Public Notice

U.S. Army Corps of Engineers, Norfolk District

CENAO-REG

August 29, 2007

Federal Public Notice

Requirement Relative to Low Impact Development

On July 22, 2004, August 10, 2006, and February 15, 2007, the Norfolk District, Army Corps of Engineers issued public notices seeking comment on a proposal to require consideration of Low Impact Development (LID) practices in the review of development projects.

In response to the public notices, we received numerous comments. Since then, we have met with many of the commenting parties to discuss their concerns. From those discussions, we have made numerous changes to our original proposal. Please find enclosed our final revised guidance and LID worksheets.

The Norfolk District encourages consultants and applicants to incorporate LID methodologies into their development plans to further reduce impacts to the aquatic environment. The Corps will consider LID practices in our review of specific commercial and institutional developments that involve impacts to streams and wetlands resulting from stormwater management facilities.

If you have any questions you may contact Hal Wiggins at (540) 548-2517 or harold.j.wiggins@usace.army.mil.

J. Robert Hume, III
Chief, Regulatory Office

How and When the Norfolk District, Corps of Engineers Will Consider Low Impact Development Practices in the Review of Permit Applications For Commercial and Institutional Development

The Corps of Engineers is responsible for administering Section 404 of the Clean Water Act. Permits are required from the Corps for proposed discharges of dredged and/or fill material into waters of the United States, including wetlands. We are required by the Environmental Protection Agency's Section 404(b)(1) guidelines to only issue a permit for the least environmentally damaging practicable alternative. Practicable includes consideration of cost, logistics, and existing technology. As part of our evaluation, we ensure that development projects are designed to minimize their impacts on waters and wetlands. The enclosed LID worksheets that were developed are specific to the review of Section 404 permit applications. Other federal, state, and local regulations may pertain to stormwater management. These worksheets are meant to augment and enhance existing stormwater management requirements that protect aquatic resources.

Stormwater management is an important component of any commercial or institutional development. Conventional stormwater management seeks to attenuate flood peaks and treat for stormwater pollutants such as phosphorus, nitrogen, and silt (sediment). At times a project proponent seeking a permit from the Corps proposes to achieve this goal through the construction of stormwater management ponds in waters and wetlands. Conventional stormwater management ponds typically detain some of the increased volume of water caused by increased impervious surfaces and release it at a lower rate. Stormwater management facilities are primarily designed to control peak discharge rates to below pre-development levels for certain storm events. However, a greater volume of runoff is released for a longer duration. The stormwater management facilities associated with many conventionally designed developments may adversely affect waters and wetlands both upstream and downstream through filling and back flooding. Changes in the pre-development hydrology of streams below conventional stormwater ponds may also result in scour and sedimentation impacts to streams.

LID practices (and design strategies) attempt to minimize impervious cover, conserve natural cover, and to replicate the pre-development runoff volume and timing, and replicate the pre-development runoff rate (volume, timing, and rate) which are the three primary elements of a natural hydrograph. These goals may be achieved through the use of such options as permeable surfaces for parking areas, residential lot setbacks, minimizing roadway widths where possible (taking into account fire and emergency vehicle access requirements), narrower sidewalks, selective clearing, flattening grades, disconnecting impervious surfaces, infiltration practices, amended soils, open, vegetated swales, and distributed versus concentrated runoff (maintaining natural runoff patterns).

In its review of proposed commercial and institutional developments involving stormwater management facilities located in waters and/or wetlands, the Norfolk District will first request project proponents to review alternatives to avoid such impacts. If those impacts can be avoided, the proponent will not be requested to conduct any additional analysis. However, if the proponent of a commercial or institutional development can not, or decides not to, avoid all impacts to waters and/or wetlands caused by the stormwater management facilities, the Norfolk District will request them to evaluate the practicability of incorporating LID practices to further minimize the impacts as outlined below.

How Low Impact Development Practices Are Being Evaluated

In establishing such a requirement to consider LID in project design, we acknowledge that LID is not practicable for all sites. Our regulations recognize that for an alternative to be practicable it has to achieve the purpose of the project, be available to an applicant, and be feasible considering cost, logistics, and existing technology. Examples of circumstances when the use of LID practices would not be practicable and the enclosed Site Design Checklist and LID Calculations Worksheet would not need to be submitted are as follows:

-projects that do not propose construction of stormwater management ponds in waters or wetlands (We do not propose to change how we review stormwater outfalls or existing stormwater facilities.)

-regions or project sites with soils that are prohibitive to the use of infiltration practices. This would include soil defined in county soil surveys as somewhat poorly drained to poorly drained for crops and pasture and/or the local hydric soils list. These are soils in the Hydrologic Soil Groups C and D (silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay loam, silty clay and clay). However, an assessment of soil permeability at various depths would be evaluated before a site is ruled out for LID practices

-regions or project sites with high water tables or Karst topography,

-regions or project sites where the use of LID practices are prohibited by local ordinance,

-for project sites where the use of distributed LID practices is incompatible with the use or development proposed, or incompatible with State/local land use planning and zoning requirements,

-residential development projects with on-lot infiltration practices. However, mixed commercial/residential projects with open space or common area with LID practices would be considered, and

-for existing ponds that are proposed for conversion to stormwater management ponds.

We believe the above clearly outlines when LID practices need to be considered. However, in cases when situating stormwater management facilities in upland areas are not practicable or LID is not considered practicable, and impacts to waters and/or wetlands will still occur, our regulations require compensatory mitigation for all unavoidable impacts to waters and wetlands.

Maintenance requirements and inspection frequencies are outlined in Commonwealth of Virginia's 2001 Stormwater Management Regulations (4VAC3-20). The responsibility of the required maintenance rests with the permittee for the life of the permit unless a transfer to another party is approved by the Norfolk District, Corps of Engineers. (Permits are transferable in whole or in part.) However, for localities which exert jurisdiction over the maintenance of LID practices, the responsibility of the required maintenance rests with the locality for the life of the permit.

With that in mind, the Norfolk District actively participates and remains committed to the preapplication consultation process. During preapplication consultations, the Norfolk District and other agencies including EPA will strongly encourage that measures be incorporated into project plans that avoid and/or minimize impacts to waters and wetlands whenever and wherever practicable. We will be contacting localities to seek an opportunity to participate in their evaluation of preliminary plans. This will ensure that project proponents and the locality are aware of our comments early in the review process and that our comments are fully considered as the project design proceeds. Projects that do not incorporate all appropriate and practicable measures to avoid and minimize impacts and compensate for unavoidable impacts will not comply with our regulations or the Environmental Protection Agency's 404(b)(1) guidelines and will be denied.

This proposed requirement will not delay the issuance of a public notice for a permit application that is otherwise complete as outlined in 33 CFR 325.1(d).

Site Design Checklist
and
LID Calculations Worksheet

Revised May 2007

INTRODUCTION

This checklist and worksheet should be completed for those commercial and/or institutional developments with stormwater management facilities located in waters and/or wetlands. To reduce permit processing time, this analysis should be submitted with the permit application or during the preapplication consultation process.

SECTION A: SITE DESIGN CHECKLIST

Prior to developing any structural stormwater practices on a site, significant reductions in stormwater quantity and quality impacts can be made through enhancements to site design. Below is a checklist of site design and planning practices that can be used to minimize stormwater impacts. Please check the practices that you are applying to your development, and note the extent to which each selected practices was implemented.

Site Design Technique 1:
Minimize direct stormwater impacts to streams and wetlands to the maximum extent practicable. This can be accomplished by avoiding streams and wetlands, maintaining natural drainage routes on site, preserving riparian buffers, and locating "integrated management practices," in lieu of centralized ponds, outside of streams and wetlands.

1. Locating stormwater facilities outside of streams and wetlands. **Describe actions taken**:

2. Maintaining natural drainages, and preserving riparian buffers. **Describe actions taken**:

3. Natural drainage routes maintained on site. **Describe actions taken**:

4. Riparian buffers preserved. **Describe actions taken**:

5. Distributed “Integrated Management Practices (i.e. engineered swales, biofiltration, etc.) ” used in lieu of centralized ponds. **Describe actions taken**:

Site Design Technique 2:
Preserve the natural cover on as much of the site as possible, especially for areas located on hydrologic soil groups (HSG) A and B.

