during construction to minimize erosion.
    b. If a live (wet) stream must be crossed by construction vehicles regularly during construction, a temporary stream crossing must be provided.
7. Construction Access Routes - Measures must be taken to prevent soil transport onto surfaces where runoff is not checked by sediment controls, or onto public roads.
8. Sloughing and Dumping
    a. No soil, rock, debris or any other material will be dumped or placed into a water resource or into such proximity that it may readily slough, slip, or erode into a water resource unless such dumping, or placing is authorized by the approving agency, and, when applicable, the U.S. Army Corps of Engineers, for such purposes, including but not limited to, constructing bridges, culverts, and erosion control structures.
    b. Unstable soils prone to slipping or land sliding will not be graded, excavated, filled or have loads imposed upon them unless the work is done in accordance with a qualified professional engineer's recommendations to correct, eliminate, or adequately address the problems.
9. Cut and Fill Slopes - Cut and fill slopes must be designed and constructed in a manner which will minimize erosion. Consideration must be given to the length and steepness of the slope, soil type, upslope drainage area, groundwater conditions and slope stabilization.
10. Stabilization of Outfalls and Channels - Outfalls and constructed or modified channels must be designed and constructed to withstand the expected velocity of flow from a post-development 10-year frequency storm.

11. Establishment of Permanent Vegetation - A permanent vegetative cover must be established on denuded areas not otherwise permanently stabilized.

12. Disposition of Temporary Practices - All temporary erosion and sediment control practices must be disposed of within thirty (30) days after final site stabilization is achieved or after the temporary practices are no longer needed, unless otherwise authorized by the approving agency. Trapped sediment must be permanently stabilized to prevent further erosion.

13. Maintenance - All temporary and permanent erosion and sediment control practices must be designed and constructed to minimize maintenance requirements. They must be maintained and repaired as needed to assure continued performance of their intended function. The person or entity responsible for the continued maintenance of permanent erosion controls must be identified to the satisfaction of the approving agency.

The standards are general guidelines and must not limit the right of the approving agency to impose additional, more stringent requirements, nor will the standards limit the right of the approving agency to waive individual requirements.

Erosion and sediment control practices used to satisfy the standards must meet the specifications in the current edition of Ohio Rainwater and Land Development Manual.

F. Maintenance

The property owner must assume responsibility for maintenance of structures and other facilities designed to control erosion.

631 Drainage Easement Criteria

A. An adequate easement must be required along any subsurface drainage tile, detention basin, drainage way, ditch, watercourse, stream, or storm sewer that is not already within the street right-of-way. The easement must be of sufficient width to allow cleaning, widening, deepening, and replacing or otherwise general maintaining of such drainage course.

Easements for flood routes (100-year) must be established to 1 foot above the 100-year storm elevation.

B. When it is required to convey subsurface drainage or surface water outside the limits of the proposed improved area in order to discharge into an approved adequate outlet, it must be the responsibility of the Developer to obtain easements or rights-of way for construction and maintenance of said drainage course.

C. All drainage easements must be shown on the final plat and the "Final Engineering and Construction Plan." The drainage easements must be recorded for public use, and the maintenance of such drainage courses must be the responsibility of the property owners receiving direct benefit therefrom, unless otherwise provided. Drainage easement widths must conform to the following 632 Table.

D. Where no direct access is provided to a drainage feature, an adequate access easement must also be provided. The minimum width of any such easement must be 15 feet.

632 Table – Minimum Permanent Easement Width for all Storm Sewers

Depth (Feet)	Total Min. Width	*Min. Dist. C.L. Offset	Total Min. Width	*Min. Dist. C.L. Offset	Total Min. Width	*Min. Dist. C.L. Offset	Total Min. Width	*Min. Dist. C.L. Offset
	12-inch		15-inch		18-inch		21-inch	
2	25	10	--	--	--	--	--	--
3	30	11	30	12	30	12	30	12
4	30	12	30	12	30	12	30	12
5	30	12	30	12	30	12	30	12
6	30	12	40	12	40	12	40	12
7	40	12	40	12	40	12	40	12
8	40	12	40	12	40	12	40	12
9	40	12	40	12	40	12	40	12
10	40	12	40	13	45	13	45	13
	24-inch		27-inch		30-inch		36-inch	
3	30	12	--	--	--	--	--	--
4	30	12	30	12	30	12	30	13
5	30	12	40	12	30	12	40	13
6	40	12	40	13	40	12	40	13
7	40	12	40	13	40	13	40	13
8	40	13	40	13	40	13	40	13
9	40	13	45	13	45	13	45	13
10	45	13	45	13	45	13	45	13
11	45	13	45	13	45	13	45	13
	42-inch		48-inch		54-inch		60-inch	
5	35	13	35	13	--	--	--	--
6	35	13	35	13	35	14	35	14
7	35	13	35	13	35	14	35	14
8	45	13	45	14	45	14	45	14
9	45	14	45	14	45	14	45	14
10	45	14	45	14	45	14	45	14
11	45	14	45	14	55	14	55	15
12	55	14	55	14	55	14	55	15

* Minimum distance from centerline of pipe to either side of easement. Table values are in feet unless otherwise noted.

