APPENDIX A.2

Minor Stormwater Management Plan
Best Management Practices Worksheets

(Minor SWM BMP Worksheets)

Minor SWM BMP Worksheets
East Nantmeal Township

Stormwater management design for earth disturbance activities qualifying under Section 106 as Minor Stormwater Plans must address the intent of the SW Ordinance by managing the increase in runoff through infiltration facilities. To determine the size of infiltration facilities, utilize a factor of 0.083 times the impervious area. This reflects the infiltration of one (1) inch of stormwater runoff from the impervious surfaces (in feet).

STEP ONE: DETERMINE REQUIRED VOLUME	
PROPOSED TOTAL AREA of IMPERVIOUS COVER Includes all areas of buildings, paving, concrete and compacted gravel that are part of the proposed work.	**sq. ft.**
Multiply by 0.083	**x 0.083**
Infiltration VOLUME REQUIRED – Total	**cu. ft.**

Details of the BMP's listed below are provided as guidelines. For additional information on how these BMP's function and ideas of other BMP's refer to the "Pennsylvania Stormwater Best Management Practices Manual" latest edition prepared by the DEP.

STEP TWO: SELECT BMP(s) TO BE UTILIZED	
BMP NAME	(How Many)
1. Infiltration Basin	
2. Infiltration Bed	
3. Infiltration Trench	
4. Rain Garden	
5. Vegetated Swale w/ Check Dam	
6. Cistern/Rain Barrel	
7. Pervious Paver Blocks	
8. Other*	
TOTAL (use of 2 encouraged)	

* As approved by the Township Engineer. Provide additional information as needed.

The first six BMP's listed are Infiltration BMP's and as such should be located on the site in areas with the most suitable soil. Areas of wet or poorly drained soils should be avoided.

Infiltration BMP's should also be located with the following minimum setbacks:

- Ten (10) feet down gradient from a building basement
- One hundred (100) feet up gradient from a building basement
- Ten (10) feet from property lines
- One Hundred (100) feet from wells
- ten (10) feet from septic system drain fields (or per Pa DEP)

BMP Installation Guidelines:

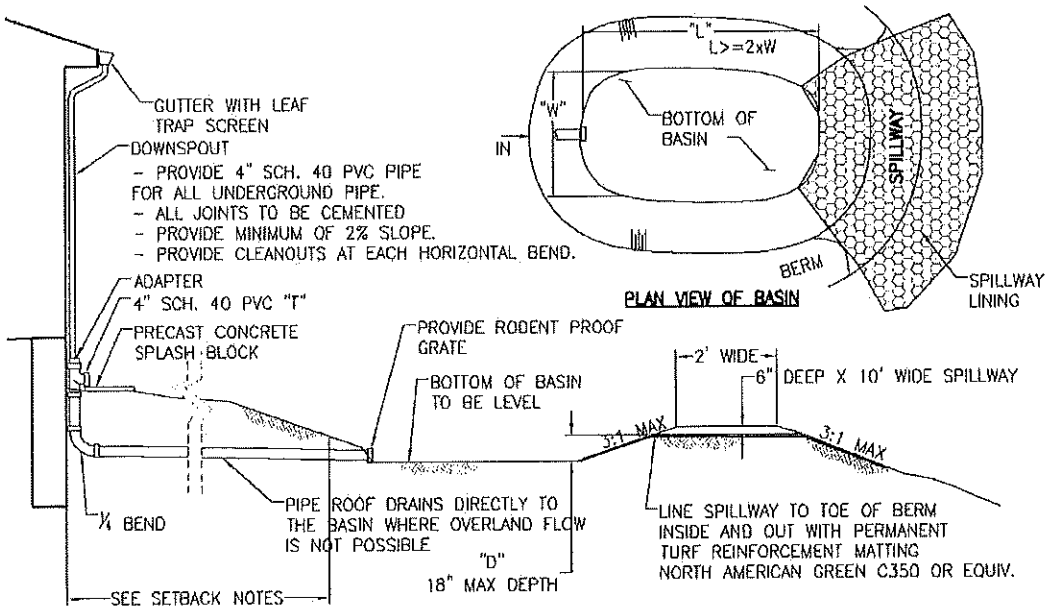
1. BMPs shall be protected during construction to prevent sediment-laden (muddy) water from entering the facility.
2. Excavation for the BMP's shall be conducted in a manner that will not compact the bottom of the facility.
3. For subsurface facilities, the bottom of the facility shall be scarified immediately prior to the placement of geotextile.
4. Geotextile shall be placed in accordance with the manufacturer's specifications. Seams shall be overlapped a minimum of 16 inches.
5. The area of the BMP shall be fenced off during site construction. Construction equipment shall be prohibited from entering the area to avoid soil compaction.