Natural vegetation helps maintain and preserve predevelopment hydrology on a site, thereby reducing the reliance on large-scale stormwater ponds. Natural cover on highly permeable soils increases filtration and infiltration.

1. Is there an opportunity to locate integrated management practices in common areas? **Describe actions taken**:

2. Utilize "fingerprint" clearing. Limit the clearing and grading of forests and native vegetation to the minimum area needed for the construction, the provision of necessary access, and fire protection. **Describe actions taken**:

3. Preserve A & B Soils in natural cover. **Describe actions taken**:

Site Design Technique 3:

Minimize the overall impervious cover.

Roadways, sidewalks, driveways and parking areas are the greatest sources of site imperviousness. Impervious areas alter runoff and recharge values and site hydrology. For LID sites, managing the imperviousness contributed by road and parking area pavement is an important component of the site planning and design process. There are several methods that can be used to achieve a reduction in the total runoff volume from impervious surfaces and limit connectivity. Examples include width of streets and sidewalks, street layouts, cul-de-sac design, parking, setbacks and frontages, and minimizing compaction.

1. Utilize structured or shared parking if economically, legally, and logistically feasible. **Describe actions taken**:

2. Reduce street widths, street layouts, cul-de-sac design, parking, setbacks and frontages. **Describe actions taken**:

3. Substitute pervious surfaces for impervious wherever practicable. **Describe actions taken**:

4. Where permitted, avoid the use of curb and gutter. Utilize vegetated open swales, preferably with a permeable soil. **Describe actions taken**:

5. Minimize compaction. **Describe actions taken:**

Site Design Technique 4:

Locate infiltration practices on HSG A and B soils wherever possible.

Are HSG A & B soils on the site? If yes, how are HSG A and B soils being utilized? Describe actions taken. If no, skip this technique. **Describe actions taken**:

Site Design Technique 5:

"Disconnect" impervious areas.

"Disconnecting" means having impervious cover drain to pervious cover, i.e. downspouts draining to the yard, not the driveway. This both decreases the runoff volume and increases the Time of Concentration (Tc). Disconnected parking lots, for example, can provide sheet flow into bioretention areas or infiltration swales or other practices. **Describe actions taken**:

<u>Site Design Technique 6</u>:
Increase the travel time of water off of the site (Time of Concentration)
Replicating the pre-development Time of Concentration is a key aspect in maintaining pre-development flow regime, and minimizing downstream impacts. The 1-year, 24-hour storm will be used in these calculations.

1. Flatten grades for stormwater conveyance to the minimum sufficient to allow positive drainage. **Describe actions taken**:

2. Increase the travel time in vegetated swales by using more circuitous flow routes, rougher vegetation in swales, and check dams. **Describe actions taken**:

3. Utilize swales in lieu of pipes or hardened channels. These swales will have shallow grades and may have sand or gravel substrate below the sod to promote infiltration and storage. **Describe actions taken**:

<u>Site Design Technique 7</u>:
Utilize soil management/enhancement techniques to increase soil absorption

1. Delineate soils on site for the preservation of infiltration capacity. Mark these areas in the field and restrict heavy equipment access. **Describe actions taken**:

2. Require compacted soils in areas receiving sheet flow runoff (such as yards, downslope of downspouts) will be "deep tilled" and amended with loam or sand prior to seeding/sodding. **Describe actions taken**:

<u>Site Design Technique 8</u>:
Use swales for conveyance in lieu of curb and gutter wherever possible. Swales utilize a sand substrate to maximize infiltration. Maintaining the predevelopment time of concentration (Tc) minimizes the increase of the peak runoff rate after development by lengthening flow paths and reducing the length of the runoff conveyance systems. **Describe actions taken**:

<u>Site Design Technique 9:</u>
Utilize level spreading of flow into natural open space unless prohibited by local or state regulations. Wherever buffers or other areas of open space are preserved, ensure that they are made hydrologically functional by making them receiving areas for sheet flow, not concentrated flow. Use level spreaders on lot or pavement edges to help spread water into the preserved areas. Ensure that flow volumes do not cause channelized flow and erosion in receiving buffers. **Describe actions taken**:

Much of the above is excerpted from the Prince George's County, Md., 1999 *Low Impact Development Design Strategies: An Integrated Design Approach*. Largo, Maryland. (See References) All planned LID techniques should conform to the designs of those presented in this manual. Descriptions of the above and other site design techniques can be found in the LID references listed in aforementioned manual.

SECTION B: LID Calculations Worksheet

Definitions

Low Impact Development (LID) – LID is a design strategy with a goal of maintaining or replicating the pre-development hydrologic regime for small storm events through the use of design techniques to create a functionally equivalent hydrologic landscape. Hydrologic functions of storage, infiltration and ground water recharge, as well as the volume and frequency of discharges are maintained through the use of integrated and distributed micro-scale stormwater retention and detention areas, reduction of impervious surfaces, and the lengthening of flow paths and runoffs time. Other strategies include the preservation/ protection of environmentally sensitive site features such as riparian buffers, wetlands, steep slopes, valuable (mature) trees, flood plains, woodlands, and highly permeable soils.

Detention – The collection of runoff in a ponding area, depression, or storage chamber followed by its gradual release through an outlet into a receiving water body. Detention is one way to reduce a site's peak runoff rate to its pre-development peak rate for the storm event of a given magnitude, but is not an effective way to reduce the runoff volume.

Retention – The collection of runoff in a ponding area or receptacle where it is kept until it soaks into the ground through infiltration. Retention reduces the volume of runoff from a site and can also be effective in reducing the peak runoff rate if the retention volume is sufficiently large.

Time of Concentration (Tc) – The time for runoff to travel from the hydraulically most distant point of the development site to the watershed outlet or study point.

Instructions

Before beginning the LID Calculations Worksheet, **first evaluate your site design using the Site Design Checklist**. The use of the site design practices is a critical component in ensuring that the pre-development hydrology on a site can be maintained.

The following worksheet follows the process detailed in *LID Hydrologic Analysis* (see references). Designers should download a copy from the internet to assist in the completion of this worksheet.

Note: Development projects that are unable to create sufficient retention practices to maintain the predevelopment runoff volume should revisit the application of the site design practices to the site. The thorough use of site design practices will reduce post-development curve numbers, and can result in decreased stormwater detention and retention volume requirements. Additionally, modifications to the design of bioretention practices, such as the inclusion of a gravel sump with a standpipe, can provide additional storage volume).

Determining the LID Runoff Curve Number
(LID Hydrologic Analysis, pg 22-25)

a. Calculate pre-development Curve Number (CN) and Time of Concentration (Tc) using TR-55 or other suitable method. The 1-year, 24-hour storm may be used in this calculation.

CN_{pre} = _____
Tc_{pre} = _____ *minutes*

b. For comparison purposes, calculate a composite curve number for the *developed site*, using the conventional TR-55 approach. For sites with less than 30% imperviousness area, calculate a composite curve number for the site, following the approach in Section 4.3 (paragraph 22-24) of LID Hydrologic Analysis"

$CN_{conventional}$ = _____

c. Calculate a composite custom LID curve number for the site, following the approach in Section 4.3 (pages 22-24) of "LID Hydrologic Analysis*". *This is much more detailed than the conventional Tr-55 approach.* This approach factors in the use of higher permeability soils for infiltration and the use of "disconnectedness" (impervious cover flowing to pervious cover). Use an R factor of "1" for bioretention practices.

$CN_{conventional}$ = _____ *(from above)*
CN_{LID} = _____

Reduction in CN achieved with site design = _____ ($CN_{conventional}$ - CN_{LID})

d. Calculate the post-development Time of Concentration (Tc). To increase the Tc to the predevelopment Tc or greater, utilize the practices described in "LID Design Strategies"*, such as flattening grades, lengthening flow paths, etc to increase the Tc to the predevelopment time.