ARTICLE 8 WATER DISTRIBUTION

801 General

The following Design Criteria are summarized herein to establish practical, uniform design of water distribution systems for the City. These criteria cover design factors and provides guidelines for evaluation of plans and specifications by the City departments having jurisdiction over the review of plans and specifications. These Design Criteria are also intended to conform to the standard drawings for water systems. All improvements to the water distribution system must be coordinated with a City representative and the Superintendent of the Service Department.

802 Basis of Design

The basis of design for water distribution systems must be the Hazen-Williams Equation, an empirical formula for estimating pipe flow:

$$V = 1.318CR^{0.63}S^{0.54}$$

V = Velocity in feet per second
C = Roughness Coefficient
R = Hydraulic Radius (pipe diameter in feet for pipes flowing full) in feet
S = Head loss per unit length of pipe

Distribution systems must be designed for the estimated maximum day rate of flow, or the fire flow plus the estimated average day rate of flow, whichever is more demanding. Selection of a roughness coefficient must be coordinated through a City representative.

803 Minimum Pressure

The minimum desirable pressure in the water distribution system, at times of no fires, must be 50 pounds per square inch in all mains and 8 pounds per square inch at the most remote house fixture in the system. The minimum fire flow for design purposes must be 600 gallons per minute at a residual pressure of 20 pounds per square inch.

804 Maximum Velocity

The maximum velocity of the water in the system is 10 feet per second.

805 Water Mains

The value of C to be used in the Hazen-Williams Equation must be C=130. The minimum size of water mains must be 8 inches in diameter. Dead-ending mains must be minimized by looping of all mains. In the event the City permits a dead-end, a fire hydrant for flushing purposes shall be provided.

The minimum depth of water mains must be 4 feet 6 inches from the top of the pipe to the finished grade elevation. The maximum depth of water mains is 6 feet from the top of the main to the finished grade elevation, except where utilities must be underpassed or as directed by the City.

806 Water Service Lines

The value of C to be used in the Hazen-Williams Equation must be C = 130. The minimum diameter of service lines must be ¾ inch, unless the distance from the main to the meter exceeds 120 feet, where the minimum service line diameter must be 1 inch.

807 Table lists required minimum service sizes as determined by residential population. Fire hydrant services must have a minimum diameter of 6 inches but must be no larger than the water main. For all ¾ through 2 inch services, a corporation stop must be installed on the main at a 45 degree angle above horizontal. For services larger than 2 inches, a tapping sleeve and valve must be installed.

807 Table - Minimum Size Water Services and Meters Residential Areas

No. of Families	Service Size (inches)	Meter Size (inches)
1	1	5/8 x 3/4
2-5	1	1
6-8	1 ½	1 ½
9-12	2	1 ½
13-20	2	2
21-50	4	3
51-115	4	4

808 Meter Installation

When not completed by the City Water Department, meter installation for individual services must be consistent with the Standard Drawings. 809 Table lists required meter sizes as determined by Maximum Flow Demand for Commercial-Industrial applications. Meters must be installed prior to connecting the service to the main and before service starts. No common meters will be approved. All plans must indicate meter and service stop location with a note stating, “Locations must be coordinated with City Water or Engineering Staff.”

809 Table – Meter Size for Commercial – Industrial Application

Maximum Flow Demand (GPM)	Meter Size (inches)
20	5/8 x 3/4
30	3/4
50	1
100	1 ½
160	2
320	3
500	4
1000	6

810 Backflow Prevention

All commercial, industrial, and other OEPA required users must provide adequate backflow prevention between the public water system and the customer's system. These devices must be approved by OEPA and the City of Brookside prior to construction and installation. These devices must be tested and inspected annually under the supervision of the Water Superintendent or the designee and paid for by the owner of the property. These devices must be repaired or replaced if they do not meet the testing requirements. An annual report must be submitted by a licensed plumber in the State of Ohio to the City of Brookville detailing the testing procedures and results.

811 Booster Pumps

Booster pumps will not be installed on service connections for residential properties. Commercial and industrial properties may have booster pumps installed on service connections after seeking prior approval from the City and clearly documenting the need for such a device.

Booster pumps must not be installed unless the pump is equipped with a low-pressure cutoff designed to shut off the booster pump per OEPA requirements. These devices must be tested and inspected annually and an annual report must be submitted to the City detailing the testing procedure and the results.

812 Fire Hydrants

Fire hydrants must be placed at all intersections and never more than 500 feet apart.

Fire hydrants must be installed with a break flange located approximately 2 inches above the ground level to protect-against flooding in case of impact to hydrant. Fire hydrants must be consistent with the standard drawings.

A valve must be installed on all fire hydrant service lines. All connections between the main and the hydrant must be restrained by anchoring pipe, tie bolts or retainer glands.

813 Valves

Valves must be located at all branches of a cross and tee-intersections, and at intervals not to exceed 800 feet in residential districts and 500 feet in high value districts.