STEP THREE: DETERMINE VOLUME PROVIDED	
BMP (see specific detail drawings for volume calculations)	**Volume (cu. ft.)**
1. Infiltration Basin	
2. Infiltration Bed	
3. Infiltration Trench	
4. Rain Garden	
5. Vegetated Swale w/ Check Dam	
6. Cisterns	
7. Pervious Paver Blocks (provide square feet of area to be covered)	
8. Other	
Infiltration VOLUME PROVIDED - TOTAL*	

*must be greater than the Infiltration VOLUME REQUIRED calculated in Step One

BMP #1 –INFILTRATION BASIN

An Infiltration Basin provides an aboveground area for water to be stored and infiltrate into the ground. Roof drains and overland stormwater runoff are directed into the aboveground basin area. A spillway is provided to release the larger storm volumes. The spillway should be located such that any down slope problems are avoided when water is flowing over it. The spillway should be lined with a permanent erosion mat to prevent deterioration. The spillway should be located as far away as possible from any inflow pipes to promote infiltration and settling of stormwater runoff contaminants. The basin needs to be planted with vegetation that is tolerant of the wet conditions that will occur. The depth of the basin may be increased with the approval of the Township Engineer.



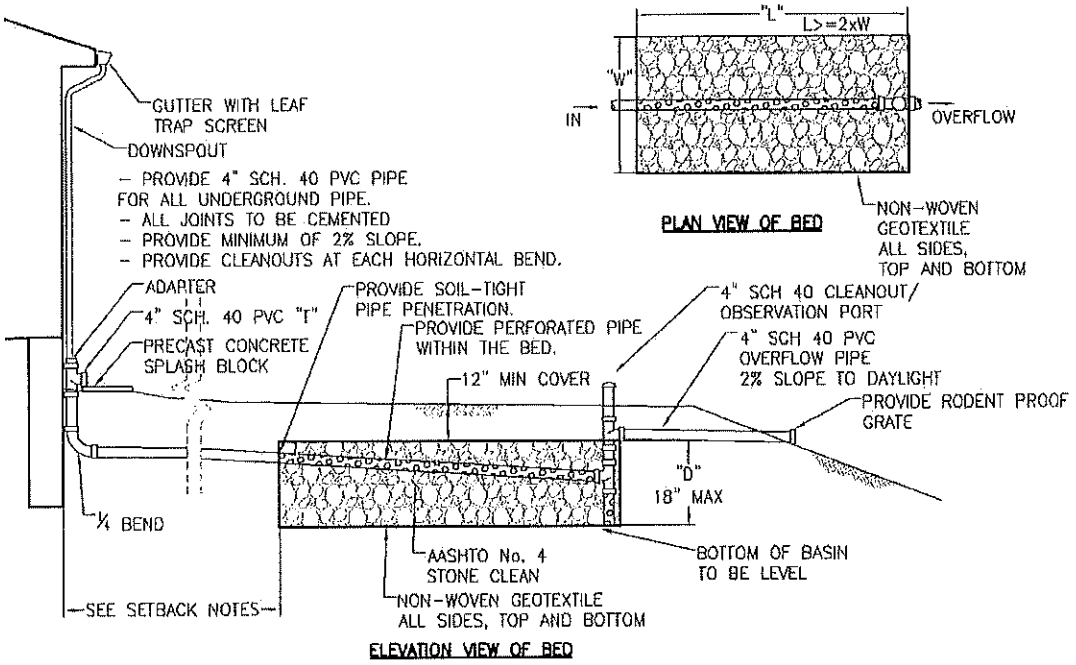
ELEVATION VIEW OF BASIN

Determination of Water Quality Volume provided:

1	Area – L (length) x W (width) for rectangular basins estimate for irregular shapes	sq. ft.
2	Depth of Basin = D	ft.
3	Volume = Area x D (Line 1 x Line 2) (assuming straight sides)	cu. ft.
4	Side Slope Factor "Z" – Use 3 for 3:1 slope, 4 for 4:1 slope, etc	
5	Approx. Additional Volume = (L+W) x Z x D x D	cu. ft.
6	TOTAL VOLUME PROVIDED (Line 3 + Line 5) (Use this number in Step Three)	cu. ft.

BMP #2 –INFILTRATION BED

An infiltration bed can be used where surface stormwater runoff does not need to be captured. Roof drains from the proposed structure are piped into an underground area to infiltrate into the ground. An overflow pipe is provided to release the larger storm volumes. A cleanout is provided to facilitate maintenance and provide an inspection port. The pipe within the bed is perforated and should be run through the basin to the fullest extent to promote infiltration and distribution of the stormwater. Additional pipe can be utilized within the bed to increase the available storage volume. The soil over the bed shall be planted with vegetation that will not interfere with the operation of the bed. The depth of the bed may be increased with the approval of the Township Engineer.



Note: AASHTO No. 4 is approximately 1-2 inch stone

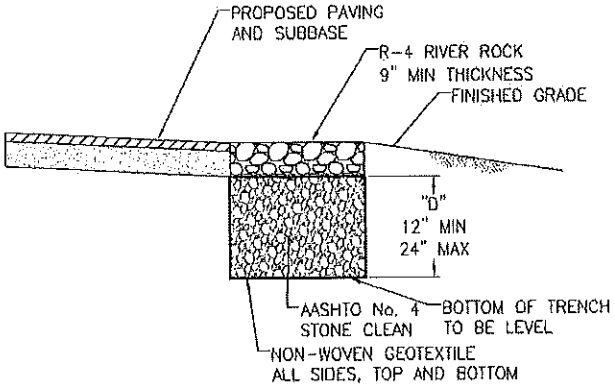
Determination of Water Quality Volume provided:

1	Area – L (length) x W (width)	sq. ft.
2	Depth of Bed = D	ft.
3	Volume = Area x D (Line 1 x Line 2) (stone not considered)	cu. ft.
4	factor to determine void volume due to stone = 0.4 x Line 3 = TOTAL VOLUME PROVIDED (Use this number in Step Three)	cu. ft.

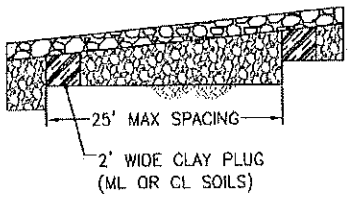
If additional perforated pipe is used in the bed, volume may be adjusted accordingly.

BMP #3 –INFILTRATION TRENCH

Infiltration trenches are utilized along the perimeter of impervious surfaces to collect, store and infiltrate stormwater runoff. River rock or equivalent will be placed on the bed to allow the stormwater runoff to enter the trench; alternately the bed may utilize a perforated pipe with inlets to get the stormwater into the trench. When on a slope, the trench is constructed as a terraced system with clay dikes to promote infiltration. The depth of the trench may be increased with the approval of the Township Engineer. Pipe can be utilized within the trench to increase the available storage volume. When the trench is installed along a paved area that will need to be compacted during construction, extra attention needs to be paid to avoid compaction in the area of the trench and to loosen the material under the trench prior to installation.