Tc_{pre} = _____
Tc_{LID} = _____ (the Tc after maximizing practices to lengthen flow travel time)

NOTE: For the LID approach to function effectively, the Tc_{pre} should be less than or equal to equal to the Tc_{LID}.. If Tc_{LID} is lower**,** **STOP here** and incorporate practices to increase it.
See "LID Design Strategies" for details.

Step 1: Determine the Retention Volume Required to Maintain Pre-development Runoff Volume

a. Calculate the **Design Rainfall** for your site, per Equation 4.9 and Example 4.6 outlined on page 38 of "LID Hydrologic Analysis". This is the rainfall at which runoff would have initiated on the site, if it were vegetated with "woods in good condition".

If your calculated value for Design Rainfall is LESS THAN the 1-year 24 hour rainfall for your area, **USE the 1-year 24 hour rainfall instead.**

Design Rainfall = _____ in

b. Use the tables in Appendix A of the "LID Hydrologic Analysis" to calculate inches of storage volume to **Maintain Predevelopment <u>Runoff Volume</u>** ***for your Design Rainfall***

Preliminary Retention Storage volume = _____ $in_{across\ entire\ site}$ = _____ ft^3

Step 2: Determine Storage Volume for Water Quality Protection

a. Per example 4.3, on page 29 of 'LID Hydrologic Analysis' ensure that the Preliminary Retention Storage Volume (Step 1.b) meets or exceeds the **"Water Quality Volume",** which is ½" of runoff from impervious areas on the site.

b. Following example 4.2 on page 29 of "LID Hydrologic Analysis", **calculate the area of IMP's required** to be distributed evenly on the site to retain the Retention Storage Volume.

Bioretention Design Option	Area ft^2	% of site
6" ponding depth		
6" ponding depth + 12" gravel sump (= 10.8" total storage)		
8" ponding depth		
8" ponding depth + 12" gravel sump (= 12.8" total storage)		
8" ponding depth + 18" gravel sump (= 15.2" total storage)		
10" ponding depth + 18" gravel sump (= 17.2" total storage)		

*Gravel sump storage estimates assume #57 stone with 40% void space. **A standpipe should be utilized with all gravel sump practices.**

Step 3: Determine the Storage Volume for Maintaining Peak Runoff Rate

Using the Charts in Appendix B of the "LID Hydrologic Analysis", determine the **storage volume** required to **<u>maintain peak Runoff Rate using 100% RETENTION storage.</u>** **(Use the chart for a Type II storm for with your design rainfall)**

Storage Volume $_{\text{Peak Rate Control}}$ *(using 100% Retention)* = _____ in (across entire site)
= _____ ft^3

Step 4: Evaluate Need for Additional Detention Storage (Hybrid Design)

Compare the volumes required for volume control and peak rate control:

If Retention Storage *Volume > Storage Volume*$_{\text{peak rate control (100\% Retention)}}$…
Design site IMPs to retain (infiltrate) the Retention Storage Volume. No additional detention is required.

If Retention Storage Volume < *Storage Volume*$_{\text{peak rate control (100\% Retention)}}$…
*(or if **Retention Storage Volume** is unachievable with infiltration IMPs due to site **constraints**) then a HYBRID DESIGN IS REQUIRED.*
Follow Steps 5,6, & 7 on pages 34-37, of "LID Hydrologic Analysis" to calculate additional detention or retention required to meet peak runoff rate. LID seeks to use distributed, micro-scale practices such as rain gardens, amended soils, green roofs, rain barrels, etc to retain this additional volume as well. If this is not practicable for the site, ponds can be used to detain the additional volume.

Additional detention required = _____ in (across entire site)
= _____ ft^3

Summary of Quantitative LID Results

Yes / No	Site design and impervious cover reduction practices were used to the maximum extent practicable to minimize runoff volume.
Yes / No	**The design results in a post-development Tc equal to or greater than the pre-development Tc.**
Yes / No	The entire **Retention Storage Volume** will be retained and infiltrated.
Yes / No / NA	If the entire **Retention Storage Volume** is not retained and infiltrated, the plans show that every practicable effort was made to implement runoff volume reduction efforts, and all potential green space areas were made hydrologically functional for retention.
Yes / No	Detention practices were used to store any additional volume required to maintain the predevelopment peak rate.

References

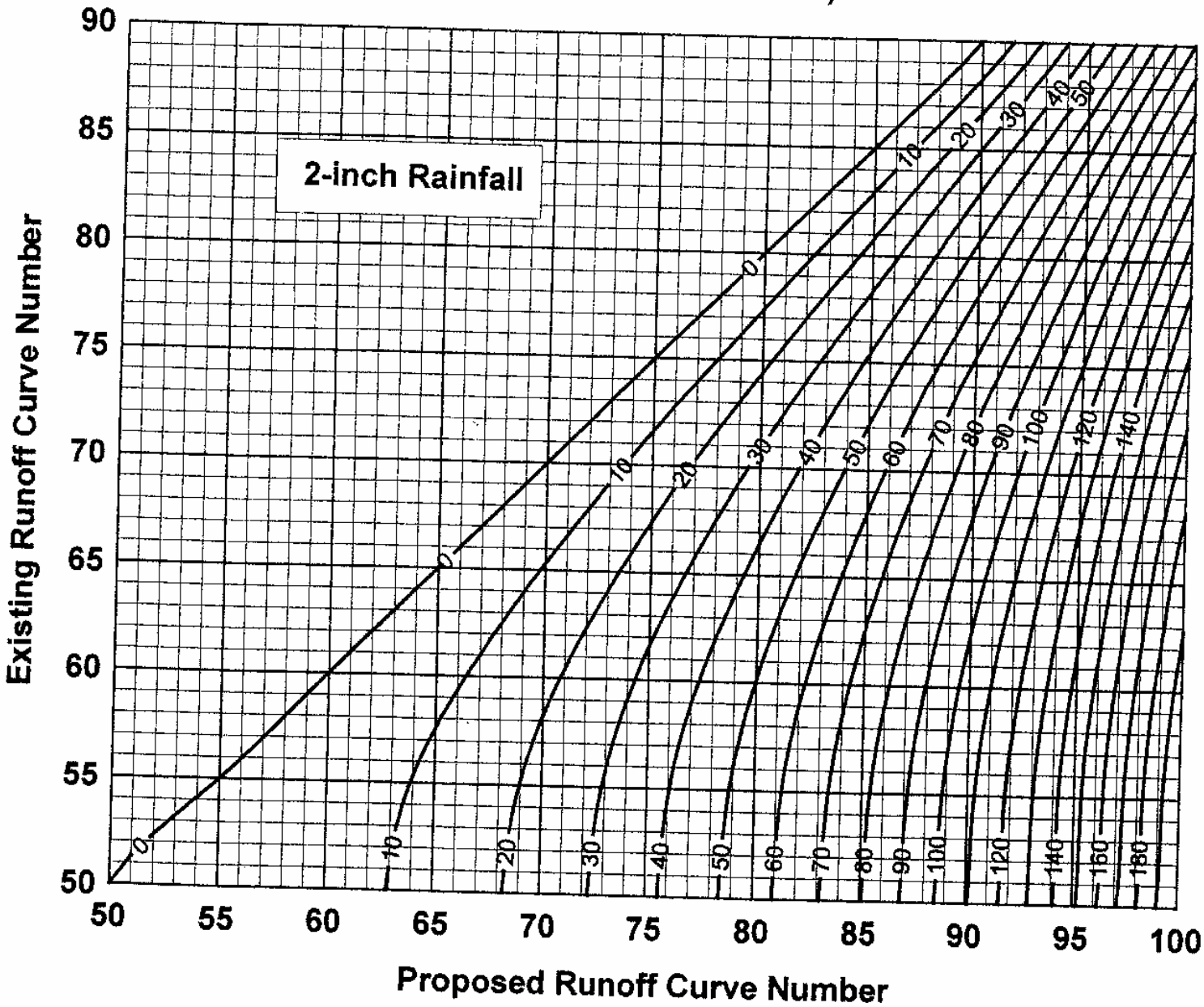
1. **Low Impact Development National Manual.** ***Low-Impact Development Design Strategies An Integrated Design Approach.*** EPA 841-B-00-003. Available on the web at http://www.epa.gov/owow/nps/lid
2. **Low Impact Development National Hydrology Manual.** ***Low-Impact Development Hydrologic Analysis***. EPA 841-B-00-002**.** Available on the web at http://www.epa.gov/owow/nps/lid

NOTE: The appendices to the hydrology document include a series of charts which are required to calculate LID storage volumes. They are not currently available in the downloadable version, but selected charts from that series are attached to the end of this document.