814 Tracer Wire

All water main and water services must be installed with tracer wire per the most recent version of the City of Brookville Standard Construction Drawing.

ARTICLE 9 SANITARY SEWERS

901 General

The following Design Criteria are summarized herein to establish practical, uniform design of sanitary sewers within the City of Brookville. These criteria cover design factors and approved guidelines for evaluation of plans and specifications by the City departments having jurisdiction over the review of plans and specifications. These design factors are consistent with the requirements of the OEPA. If these Design Criteria should conflict in the future with the requirements of the OEPA, these criteria must be modified to conform to their requirements. These Design Criteria are also intended to conform to the City Standard Drawings for sanitary sewers.

902 Basis of Design

The basis of design must be the Manning Formula. This is used to calculate the capacity of a pipe flowing full:

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

Q = Flow in cfs
A = Area of cross section – square feet
n = Coefficient of roughness (n = 0.013)
R = Hydraulic Radius – feet
S = Slope in ft/ft

903 Maximum Depth of Flow

Recommended design practices limit the depth of flow in a sanitary sewer. The maximum depth of flow should be equal to or less than 0.8 of the diameter of the pipe.

904 Average Daily Flow

The average daily flow must be 100 gallons per capita per day and includes normal infiltration.

905 Population Density

The average household consists of 4 persons. Therefore, for design purposes, there would be 4 capita per equivalent single-family dwelling.

906 Peak Design Flow

Sanitary sewers must be designed on a peak design flow basis using one of the following methods:

A. The ratio of peak average flow (ADF).
B. Values established from the infiltration/inflow study approved by the OEPA.
C. Values obtained from the flow records of a similar facility over a period of time sufficient to establish with a reasonable degree of reliability the relationship between average dry weather flow and peak design flow.
D. Peak flows as determined by the Great Lakes Upper Mississippi River Board (GLUMRB) (Ten States Standards), latest version.

Use of other values for peak design flow will be considered, if justified, on the basis of extensive documentation.

907 Suggested Sewage Flow Guide

Must use most recent version of OEPA Design Flow Requirements.

Place	Notes	Design flow (gpd)	Waste strength BOD5 (mg/l)
Airport	b, i, j, p, r, t	15 / employee 4 / parking space	200 to 280 [r, s, t]
Apartment	b, l	120 / bedroom	200 to 280 [r, s, t]
Assembly hall	a, i, j	15 / employee 3 / seat w/o kitchen facilities 7 / seat w/ kitchen facilities	200 to 280 [r, s, t]
Banquet hall	b i, j	15 / employee 3 / seat w/o kitchen facilities 7 / seat w/ kitchen facilities	400
Barber shop	i, j	80 / basin	200 to 280 [s]
Beauty shop, styling salon	i, j	200 / basin	200 to 280 [s]
Bowling alley	a, i, j, p	75 / lane	200 to 280 [r, s, t]
Car wash	i, u	Sewer Connection Required	
Campground or recreational park	a, i, j, m, n, p	30 / primitive camp site w/o showers; 60 / primitive camp site w/ showers; 60 / camp site w/o water hook-up; 90 / camp site w/ water hook-up	200 to 280 [r, s, t]
Church (less than 200 sanctuary seats)	a, h, j, k, o, p	3 / sanctuary seat w/o kitchen; 5 / sanctuary seat w/ kitchen	200 to 280 [r, s, t]
Church (greater than 200 sanctuary seats)	b h, j, k, o, p	5 / sanctuary seat w/o kitchen; 7 / sanctuary seat w/ kitchen	200 to 280 [r, s, t]
Coffee shop	a i, j	15 / employee 5 / seat	200 to 280 [r, s, t]
Convenience store (facility with gas sales must be designed for a minimum of 500 gallons / day)	a, d, i, j, p, q	15 / employee 5 / parking space 500 / pump island	200 to 280 [r, s, t]
Country, Sportsman or Gun Club	b i, j, m, n, o, p	50 / member	200 to 280 [r, s, t]
Dance hall	a, i, j, p	15 / employee 3 / patron w/o kitchen facilities 7 / patron w/ kitchen facilities	200 to 280 [r, s, t]
Daycare facility	a, i, j, p	35 / employee 10 / student	200 to 280 [r, s, t]
Dentist/Doctor office	i	35 / employee 10 / patient 75 / dentist or doctor	200 to 280 [s]

