

CHAPTER 21**RESIDENTIAL SITE IMPROVEMENT STANDARDS****Authority**

N.J.S.A. 40:55D-40.4.

Source and Effective Date

R.1997 d.5, effective January 6, 1997 (operative June 3, 1997).
See: 28 N.J.R. 2671(a), 28 N.J.R. 3491(a), 29 N.J.R. 159(a).

Executive Order No. 66(1978) Expiration Date

Chapter 21, Residential Site Improvement Standards, expires on January 6, 2002.

Chapter Historical Note

Chapter 21, Uniform Standards Code for Mobile Homes, was adopted pursuant to authority of N.J.S.A. 52:2D-25.1 et seq. and was filed and became effective December 7, 1972, as R.1972 d.248. See: 4 N.J.R. 260(f), 5 N.J.R. 7(a). Chapter 21 was amended by R.1974 d.275, effective January 1, 1975. See: 6 N.J.R. 343(a), 6 N.J.R. 427(b); and R.1975 d.166, effective July 1, 1975. See: 7 N.J.R. 200(a), 7 N.J.R. 306(a). Chapter 21, Uniform Standards Code for Mobile Homes, was repealed by R.1982 d.7, effective February 1, 1982. See: 13 N.J.R. 717(a), 14 N.J.R. 142(a).

Chapter 21, Residential Site Improvement Standards, was adopted as R.1997 d.5, effective January 6, 1997 (operative June 3, 1997). See: Source and Effective Date.

CHAPTER TABLE OF CONTENTS**SUBCHAPTER 1. GENERAL PROVISIONS**

- 5:21-1.1 Title; division into subchapters
- 5:21-1.2 Authority
- 5:21-1.3 Intent and purpose
- 5:21-1.4 Definitions and abbreviations
- 5:21-1.5 Scope and applicability
- 5:21-1.6 Development over limestone geologic formations
- 5:21-1.7 Administration and enforcement
- 5:21-1.8 Approval
- 5:21-1.9 Violations
- 5:21-1.10 Operative date
- 5:21-1.11 Validity

APPENDIX 1-A NEW JERSEY MUNICIPALITIES—LIMESTONE AREAS**SUBCHAPTER 2. APPLICATION AND REVIEW PROCEDURES**

- 5:21-2.1 Application and review procedures
- 5:21-2.2 Application form and checklist (Reserved)

SUBCHAPTER 3. EXCEPTIONS, WAIVERS, AND SPECIAL AREA STANDARDS

- 5:21-3.1 Exceptions
- 5:21-3.2 Waiver request
- 5:21-3.3 Waiver review
- 5:21-3.4 Appeal of waiver decisions
- 5:21-3.5 Special area standards
- 5:21-3.6 Agreement to exceed standards

SUBCHAPTER 4. STREETS AND PARKING

- 5:21-4.1 Street hierarchy

- 5:21-4.2 Cartway width
- 5:21-4.3 Curbs or curbs and gutters
- 5:21-4.4 Shoulders
- 5:21-4.5 Sidewalks and graded areas
- 5:21-4.6 Bikeways
- 5:21-4.7 Utility areas
- 5:21-4.8 Right-of-way and cartway
- 5:21-4.9 Street grade and intersections
- 5:21-4.10 Pavement
- 5:21-4.11 Street and site lighting (Reserved)
- 5:21-4.12 Underground wiring
- 5:21-4.13 Street and traffic signs
- 5:21-4.14 Parking: number of spaces
- 5:21-4.15 Parking space size
- 5:21-4.16 Parking areas
- 5:21-4.17 Curb construction standards
- 5:21-4.18 Sidewalks and bikeways construction standards
- 5:21-4.19 Street grade, intersections, pavement, and lighting construction standards
- 5:21-4.20 Curves

SUBCHAPTER 5. WATER SUPPLY

- 5:21-5.1 Water supply system
- 5:21-5.2 Capacity
- 5:21-5.3 System design and placement
- 5:21-5.4 Fire hydrants

APPENDIX HARDY-CROSS METHOD**SUBCHAPTER 6. SANITARY SEWERS**

- 5:21-6.1 Sanitary sewer system
- 5:21-6.2 System planning, design, and placement

SUBCHAPTER 7. STORMWATER MANAGEMENT

- 5:21-7.1 Stormwater management: general system strategy
- 5:21-7.2 Runoff estimation techniques
- 5:21-7.3 Runoff collection system design
- 5:21-7.4 Stormwater management: system design
- 5:21-7.5 Stormwater management: system design—detention facilities
- 5:21-7.6 Stormwater management: water quality

APPENDIX CORRUGATED METAL PIPE STANDARDS**SUBCHAPTER 8. REFERENCED STANDARDS**

- 5:21-8.1 Referenced standards

SUBCHAPTER 1. GENERAL PROVISIONS**5:21-1.1 Title; division into subchapters**

(a) These rules shall be known as the "New Jersey Residential Site Improvement Standards" and are referred to herein as "the rules."

(b) This chapter consists of the following subchapters:

1. "General Provisions," which may be cited throughout the rules as N.J.A.C. 5:21-1 and when referred to in subchapter 1 of this chapter, may be cited as "this subchapter."

2. "Application and Review Procedures," which may be cited throughout the rules as N.J.A.C. 5:21-2 and when

referred to in subchapter 2 of this chapter, may be referred to as "this subchapter."