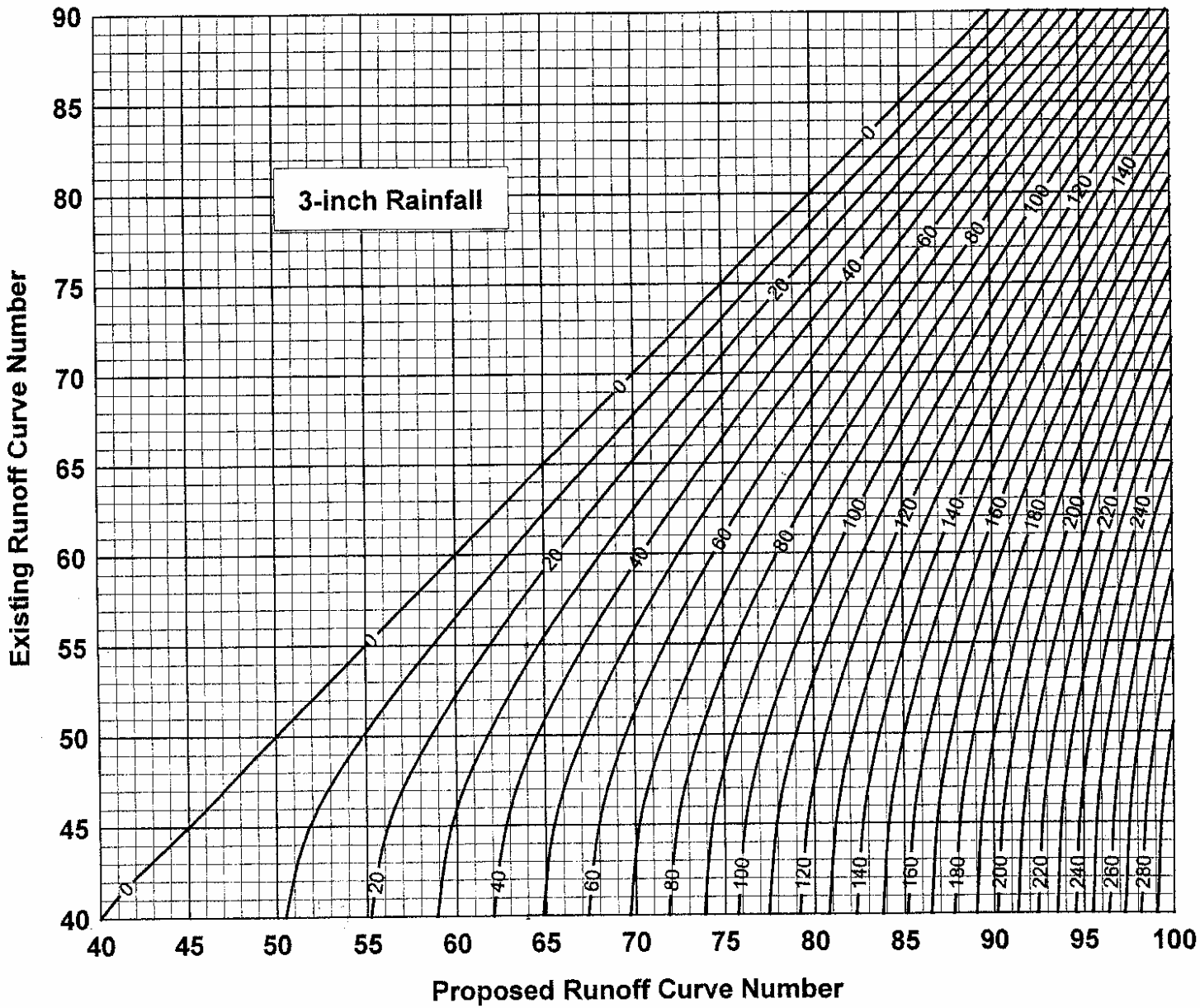
Selected Charts for Calculating LID Storage Volumes

taken from
"LID Hydrologic Analysis"
(Low Impact Development National Hydrology Manual)
Prince Georges County, Md. – June 2002

Storage Required to Maintain Pre-Development Runoff Volume (hundredths of an inch)



Storage Required to Maintain Pre-Development Runoff Volume (hundredths of an inch)



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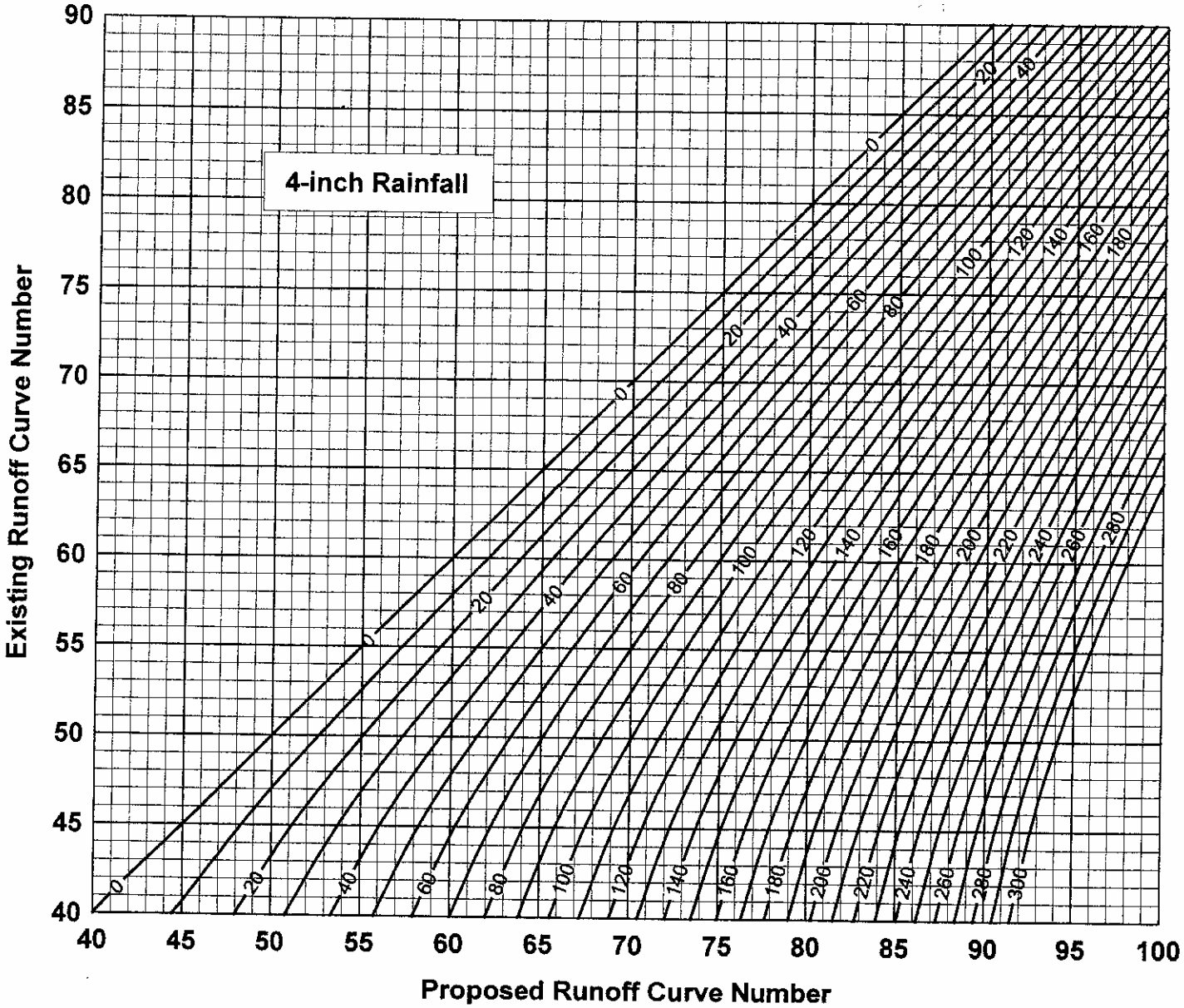