Dry cleaner	i	Contact OEPA District Office	200 to 280 [s]
Factory	i, q	25 / employee w/o showers; 35 / employee w/ showers	200 to 280 [r, s, t]
Food service operation/restaurant categories (as noted below)			
Ordinary restaurant (not 24 hrs)	c, i, j, p	35 / seat	400 to 600
24-hour restaurant	c, i, j, p	60 / seat	400 to 600
Restaurant along freeway	c, i, j, p	100 / seat	400 to 600
Tavern (very little food service)	c, i, j, p	35 / seat	400 to 600
Bar (full food service)	c, i, j, p	35 / seat	400 to 600
Curb service (drive-in)	c, i, j, p	40 / car space	400 to 600
Vending machine	c, i, j, p	100 / machine	400 to 600
Homes in subdivision	b, l	120 / bedroom	200 to 280 [r, s]
Hospital	b, i, j, p	300 / bed 35 / employee	200 to 280 [r, s, t]
Hotel or motel	a, i, j, p	100 / room	200 to 280 [r, s, t]
Institution (psychiatric hospitals, prisons, etc.)	b, i, j, p	100 / bed 35 / employee	300
Laundromat	i, q	15 / employee 400 / machine	200 to 280 [s]
Marina (restrooms & showers only)	a, i	20 / boat mooring or slip	200 to 280 [r, s, t]
Migrant labor camp	e, i, j, p	50 / employee	200 to 280 [r, s, t]
Mobile home park	b, i, j, p	300 / mobile home space	200 to 280 [r, s, t]
Nursing and rest homes	b, i, j, p	200 / bed 100 / resident employee 50 / non-resident employee	300
Office building	a, i, j, k	20 / employee	200 to 280 [r, s, t]
Playground or day park	a, i, k, p	15 / employee 12 / parking space	200 to 280 [s]
Retail store	a, i, j, p	15 / employee 12 / parking space	200 to 280 [r, s, t]
School	b, i, j, k, p, t	15 / employee 15 / pupil for elementary schools; 20 / pupil for junior and high schools; 85 / pupil for boarding schools	200 to 280 [r, s, t]
Service station or gas station	a, i, q	500 / pump island; 500 / service bay; minimum of 750	200 to 280 [r, s, t]

Shopping center	a, f, l, p, q	15 / employee 2 / parking space w/o food service 5/ parking space w/ food service	200 to 280 [r, s, t]
Swimming pool	a, i, m, n	5 / swimmer w/o hot showers 10 / swimmer w/ hot showers	200 to 280 [r, s, t]
Theater	a, i, j, p	5 / seat for indoor auditorium 10 / car for drive-in	200 to 280 [r, s, t]
Vacation cottage	b, i, j, p	50 / person w/o kitchen 75 / person w/ kitchen	200 to 280 [r, s, t]
Veterinarian office & animal hospital	f, i, j	15 / employee 100 / doctor 20 / run and cage	200 to 280 [r, s, t]
Youth and recreation camps	b, i, j, p	15 / employee for day camp 15 / camper for day camp w/ food 10 / camper for day camp w/o food 50 / employee for overnight camp 50 / camper for overnight camp	200 to 280 [r, s, t]

Notes:

Note a: Food service waste not included.

Note b: Food service waste included, but without garbage grinders.

Note c: Aeration tanks for these systems require forty-eight-hour detention periods. Garbage grinders not permitted.

Note d: Truck parking areas will require consideration for treatment of runoff at large truck stops.

Note e: Twenty gallons per day of a vault latrine is used for toilet wastes.

Note f: Assume manual hosing of dog runs and solids (food droppings, etc.) removal prior to hosing.

Note g: Year-round disinfection of all wastewater may be required before discharge to waters of the state or to any other surface or subsurface disposal systems.

Note h: Lower per seat estimate assumes a max of 1 church service per day, higher per seat estimate assumes a max of 3 church services per day. Weddings & funerals will be counted as services.

Note i: Non-domestic or industrial wastes are prohibited from being discharged to soil-based treatment systems.

Note j: Total capacity for number of persons should be confirmed by occupancy license or total occupancy capacity.

Note k: Higher flows will be estimated when showers are available.

Note l: Deviating from this estimated design flow will require the director's approval, prior to applicant submitting the permit to install.

Note m: Pools cannot discharge pool filter backwash into soil-based treatment systems.

Note n:	Pool de-watering is prohibited from discharging to soil-based treatment systems.
Note o:	Flow estimates do not consider daycare facilities. If a daycare is present, the flow requirements for a daycare facility must be included.
Note p:	An external grease trap is required for facilities with food service for OSTS.
Note q:	Assume 1 working shift of not more than eight hours. Assume higher flows for two or 3 shift operations.
Note r:	Assume no garbage grinder and normal domestic waste. If garbage grinders are present, the waste strength should be increased from twenty to sixty-five per cent.
Note s:	Data for regular strength waste range of 200 to 280 milligrams per liter was obtained from U.S. EPA's manual "Onsite Wastewater Treatment Systems Manual, February 2002 (EPA/625/R-00/008)."
Note t:	Waste strength should be twenty to 26 percent higher for facilities that include food service operations, such as cafeterias, service stations & for facilities that may handle pet wastes.
Note u:	Sewer connection is required for a car wash. Please contact your district office.

Note: For additional information, refer to OAC 3745-42-05

908 Minimum Velocity

All sanitary sewers must be designed to give a mean velocity of at least 2.0 feet per second, when flowing full, based on Manning's Formula using an "n" value of 0.013. Use of other "n" values will be considered, if deemed justifiable, on the basis of extensive field data.