SECTION AT EDGE OF PAVING



LONGITUDINAL SECTION OF TRENCH

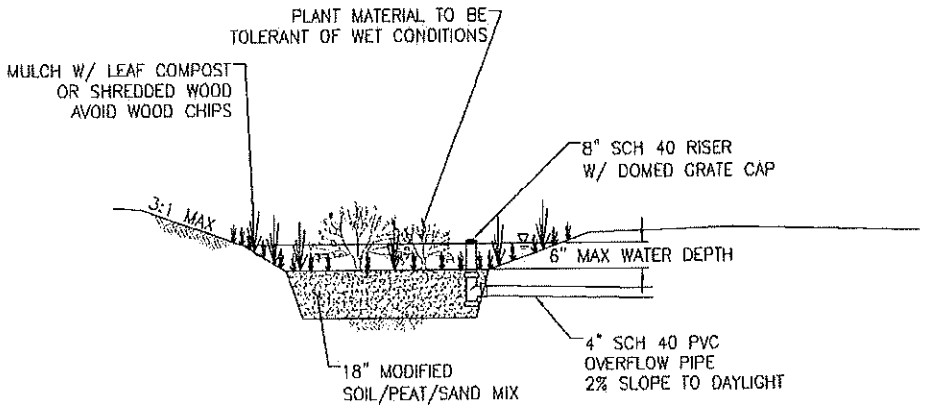
Determination of Water Quality Volume provided:

1	Area = L (length) x W (width)	sq. ft.
2	Depth of Trench = D	ft.
3	Volume = Area x D (Line 1 x Line 2) (stone not considered)	cu. ft.
4	factor to determine void volume due to stone = 0.4 x Line 3 = TOTAL VOLUME PROVIDED (Use this number in Step Three)	cu. ft.

If perforated pipe is used in the bed, volume may be adjusted accordingly.

BMP #4 –RAIN GARDEN

Rain gardens are similar to the infiltration basin, but provide less storage volume and rely more on the plantings to provide water quality and to remove the water through evapo-transpiration. Plant material utilized in the rain garden should be selected by a landscaping professional and be suitable for the proposed conditions. The bottom of the garden is a modified soil intended to hold water and allow it to infiltrate. An overflow pipe is provided to take larger stormwater runoff away. The planted bed needs regular maintenance and should be mulched on an annual basis. The entire bed should be dug up and rejuvenated every three years or as necessary to maintain function. The owner of the facility should be aware of the long term maintenance needs of the plant materials utilized.

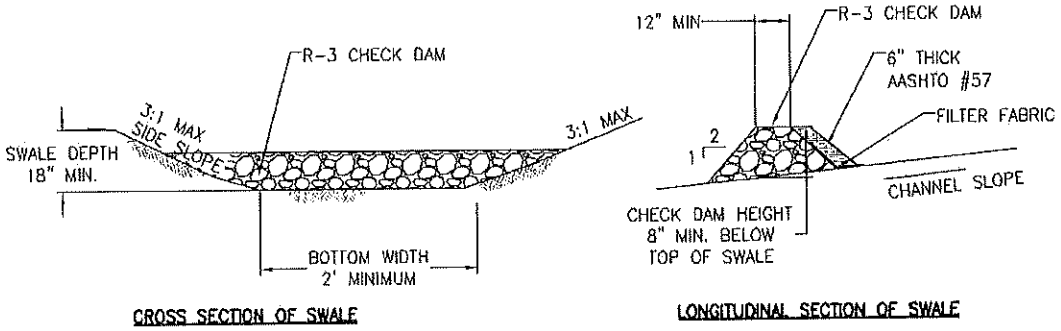


Determination of Water Quality Volume provided:

1	Area – L (length) x W (width) for rectangular areas estimate for irregular shapes	sq. ft.
2	Depth of Water on Surface = 6" = 0.5'	0.5 ft.
3	Approx. Above Ground Volume = Area x D (Line 1 x Line 2)	cu. ft.
4	Depth of Modified Soil Mix = 18" = 1.5'	1.5 ft.
5	factor to determine void volume due to modified soil mix = Approx Volume in Soil = Area x D x 0.4 (Line 1 x Line 4 x 0.4)	cu. ft.
6	TOTAL VOLUME PROVIDED (Line 3 + Line 5) (Use this number in Step Three)	cu. ft.