Charts Taken from

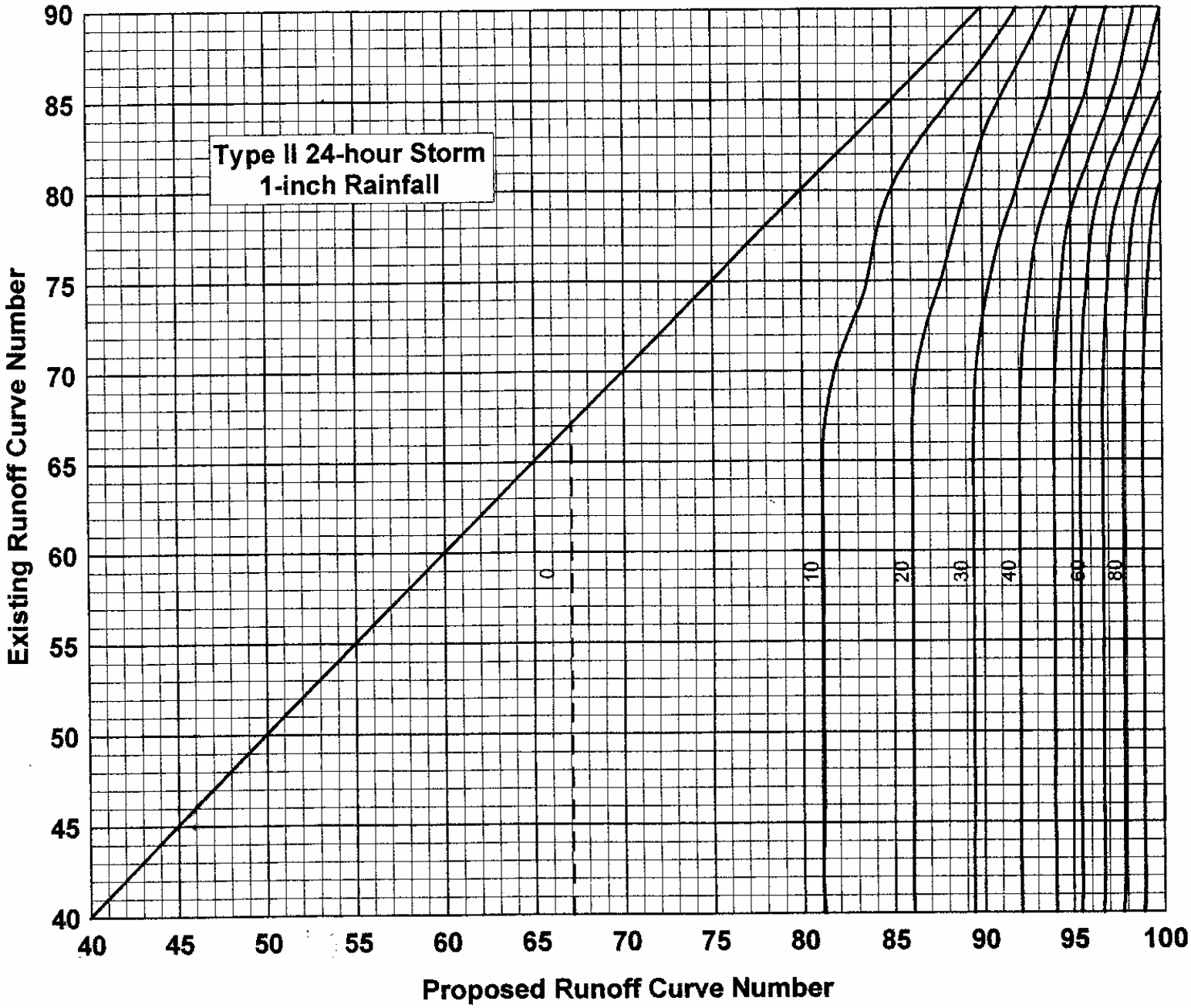
APPENDIX B

Of

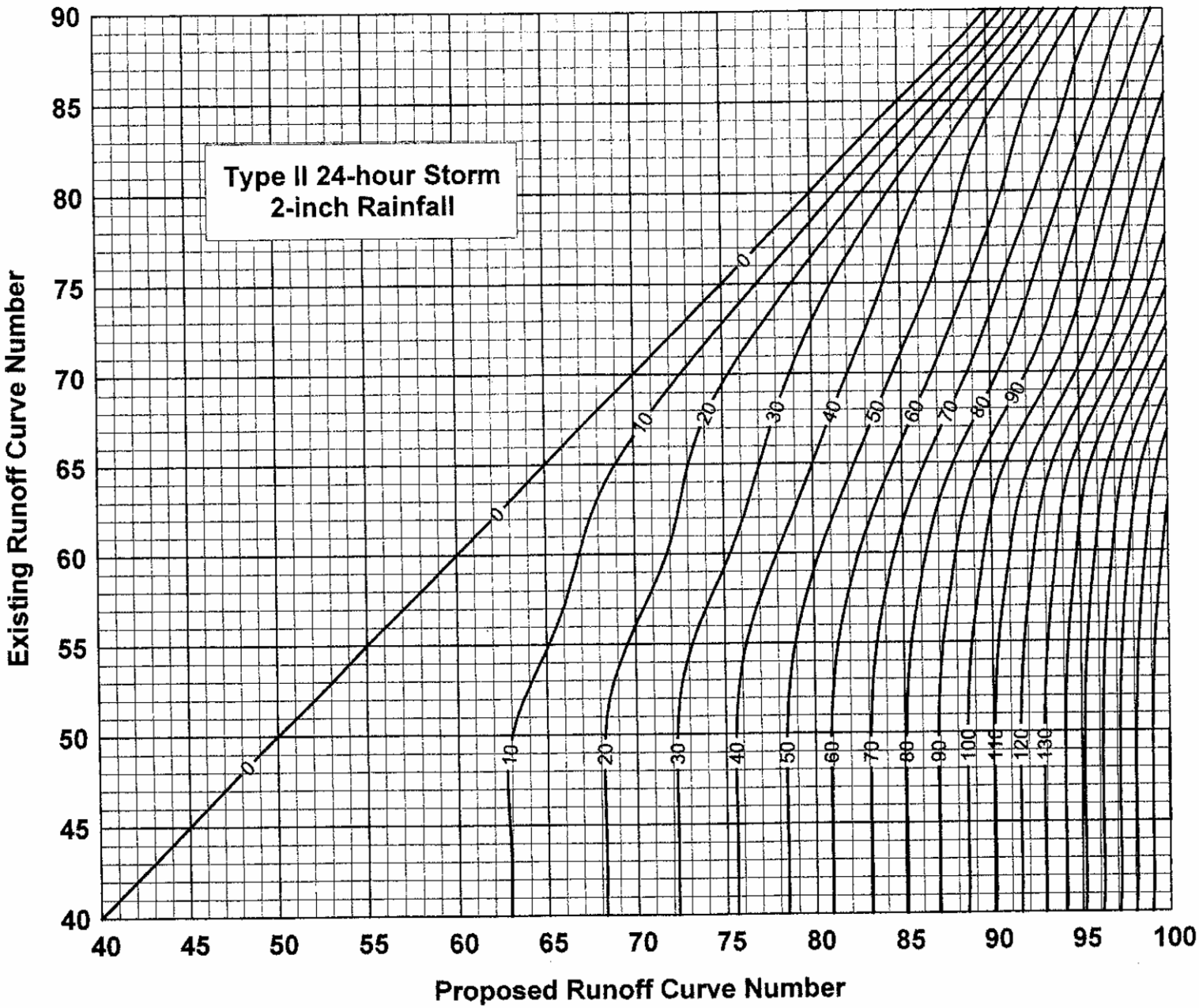
LID Hydrologic Analysis

“Storage Required to Maintain Peak Runoff using 100% Retention”