909 Maximum Velocity

The maximum velocity must be 15 feet per second. If the velocity is greater than 15 feet per second, provisions should be made to protect against displacement.

910 Minimum Grades

All sanitary sewers must be designed to give a mean velocity of at least 2.0 feet per second when flowing full based on Manning's Formula. Values of "n" to be used with the Manning Formula vary from 0.010 to 0.015 with 0.013 recommended. Use of "n" values other than 0.013 may be considered, if justified. Use of formulas other than Manning's Formula may be accepted. If plans are recommended for approval with a slope less than the minimum, the consulting Engineer must show justification for the recommendation and obtain approval from OEPA. See 911 Table.

911 Required Minimum Slope

Based on "n" Value of 0.013 – plus 10% Sewer Sizes – 8 through 36 inches	
Sewer Size	Minimum Slope in Feet Per 100 Feet
8	0.44
10	0.31
12	0.24
15	0.17
18	0.13
21	0.11
24	0.088
27	0.074
30	0.064
36	0.051

912 Sanitary Sewers

In general, the minimum size of sanitary sewers must be 8 inches. However, 6-inch sanitary sewers may be used as private lateral sewers for apartments, camps, schools, restaurants, and other semi-public operations, provided their hydraulic capacity is not exceeded because of short run-off periods (high peak flows).

The lateral connections must be premium joint construction and should be made of the same material as the street sewer whenever possible to minimize infiltration from the connection between the street main and house lateral. When joint material and/or dimensions are not compatible, a commercial adapter must be provided.

913 House Laterals

4-inch sewer pipe may be used for house connections. The cover over the lateral coming out of the house must be a minimum 3-foot depth. The house connections must be of premium joint construction and made of PVC schedule 40 pipe or SDR 35. Cleanouts are required outside all structures or units. In multi-tenant buildings, individual services must be provided to a common pipe, then to the main. Individual meters must be used for separate sanitary sewers. When joint material and/or dimensions are not compatible, a commercial adapter must be provided. A copy of an ordinance or regulation requiring this type of construction must be on file with OEPA district office or submitted with all sewer plans to receive approval. No gravity drains to serve basements sewer connections will be permitted.

914 Invert Drop in Manhole

When a smaller sewer discharges into a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing this result is to place the 0.8 depth point of both sewers at the same elevation or matching the top elevation of the pipes. When a larger sewer discharges into a smaller, the invert of the smaller should not be raised to maintain the same energy gradient.

915 Illegal Connections

Roof drains, foundation drains, sump pumps, yard drains, and all other clear water connections to the sanitary sewer are prohibited.

There must be no physical connection between a public or private potable water supply system and a sewer or appurtenances thereto which would permit the passage of any sewage or polluted water into the potable supply.

916 Horizontal Separation

If possible, sanitary sewers and sewage forcemains should be laid with at least a 10-foot horizontal separation from any water main.

917 Vertical Separation

Sewers (or sewage forcemain) may be laid closer than 10 feet to a water main if it is laid in a separate trench and elevation of the crown of the sewer (or sewer forcemain) is at least 18 inches below the bottom of the water main. If it is impossible to maintain the 18-inch vertical separation when the sewer is laid closer than 10 feet to the water main, the sanitary sewer should be constructed of (or encased in) water main type materials which will withstand a 50 psi water pressure test.

If a sewage force main is laid closer than 10 feet to a water main, in no case should the sewage force main be laid such that the crown of the sewage force main is less than 18 inches below the water main.

918 Crossing Utilities

Whenever a sanitary sewer and water main must cross, the sewer must be laid at such an elevation that the crown of the sewer is at least 18 inches below the bottom of the water main. If it is absolutely impossible to maintain the 18-inch vertical separation, the sanitary sewer should be constructed of (or encased in) water main type material which will withstand a 50-psi water pressure test for a distance of 10 feet on both sides of the water main.

Whenever a sewage force main and water main must cross, the sewage force main must be at least 18 inches below the bottom of the water main.

919 Parallel Installation

Sanitary sewers and manholes should be laid with at least 10 feet, measured from edge to edge, horizontal separation from any water main. If separation cannot be maintained, the sanitary sewer must be constructed to water main standards.

920 Manholes

Manholes must be installed at the end of each line, at all changes in grade, size, alignment, and at all pipe intersections. Manholes must be installed at a distance not greater than 400 feet. Greater spacing may be allowed in larger sewers and in those carrying a settled effluent.

Manholes may be either poured in place or pre-cast concrete. Concrete construction must conform to ASTM C-478 with joints between sections conforming to ASTM C-443.

The flow channel through manholes should be made to conform in shape, slope, and smoothness to that of the sewers.

All manhole covers must be adjusted to grade by the use of no more than 12 inches of pre-cast concrete adjusting collars. In areas outside the pavement, the manhole casting should be adjusted so that the top is slightly above grade to prevent the entrance of the surface water.

921 Manhole Minimum Diameter

Manholes must be constructed large enough to allow access to the sewer. The minimum diameter of manholes must be 48 inches. Where manhole diameters of greater than 48 inches are used to accommodate the sewer pipes, the manhole must be returned to 48-inch diameter as soon as practical above the sewer crown. Manhole openings 24 inches or larger are recommended for easier access with safety equipment to facilitate maintenance.