BMP #5 –VEGETATED SWALE WITH CHECK DAM

A vegetated swale with a check dam provides both a way to convey water around the site and provide an infiltration component. Swales should be installed with longitudinal slopes of 1-6%. Check dams are provided for swales over 3% in slope. The swales should be planted with grasses that are sod forming and can withstand frequent inundation or may be planted with other dense vegetation. For maximum benefit the grasses in the swale should be mowed infrequently. The swale and check dams should be inspected after every storm event to repair any erosion areas that may form. The dimensions shown for the channel and check dam will satisfy most applications. Larger swales may be required depending on actual site conditions.



Note: R-3 is approximately 3 inch stone & AASHTO No. 57 is approximately ½ inch stone

Determination of Water Quality Volume provided:

1	Check Dam Height	ft.
2	Channel Slope = Vertical Rise / 100 ft length x 100%	%
3	Impoundment Length = (Line 1 / Line 2) x 100	ft.
4	Side Slope (Horizontal Length in Ft./ 1 ft Vertical Rise)	
5	Bottom Width of Channel	ft.
6	Top Width of Check Dam = Line 5 + 2 x Line 4 x Line 1	ft.
7	TOTAL VOLUME PROVIDED = 0.5 x Line 3 x Line 1 x (Line 5 + Line 6) / 2 (Use this number in Step Three)	cu. ft.

SWM BMP #6 –CISTERN/RAIN BARREL

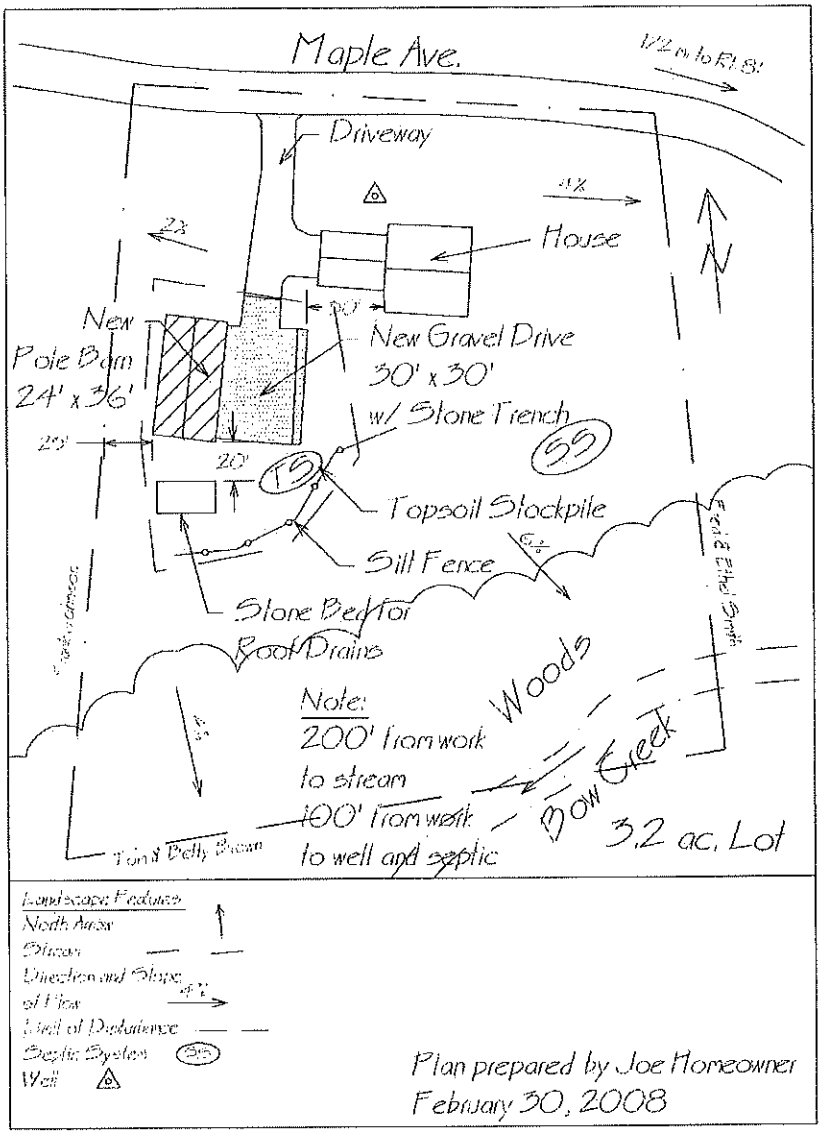
A cistern provides an artificial reservoir, such as a tank, for storing water. Cisterns date back to early civilizations as a way to collect and manage stormwater. Historically the water was collected to serve as a source of drinking water, but for these purposes, that is, as a SWM BMP, the cistern is not intended as a source of drinking water but for utilization for watering plants/irrigation systems. The sizing of the facility is primarily based on the intended use of the water. In order for the facility to be effective during storm events it must be emptied on a regular basis between storms. No details are provided here since each use would be unique. The following design criteria should be considered:

A. Determine the amount needed. Consider the area to be irrigated and the amount to be applied and the frequency. This is the minimum volume to be stored. Consider a factor of safety to allow for drought conditions.
B. Conversely, methods should be provided to draw down the cistern from time to time especially during non-growing seasons to insure that there is adequate volume in the cistern for storm events.
C. Stormwater from roofs is preferred due to their low amounts of pollutants and sediments.
D. Pumps and piping utilized in the system should be clearly labeled that this is not potable water and cross-contamination of drinking water supplies must be avoided. All systems should be watertight.
E. An overflow system should be provided.
F. Facilities need to be kept from freezing.

BMP #7 –PERVIOUS PAVER BLOCK

Pervious paver blocks consist of interlocking units (often concrete) that provide some portion of the surface that may be filled with a pervious material such as gravel or topsoil. These are often used in patio area or small parking areas. Pervious paver blocks can be utilized as part of site landscaping plan to minimize the impervious coverage. Brand names of such products include, but are not limited to: Turfstone, UNI Eco-stone, Checkerblock, EcoPaver, Turf Pavers, or Monoslab. If the products are installed per manufacturer's specification as part of a permeable paving system with minimal compaction, the area can be considered as a non-impervious area in calculating the Water Quality Volume requirements as part of Step One of the BMP Worksheets. The Township Engineer shall review all materials proposed to determine if they are suitable for this application.