Storage Required to Maintain Pre-Development Peak Runoff Rate Using 100% Retention (hundredths of an inch)



Storage Required to Maintain Pre-Development Peak Runoff Rate Using 100% Retention (hundredths of an inch)



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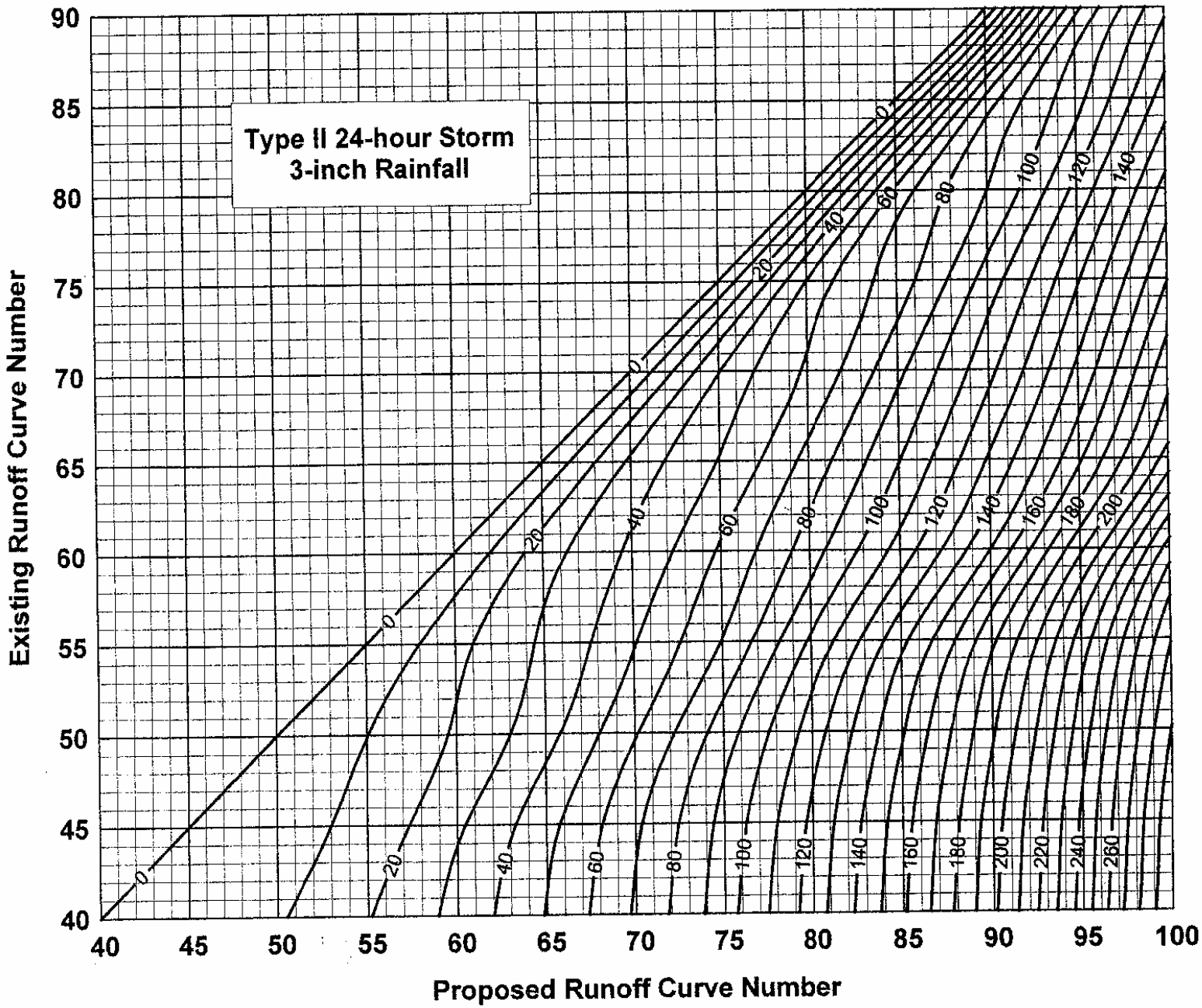
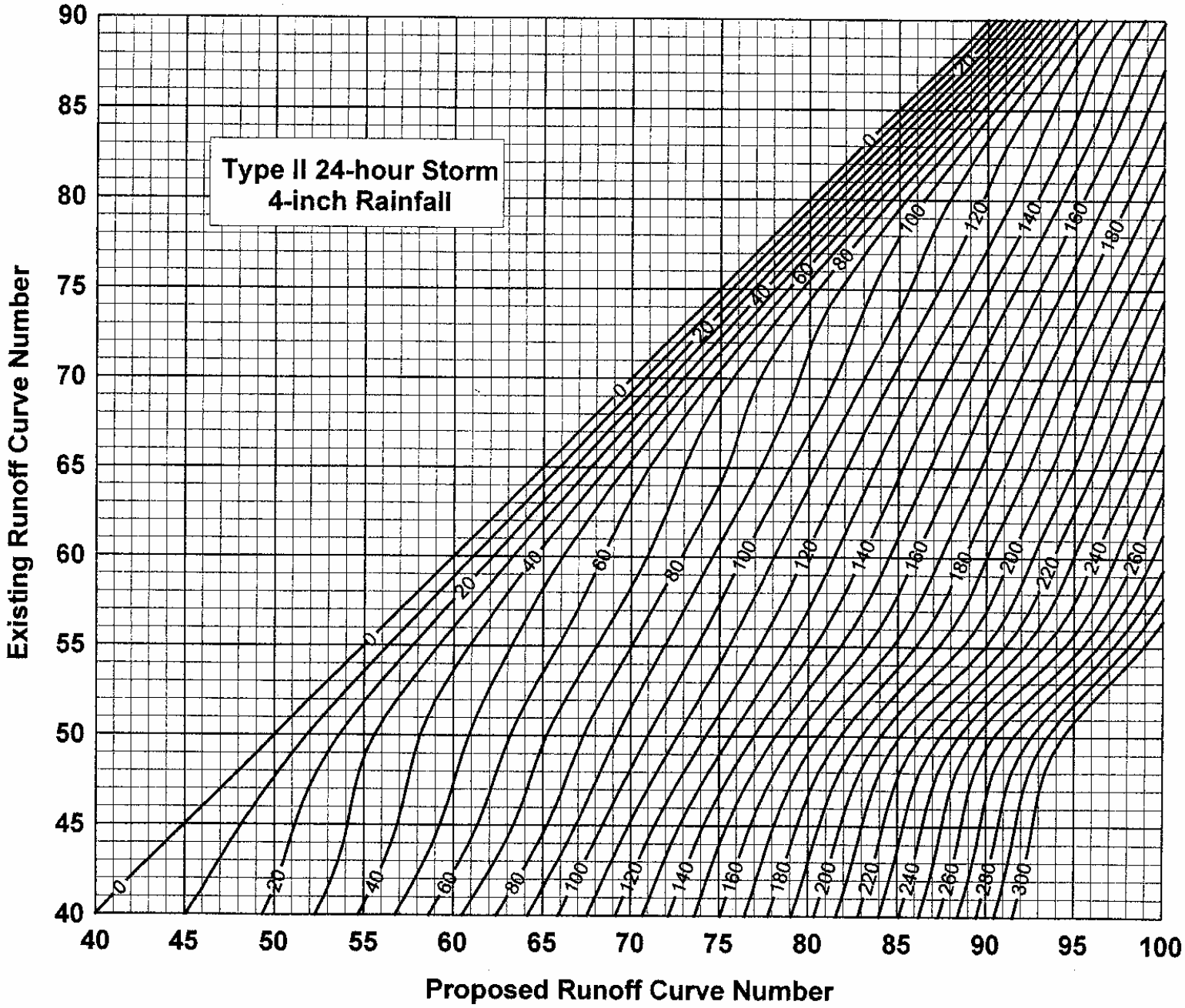