922 Manhole Water Tightness

Manholes must be constructed to permit casting adjustments by use of cast-in-place or pre-cast concrete adjusting collars not to exceed 12 inches in height. Solid manhole covers must be used in all pavement locations. In other areas, the manhole casting must be adjusted so the top of the manhole cover is slightly above grade to prevent the entrance of the surface water. In areas subject to flooding, secured watertight and solid manhole covers should be used. All manhole covers, seating frames, and adapter rings must be machined to a firm and even bearing to provide a true fit into the frames. Manholes must be installed with chimney seals and watertight dishes. In high water table situations, manhole joints must be installed with 9” wide joint wrap on all joints on the outside of the manhole.

Inlet and outlet pipes should be joined to the manhole with a gasketed and/or flexible watertight connection meeting ASTM Specification C-443. Where three or more manholes in sequence are to be constructed with solid, watertight covers, adequate ventilation must be provided.

923 Flow Channel

The invert of the lowest pipe entering a manhole must be at least 3 inches (75 mm) above the top of the base slab so that the sewer flow channel may be installed and shaped when channel is not precast. The flow channel through the manholes should be made to conform in shape, slope, and smoothness to that of the sewers.

Cut pipe must not extend beyond the inside face of the manhole wall. Concrete placed inside the manhole to form the channel through the manhole must not be placed between the pipe and the opening so as to interfere in any way with the flexibility of the joint.

924 Drop Manholes

Drop manholes must be used when the invert of the inflow sewer is 2.0 feet or higher than the manhole invert. When this difference of elevation is less than 2.0 feet, the manhole invert must be filled and channeled to prevent solids deposition.

Due to the unequal earth pressure that would result from the backfilling operation in the vicinity of the manhole, the entire outside drop connection must be encased in concrete.

Drop manholes must be constructed with outside drop connection, except where such connection is not practical. Inside drop connection to be used only with the approval of the City. Minimum diameter for

inside drop must be 5 feet inside the diameter. Manholes located in isolated areas should be provided with bolted covers for safety and to discourage vandalism.

925 Test Inspection

The leakage and deflection tests are to be carried out by the contractor and witnessed and certified by the City officials and/or their representative.

All pipe which does not meet the testing requirements must be repaired and retested until it meets the requirements.

926 Railroad and Highway Crossings

When boring is required, the casing pipe shall be designed to meet the requirements of the local authority having jurisdiction and in compliance with the City of Brookville Construction Standards and Drawings. The size of the casing pipe shall be at least four (4) inches greater than the largest outside diameter of the sewer pipe, joints or couplings.

927 Stream Crossings

A. Location of sewers in streams

1. Cover Depth

   The top of all sewers entering or crossing streams must be a sufficient depth below the natural bottom of the streambed to protect the sewer line. In general, the following cover requirements must be met:

   a. One foot of cover where the sewer is located in rock.
   b. Three feet of cover in other material. In major streams, more than 3 feet of cover may be required.
   c. In paved stream channels, the top of the sewer line should be placed below the bottom of the channel pavement.

   Less cover will be approved only if the proposed sewer crossing will not interfere with the future improvements to the stream channel. Reasons for requesting less cover must be provided in the project proposal.

2. Horizontal Location

   Sewers located along streams must be located outside of the streambed and sufficiently removed therefrom to provide for future possible stream widening and to prevent pollution by siltation during construction.

3. Structures

   The sewer outfall, headwalls, manholes, gate boxes, or other structures must be located so they do not interfere with the free discharge of flow through the stream.

4. Alignment

   Sewer crossing streams should be designed to cross the stream as nearly perpendicular to the stream flow as possible and must be free from change in grade. Sewer systems must be designed to minimize the number of stream crossings.

B. Construction

1. Materials

   Sewers entering or crossing streams must be constructed of ductile iron pipe with mechanical joints; otherwise they must be constructed so they will remain watertight and free from changes in alignment or grades. Material used to backfill the trench must be stone, coarse aggregate, washed gravel, or other materials which will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe.

2. Siltation and Erosion

   Construction methods that will minimize siltation and erosion must be employed. The design engineer must include in the project specifications the method(s) to be employed in the construction of sewers in or near streams. Such methods must provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting trees and vegetation, dumping of soil or debris, or pumping silt-laden water into the stream. Specifications must require that cleanup, grading, seeding, and planting or restoration of all work areas must begin immediately. Exposed areas must not remain unprotected for more than seven days.

928 Sewage Pumping Stations

A. General

1. When sewage pump stations are required, they must be designed and installed per the following standards:
   a. Great Lakes Upper Mississippi River Board (GLUMRB) (Ten States Standards) "Recommended Standards for Wastewater Facilities", latest version.
   b. OEPA's latest requirements.
   c. City of Brookville Design Criteria and Standard Construction Drawings.
   d. All other applicable codes and regulations.
2. Flooding

   The wastewater pumping station structures and electrical and mechanical equipment must 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 floodplain obstructions must be followed.
3. Grinder Pumps

   No individual residence or common residence grinder pumps will be permitted. Gravity sewers outletting into a common pump station will be required.

