APPENDIX B: STORMWATER MANAGEMENT PLAN (SMP) REQUIREMENTS

The criteria contained in this document is required for all Stormwater Management Plans (SMPs) submitted to the City of Bellbrook for land development or re-development as specified under Chapter 1226, Section 1226.02(c):

(a) The minimum elements required in the Site Development Plan (SDP) described in Section 1226.05(c) (1) (A-E);

(b) The minimum elements required in the Storm Water Pollution Prevention Plan (SWP3) described in Appendix A;

(c) Copies of pertinent Notices of Intent (NOI), permits, public notices and letters of authorization must be included with SMP submissions. These may include, but are not limited to, Ohio EPA NPDES Permits authorizing stormwater discharges associated with construction activity, Ohio EPA Phase II Storm Water Permits, Section 401 and 404 Clean Water Act Permits, Ohio EPA Isolated Wetland Permit, and Ohio Dam Safety Law Permits;

(d) **The design of stormwater controls for storage volume and runoff rate** shall conform to the following :

(1) All proposed land uses and developments, which increase the runoff rate and/or volume, shall be required to control the rate of runoff discharging from the site;

(2) The United States Department of Agriculture, Conservation Engineering Division of the Natural Resources Conservation Service, "Urban Hydrology for Small Watersheds," Technical Release No. 55, June 1986 or the most current edition, shall be the method used by the applicant to determine the change in runoff rate and volume for the proposed development; and

(3) To determine the type and amount of runoff control required for the site, the applicant shall provide a comprehensive drainage area map that accurately shows the pre-development and post-development site conditions, including but not limited to:

(A) Existing and proposed topography;

(B) Soil types;

(C) Drainage and sub-drainage areas for both on-site and any contributing off-site drainage and sub-drainage areas;

(D) The hydraulically longest time of concentration pathways used:

(i) The maximum length of overland flow for sites with varying or steep topography shall be one hundred (100) feet;

(ii) Use of a maximum length of overland flow in excess of one hundred (100) feet but less than three hundred (300) feet must be clearly documented and accurate for the site conditions presented; and

(iii) Only the actual reasonable length of overland flow shall be accepted.

(E) Existing and proposed storm sewer structures;

(F) Existing and proposed man-made features, such as roads, buildings, other public amenities, etc., contributing to impervious areas;

(G) Existing and proposed natural features, such as wooded areas, open spaces, etc., contributing to pervious areas;

(H) Determine the percent increase in runoff volume in inches for a one-year frequency, twenty-four (24) hour storm occurring on the developed area for both pre-development and post-development conditions;

(I) Determine the critical year storm frequency for which runoff volume and rate control will be required for the site;

Percentage Increase Equal To or Greater Than (percent)	**Percentage Increase Less Than (percent)**	**Critical Year Storm Frequency (years)**
-	10	1
10	20	2
20	50	5
50	100	10
100	250	25
250	500	50
500	-	100

(J) Control the rate of runoff from the post-development storms of a frequency between the one year storm to the critical year storm so as to be equal to or less than the rate of runoff from the pre-development one-year frequency, twenty-four (24) hour storm;

(K) Control the rate of runoff from the post-development storms of a frequency above the critical year storm to the one hundred (100) year storm so as to be equal to or less than the rate of runoff from the corresponding pre-development storm frequency, twenty-four (24) hour storm;

(L) Control the rate of runoff from all off-site contributing drainage areas traveling through the site to the pre-development runoff rate;

(M) Provide a detention, infiltration and/or retention facility, including an outlet control structure to accommodate the storage of the runoff volume and the

control of the runoff rates to the allowable peak discharges from the site for all frequency, twenty-four (24) hour storms up to the one hundred (100) year storm;

(N) Provide the pre-development and post-development hydrographs and stage, storage and discharge tables developed for each frequency, twenty-four (24) hour storm;

(O) Provide an emergency overflow structure for flows exceeding the one hundred (100) year frequency, twenty-four (24) hour storm;

(P) Provide one (1) foot of freeboard as a factor of safety for the design of all water storage facilities; and

(Q) Provide animal and child protection devices on the outlet structure of the detention basin.

(e) **Stormwater Control Facilities**. All stormwater control facilities shall be contained within the proposed development. Exceptions to requiring permanent on-site runoff control may be considered by the City of Bellbrook, the Planning Board and/or its authorized agent(s), provided the applicant can prove that:

(1) The intent and standards of this Ordinance for runoff control can be best achieved by the utilization of off-site stormwater control facilities;

(2) Runoff from the site can be conveyed to off-site stormwater facilities in a manner and by means, which satisfy or surpass the standards of this Ordinance; and

(3) The applicant has ownership or the right to use the off-site facility in question.