Storage Required to Maintain Pre-Development Peak Runoff Rate Using 100% Retention (hundredths of an inch)



Charts Taken from

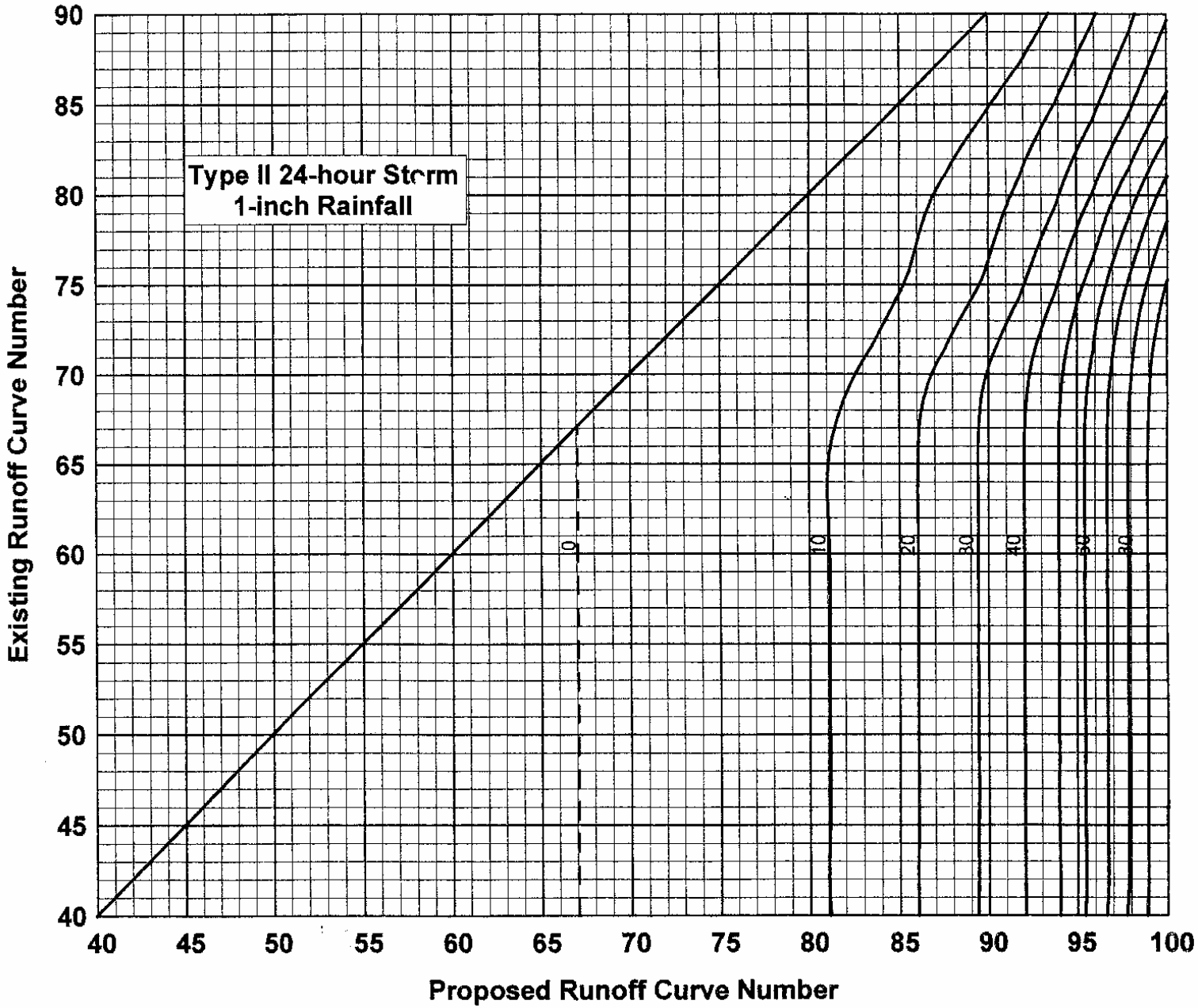
APPENDIX C

Of

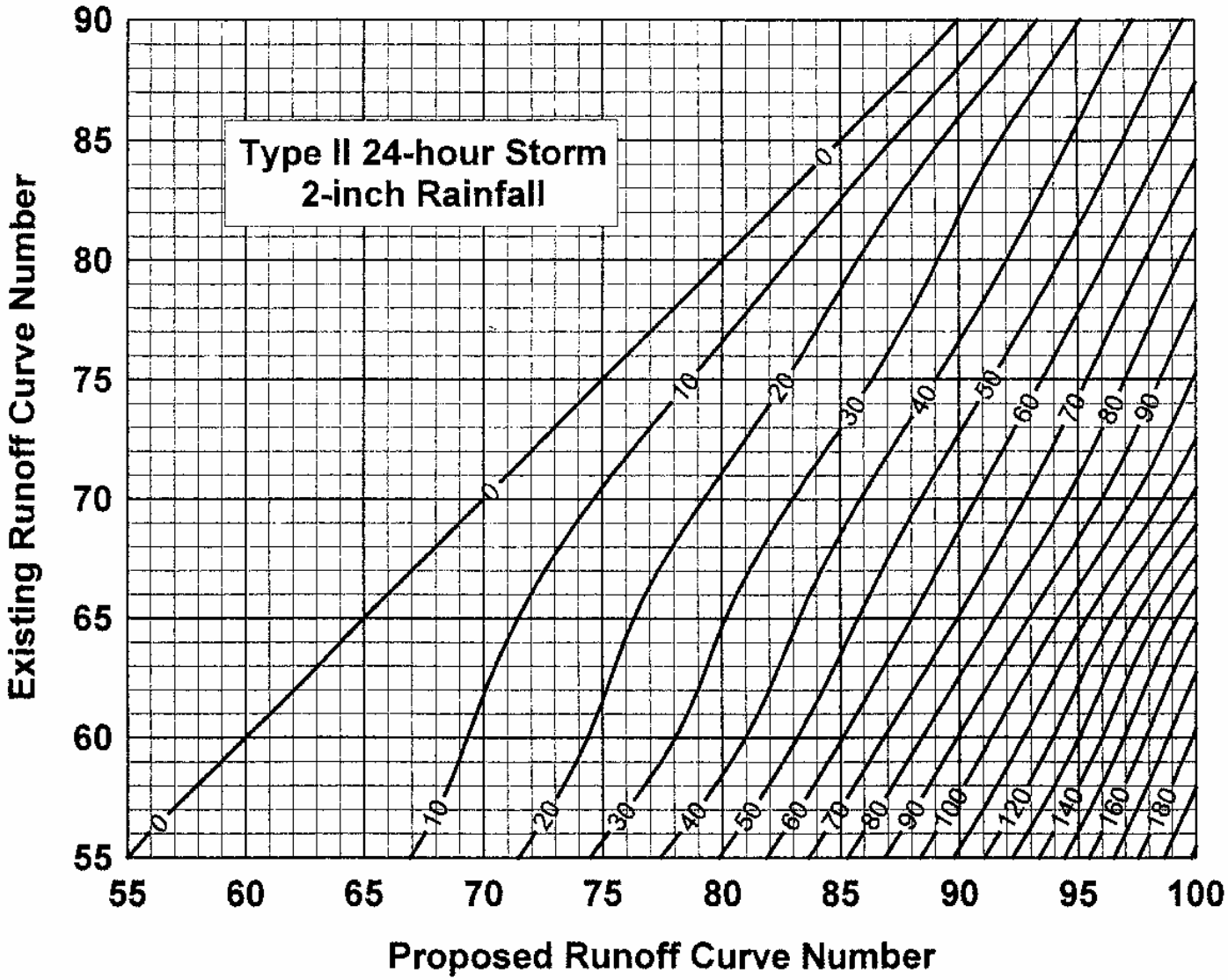
LID Hydrologic Analysis

“Storage Required to Maintain Peak Runoff using 100% Detention”