B. Pump Station Type & Standard Requirements

Listed below are the standard requirements for pump stations in the City. However, it is realized that certain situations may require other types of pump stations. It is highly recommended that early preliminary pumping station plans be submitted to the City for their approval prior to beginning final engineering.

1. Type

Submersible Pump Stations with separate wet well and valve chamber is preferred by the City.

2. Pump Type
   Submersible explosion proof pumps capable of pumping raw, unscreened sewage, 3-inch spherical solids and stringy materials typical of domestic sewage will be required. Multiple pumps shall be provided.

3. Electrical Installation
   a. All electrical installations and components must be designed and installed per the National Electric Code (NEC) and all other electrical codes.
   b. All equipment and components must be housed in NEMA 4X stainless steel enclosures.
   c. Controls and other equipment must be Cutler-Hammer, or equivalent, as approved by the Engineer.
   d. The cabinet must be provided with a removable backplate on which all the components must be mounted, with the exception of the H-O-A switches. The pump run lights must be located on the outside door of the enclosure.
   e. The pump control panel must contain a circuit breaker, magnetic starter, hand-and-off-auto-selector-switch, run light, and seal leak indicating light for each pump.
   f. There must be furnished atop the control panel enclosure, a high-water alarm flashing red light.

4. Liquid Level Control
   The pumps are to be controlled by four mercury float switches, with brackets fastened inside the wet well.

5. Alarm Appurtenances
   a. Alarm signal must be initiated by liquid level control system which must be connected to the current City alarm system.
   b. Power failure relay: provide to the current City alarm system.
   c. High wet well level alarm: Provide high-water alarm for the current City alarm system.

6. Guide System
   a. System Design
      i. Permit removal of pumping units for inspection or service without dewatering wet well or interrupting operation of other pump equipment.
      ii. Pumps, when lowered into place, to be automatically connected to discharge piping with positive seal.
      iii. Incorporate fabricated aluminum access frame with provisions for mounting guide rails and hooks to retain pump cables.

b. Guide Rails
    i. Two lengths of stainless-steel pipe with pilots; 2-inch Schedule 40, stainless steel (304) size per pump manufacturer's recommendation. Top and bottom pilots must be Class 30 cast iron with flake glass/polyester coating.
c. Pump Guides
    i. Fabricated from bronze for spark proof operation.
    ii. Attached to pump volute with 316 stainless steel hex head cap screws.
d. Lift Chain
    i. Lift chain must be 304 stainless-steel, size to support pump with 4 to 1 safety factor.

7. Valve Pit
    a. Valve pit structure must be constructed of precast concrete sections conforming to ASTM C-478.
    b. Valve Pit Access
        i. An aluminum access door and frame assembly must be installed in the top slab.
        ii. The door must have a handle, latch in the open position, and have a hasp for a padlock. Surface must be non-skid, diamond tread.
    c. Valve Pit Drain
        i. The valve pit floor must be sloped to drain with a 3-inch drainpipe and check valve at the wet well as shown on the plans.
8. Wet Well Structure
    a. The wet well (minimum 6-foot diameter) must be constructed of precast concrete sections conforming to ASTM C-478.
    b. Wet Well Access
        i. The door must be of aluminum construction and have a handle, latch in the open position, and have a hasp for padlock. Surface must be non-skid, diamond tread. Minimum size must be 36" x 36" unless larger is required by the City.
    c. Vent
        i. A vent with screen must be installed in the top slab.
    d. Hoist Stand
        i. A hoist stand to fit the existing pump hoist must be mounted to the top slab to assure easy pump removal.
    e. Manhole Steps
        i. Manhole steps must be installed and conform to the current accepted manhole steps.
9. Piping and Valves
    a. Materials

    All piping and fittings beginning after the hydraulic sealing flange unit must be 4-inch diameter ductile iron pipe with flanged joints. Pipe joints must be flanged and conform with ANSI Specification A21.10 (AWWA C110) for cast iron pipe

flanges and flanged fittings, Class 125. Link seals or equivalent must be used around all piping passing through structures.

b. Valves
    i. Check valves to be 4 inch with outside lever and weight. Valves to be rated for 175 psi water working pressure and 350 psi hydrostatic test pressure.
    ii. Eccentric plug valve to be 4 inch, specifically designed for sewage applications with 100% port opening. Valve to have cast iron with Buna-N rubber coating to minimize wear and corrosion. Seat rings to seal at 175 psi. Valves to have flanged ends (ANSI B16.1) and nut operator.
    iii. A guide disconnect assembly as shown on the plans must be installed in the valve pit.

C. Emergency Operation

1. Objective
   The objective of emergency operation is to prevent the discharge of raw or partially-treated wastewater to any waters and to protect public health by preventing back-up of wastewater and subsequent discharge to basements, streets, and other public and private property.