Example of Site Sketch Plan



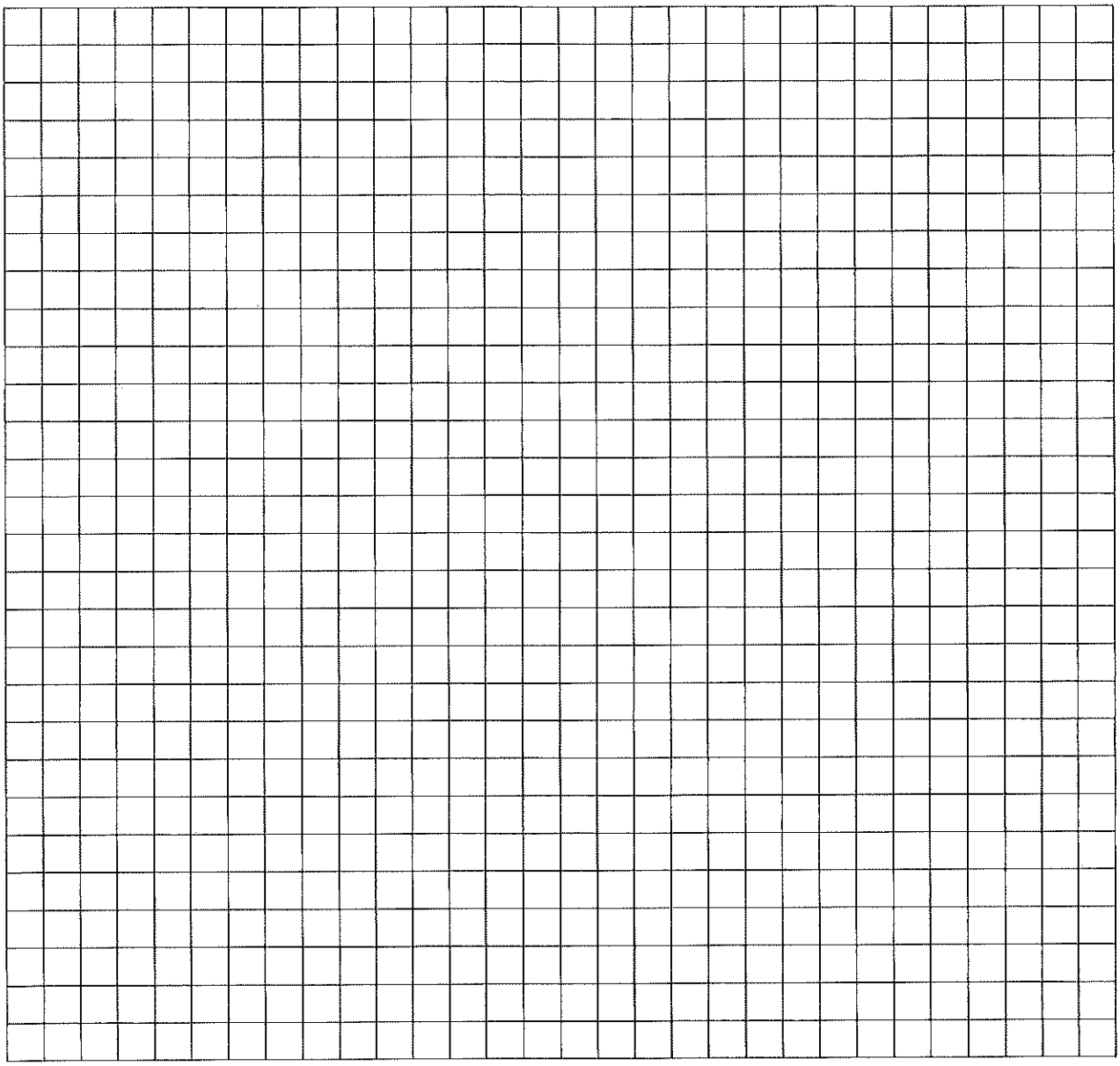
Plan shall contain the following items:

- Lot configuration and total acreage.
- Existing features: buildings, driveways, parking areas, woodland, streams, etc.
- Proposed impervious surfaces: driveways, parking areas including dimensions.
- Names of owners immediately adjacent to the project site location.
- Locations of existing streets or easements, railroads, drainage facilities.
- Proposed erosion and sedimentation control facilities.
- Location of watercourses, wetlands, and riparian stream buffer located within the property or one hundred (100) feet from the project site location.
- Distances between the proposed activity and existing features, property lines, on-lot sewage facilities, wells and watercourses.

SITE SKETCH PLAN

NAME: _____

LOCATION: _____



Is your drawing to scale Y / N? If yes, what is the scale? _____

Any questions, please contact:
LTL Consultants, Ltd. at 610-987-9290 or 1-888-987-8886