(f) **The design of stormwater quality volume controls** shall conform to the following:

(1) All proposed land uses and developments, which disturbs more than one acre of land shall design a BMP to detain and treat a water quality volume (WQv) equivalent to the volume of runoff from a 0.75-inch rainfall;

(2) The following equation shall be used to calculate the required water quality volume:

$WQv = (P * A * Cq)/12$

Where:

WQv = Water quality volume (acre-feet)
P = Precipitation (0.75 inches)
A = Contributing drainage area (acres)
$Cq = 0.858i^3 – 0.78i^2 + 0.774i + 0.04$
i = Impervious area divided by the total area;

(3) Draw-down time for design of the water quality volume controls shall be as listed in Appendix A, (7) Post Construction Stormwater Management, Table 4;

(4) Permitted BMPs for use are as follows:

(A) Infiltration:

(i) Trenches;

(ii) Basins; and

(iii) Retention;

(B) Detention and Settling:

(i) Wet Pond;

(ii) Constructed Wetlands; and

(iii) Extended Detention Basin;

(C) Bio-filtration:

(i) Vegetated Buffer Strip;

(ii) Bioretention; and

(D) Filtration:

Media Filter.

(5) Provide BMP details, detailed design calculations and a long-term maintenance plan for each type of BMP proposed for the development; and

(6) Alternative BMPs may be proposed for the improvement, but will require pre-approval by the City of Bellbrook and/or its authorized agent(s) prior to finalizing project plans. Supporting documentation such as detailed calculations, BMP details and long-term maintenance documentation are also required for review.

(g) **The design of a storm sewer system** shall conform to the following:

(1) All street curb and gutters, closed pipes, manholes, culvert and open channels/drainage ways used to collect and convey water through a site shall be classified as a storm sewer system;

(2) The Rational Formula shall be used to calculate flows for the storm sewer system and is as follows:

$$q = ciA$$

Where:

q = Flow rate (cubic feet per second (cfs))
c = Runoff coefficient (0.90 for impervious and 0.4 for pervious)
i = Intensity of rainfall (inches per hour (in/hr)) as determined by charts 1101-2 and 1101-3 of ODOT's Location and Design Manual Volume #2
A = Tributary area (acres);

(3) Storm sewer systems shall be designed for the ten (10) year storm with a hydraulic grade line check of the system based on the twenty-five (25) year storm;

(4) Spread and by-pass calculations shall be provided for all roadway catch basin designs to ensure that the maximum width of flow in the street is less than half a lane width for the two (2) year storm for residential streets and the five (5) year storm for thoroughfares;

(5) Provide a comprehensive drainage area map that accurately shows the pre-development and post development site conditions, including, but not limited to:

(A) Existing and proposed topography;

(B) Drainage and sub-drainage areas for both on-site and any contributing off-site drainage and sub-drainage areas;

(C) The hydraulically longest time of concentration pathways used; the minimum time of concentration to the first catch basin shall be ten (10) minutes;

(D) Existing and proposed storm sewer structures;

(E) Existing and proposed man-made features, such as roads, buildings, other public amenities, etc., contributing to impervious areas; and

(F) Existing and proposed natural features, such as wooded areas, open spaces, etc., contributing to pervious areas;

(6) The minimum requirements for **a closed storm sewer design** shall conform to the following:

(A) The minimum size pipe shall be twelve (12) inches;

(B) The minimum depth of cover over the pipe shall be eighteen (18) inches;

(C) Maximum manhole spacing shall be no more than three hundred (300) feet; and

(D) Outlet pipe erosion protection shall be required if the velocities of flow in the receiving channel or stream exceed four (4) feet per second for soil conditions or six (6) feet per second for grass conditions. If the exit velocities exceed the allowable velocities, an energy dissipation device such as a manhole or heavy rock channel protection may be required; and

(7) The minimum requirements for an **open channel/drainage system design** shall conform to the following:

(A) The minimum centerline radius of constructed channels shall be five (5) times the top width of the channel;

(B) The minimum bottom width of the channel shall be two (2) feet;

(C) The horizontal to vertical ratio of a channel side slope shall be a minimum of 3:1, or flatter;

(D) The top of the bank shall be graded so that positive drainage is maintained from the surrounding areas to the channel and erosion is minimized;

(E) Bank stabilization and stream bed stabilization along constructed or natural channels will be required if the channel velocities are sufficient to cause erosion; and

(F) Stabilization methods, include, but are not limited to:

(i) Rock channel protection per chart 1107-1 of ODOT's Location and Design Manual Volume #2 or as deemed necessary by the City of Bellbrook or its authorized agent(s);

(ii) Gabions;

(iii) Concrete lining; or

(iv) Other permanent erosion control measures as approved by the City of Bellbrook and/or its authorized agent(s).

(h) **The design of major drainage systems or flood pathways** shall conform to the following:

(1) Surface drainage flood routes shall be provided for flows in excess of the storm sewer system frequencies as noted above resulting from the one hundred (100) year storm. Surface drainage flood routes shall direct the excess flow so that a major loss of property or life is prevented; and

(2) Detailed calculations, plan details and the flood route shall be provided on the plans for review and approval.

(i) The City of Bellbrook's authorized agent(s) shall approve or reject any calculation method based on its technical validity for a given situation.