2. Emergency Pumping Capability
   Emergency pumping capability is required unless on-system overflow prevention is provided by adequate storage capacity.

3. Emergency High-Level Overflows
   For use during possible periods of extensive power outages, mandatory power reductions, or uncontrollable emergency conditions, consideration should be given to providing a controlled, high-level wet well overflow to supplement alarm systems and emergency power generation in order to prevent backup of wastewater into basements, or other discharges which may cause severe adverse impacts on public interests including public health and property damage. Where a high-level overflow is utilized, consideration must be given to the installation of storage/detention tanks or basins, which must be made to drain to the station wet well. Where such overflows affect public water supplies or other critical water uses, the regulatory agency must be contacted for the necessary treatment or storage requirements.

4. Equipment Requirements
    a. General
       The following general requirements must apply to all internal combustion engines used to drive auxiliary pumps, service pumps through special drives, or electrical generating equipment.
        i. Engine Protection - The engine must be protected from operating conditions that would result in damage to equipment. Unless continuous manual supervision is planned, protective equipment must be capable of shutting down the engine and activating an alarm on site.

Protective equipment must monitor for conditions of low oil pressure and overheating, except the oil pressure monitoring will not be required for engines with splash lubrication.

ii. Size - The engine must have adequate rated power to start and continuously operate under all connected loads.

iii. Fuel type - Reliability and ease of starting, especially during cold weather conditions, should be considered in the selection of the type of fuel.

iv. Engine Ventilation - The engine must be located above grade with adequate ventilation of fuel vapors and exhaust gases.

v. Routine Start-Up - All emergency equipment must be provided with instructions indicating the need for regular starting and running of such units at full loads.

vi. Protection of Equipment - Emergency equipment must be protected from damage at the restoration of regular electrical power.

vii. Fuel Storage - All fuel storage must be in aboveground tanks with an appropriate dike system

b. Engine-Driven Pumping Equipment

Where permanently installed or portable engine-driven pumps are used, the following requirements in addition to general requirements must apply:

i. Pumping Capacity - Engine-driven pumps must meet the design pumping requirements unless storage capacity is available for flows in excess of pump capacity. Pumps must be designed for anticipated operating conditions, including suction lift, if applicable.

ii. Operation - The engine and pump must be equipped to provide automatic start-up and operation of pumping equipment unless manual start-up and operation is justified. Provisions must also be made for manual start-up.

iii. Manufacture - Permanently installed engine-driven pumping equipment must be manufactured by Kohler.

c. Engine-Driven Generating Equipment

Where permanently installed generating equipment is used, the following requirements must apply:

<u>Generating Capacity</u>

i. Generating unit size must be adequate to provide power for pump motor starting current and for lighting, ventilation, and other auxiliary equipment necessary for safety and proper operation of the lift station.

ii. The operation of only one pump during periods of auxiliary power supply must be justified. Such justification may be made on the basis of the design peak hourly flows relative to single-pump capacity, anticipated length of power outage, and storage capacity.

iii. Special sequencing controls must be provided to start pump motors unless the generating equipment has capacity of start all pumps simultaneously with auxiliary equipment operating.

Operation

Provisions must be made for automatic and manual start-up and load transfer unless only manual start-up and operation is justified. The generator must be protected from operating conditions that would result in damage to equipment. Provisions should be considered to allow the engine to start and stabilize at operating speed before assuming the load.

Portable Generating Equipment

No portable generation equipment will be allowed to operate a lift station.

929 Force Mains

A. Velocity and Diameter

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 must be 4 inches.

B. Air and Vacuum Relief Valve

An air relief valve must 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. Force mains must be installed to keep high points and low points to a minimum. All combined air release valves must contain non-corrosive materials such as stainless steel or plastic.

C. Termination

Force mains should enter the gravity sewer system at a point not more than 2 feet above the flow line of the receiving manhole.

D. Pipe and Design Pressure

Pipe and joints must be equal to water main strength material suitable for design conditions. The force main, reaction blocking, and station piping must be designed to withstand water hammer pressures and associated cyclic reversal of stresses that are expected with the cycling of wastewater pump stations.

E. Design Friction Losses

Friction losses through force mains must be based on the Hazen and Williams formula or other acceptable methods. When the Hazen and Williams formula is used, the value of "C" must be 100 for unlined iron or steel pipe for design. For other smooth pipe materials such as PVC, lined ductile iron, etc., a higher "C" value not to exceed 120 may be allowed for design.

F. Identification

Where force mains are constructed of material which might cause the force main to be confused with potable water mains, the force main must be appropriately identified.

G. Leakage Testing
Leakage tests must be required per the water main testing requirements as shown in the City of Brookville Standard Construction Drawings.

H. Cleaning of the Force Main
All force mains must include sealed cleanouts for cleaning purposes at a maximum spacing of 600 feet or as approved by the City.

I. Tracer Wire
All force mains must be installed with tracer wire. Wire must be solid core and fastened to the force main every 10 feet. See tracer wire detail in Standard Construction Drawings.