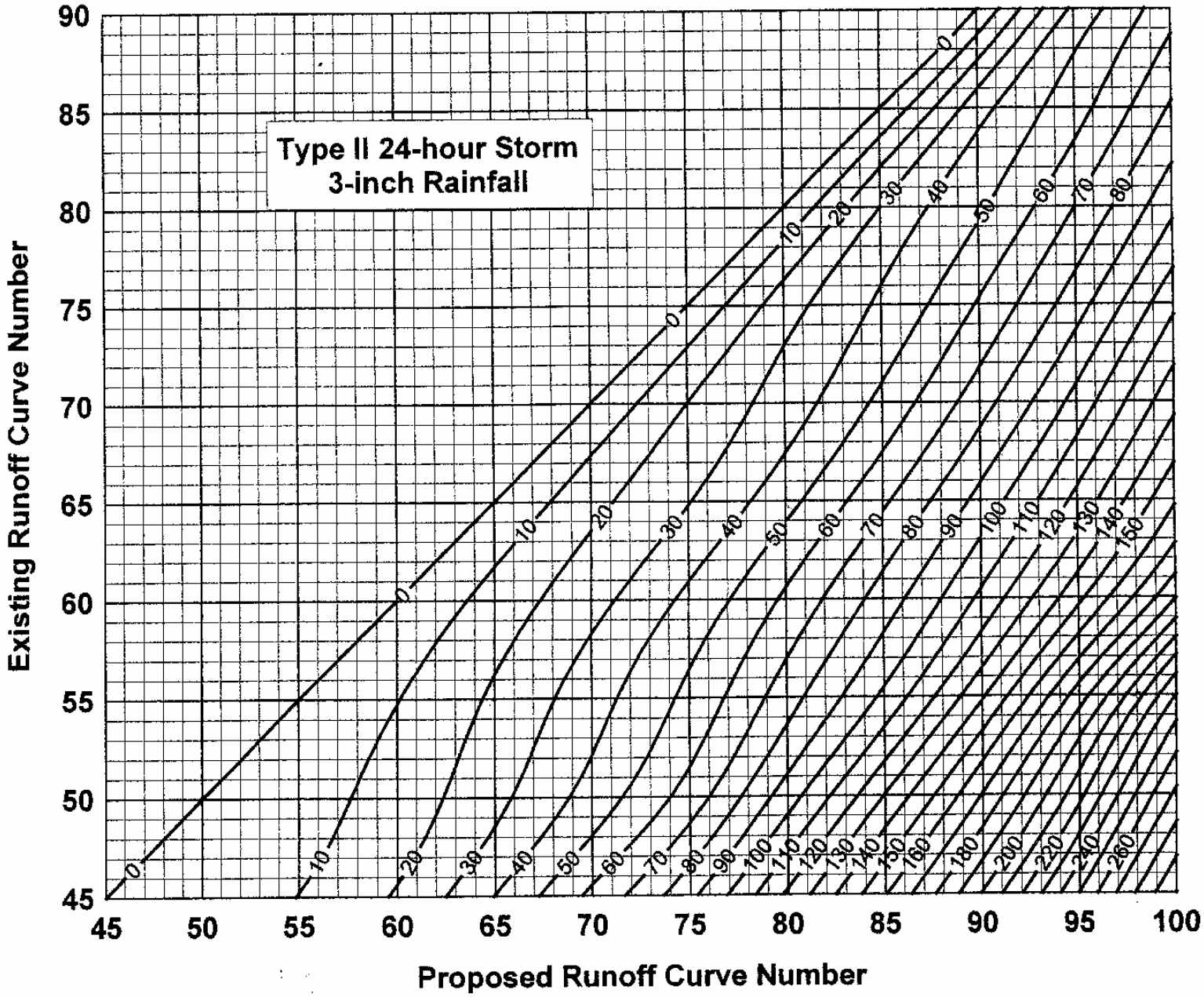
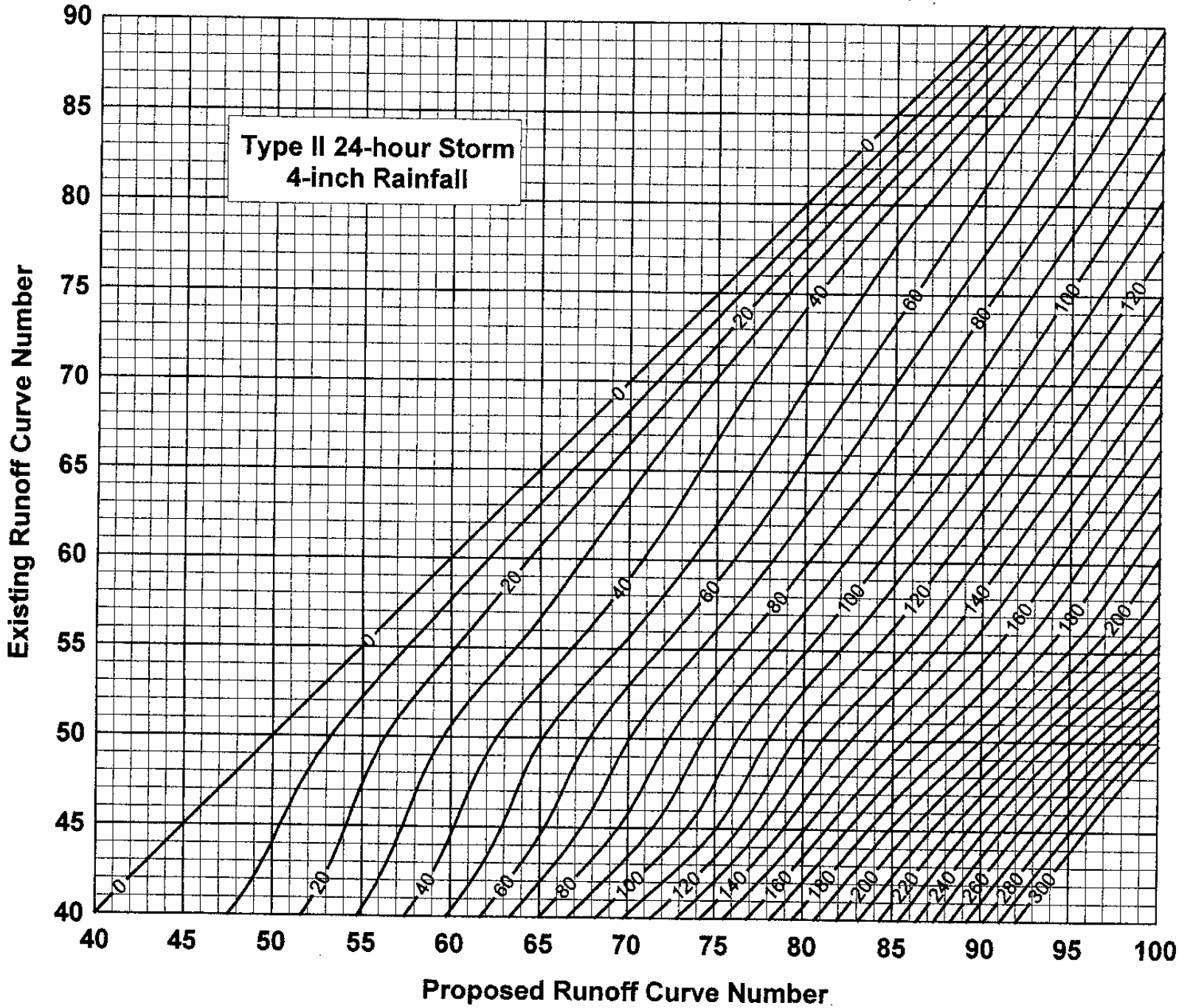
Storage Required to Maintain Pre-Development Peak Runoff Rate Using 100% Detention (hundredths of an inch)



Storage Required to Maintain Pre-Development Peak Runoff Rate Using 100% Detention (hundredths of an inch)



Storage Required to Maintain Pre-Development Peak Runoff Using 100% Detention (hundredths of an inch)



Storage Required to Maintain Pre-Development Peak Runoff Rate Using 100% Detention (hundredths of an inch)