3. "Exceptions, Waivers, and Special Area Standards," which may be cited throughout these rules as N.J.A.C. 5:21-3 and when referred to in subchapter 3 of this chapter, may be referred to as "this subchapter."

4. "Streets and Parking," which may be cited throughout these rules as N.J.A.C. 5:21-4 and when referred to in subchapter 4 of this chapter, may be referred to as "this subchapter."

5. "Water Supply," which may be cited throughout these rules as N.J.A.C. 5:21-5 and when referred to in subchapter 5 of this chapter, may be referred to as "this subchapter."

6. "Sanitary Sewers," which may be cited throughout these rules as N.J.A.C. 5:21-6 and when referred to in subchapter 6 of this chapter, may be referred to as "this subchapter."

7. "Stormwater Management," which may be cited throughout these rules as N.J.A.C. 5:21-7 and when referred to in subchapter 7 of this chapter, may be referred to as "this subchapter."

8. "Referenced Standards," which may be cited throughout these rules as N.J.A.C. 5:21-8 and referred to in subchapter 8 of this chapter, may be referred to as "this subchapter."

5:21-1.2 Authority

These rules are promulgated by the Commissioner of the Department of Community Affairs pursuant to the authority of P.L. 1993, c.32 (N.J.S.A. 40:55D-40.1 et seq.)

5:21-1.3 Intent and purpose

(a) It is the intent and purpose of these rules:

1. To reduce the multiplicity of standards for residential subdivisions and site improvements which currently exists in this State in order to eliminate unnecessary increases in the cost of housing where there are noncommensurate gains in the protection of public health and safety;

2. To avoid unnecessary cost in the construction process, and to provide site improvement standards that are both sound and cost effective;

3. To ensure predictability in the site improvement standards applicable to residential construction;

4. To provide for development reviews of residential projects that are based, to the greatest extent possible, upon sound objective site improvement standards rather than upon discretionary design standards;

5. To streamline the development approval process and improve the efficiency of the application process by providing a uniform set of technical site improvement standards for land development;

6. To provide the widest possible range of design freedom and promote diversity through performance-oriented site improvement standards; and

7. To separate the policy-making aspects of development review from the making of technical determinations.

5:21-1.4 Definitions and abbreviations

The following words, terms, and abbreviations, when used in this chapter, shall have the following meanings, unless the context clearly indicates otherwise. There a word or term is defined in this chapter and the Municipal Land Use Law (N.J.S.A. 40:55D-1 et seq.), then the definition of that word or term found in the Municipal Land Use Law shall govern. Words and terms found in the Municipal Land Use Law, and defined here for convenience, have been designated by the use of "(MLUL)" following their meaning.

"AASHTO" means American Association of State Highway and Transportation Officials.

"ABS" means acrylonitrile-butadiene-styrene.

"ACI" means American Concrete Institute.

"Administrative Officer" means the clerk of the municipality, unless a different municipal official or officials are designated by ordinance or statute. (MLUL).

"ADT" (see average daily traffic.)

"Aggressive Soils" means soils which may be corrosive to metallic pipe or tubing.

"Aisle" means the traveled way by which cars enter and depart parking spaces.

"Alley" means a service road that provides a secondary means of access to lots.

"ANSI" means American National Standards Institute.

"Applicant" means a developer submitting an application for development. (MLUL).

"Application For Development" means the application form and all accompanying documents required by ordinance for approval of a subdivision plat, site plan, planned development, conditional use, zoning variance, or direction of the issuance of a permit pursuant to the Municipal Land Use Law. (MLUL).

(b) Any proposed revisions to the standards established by the Site Improvement Advisory Board may be submitted for consideration by any municipality shown on the list set forth as Appendix 1-A to this subchapter, incorporated herein by reference, or by any municipality where these materials are found to be present. Proposed revisions to the within standards shall be reviewed by the technical committee and recommended to the Site Improvement Advisory Board for approval.

5:21-1.7 Administration and enforcement

(a) Wherever a municipality has enacted an ordinance which requires subdivision and/or site plan approval pursuant to N.J.S.A. 40:55D-37, then the planning board of such municipality shall ensure that the plans and plats for any residential development subject to review under such ordinance comply with the requirements of these rules before issuing a preliminary or final approval.

(b) Whenever a zoning board of adjustment created pursuant to N.J.S.A. 40:55D-69 grants subdivision or site plan approval pursuant to the provisions of N.J.S.A. 40:55D-76(b), then that board shall ensure that any plans and plats comply with the requirements of these rules before issuing a preliminary or final approval.

Administrative correction.
See: 29 N.J.R. 1296(a).

5:21-1.8 Approval

(a) All materials, equipment, and devices required to be approved by a board or official pursuant to N.J.A.C. 5:21-1.7 shall be constructed and installed in accordance with such approval.

(b) The standards referenced in these rules and listed in N.J.A.C. 5:21-8 shall be considered a part of the requirements of these rules to the prescribed extent of each reference. Where deficiencies occur between provisions of these rules and referenced standards, the provisions of these rules shall apply, except as provided in N.J.A.C. 5:21-1.5(e).

Administrative correction.
See: 29 N.J.R. 1296(a).

5:21-1.9 Violations

(a) Where any site improvement is required to meet any part of these rules pursuant to the requirements of any ordinance adopted pursuant to N.J.S.A. 40:55D-37, Subdivision and Site Plan Review and Approval, or N.J.S.A. 40:55D-62, Zoning, then any failure of any person to construct such site improvements in accordance with the requirements of these rules shall constitute a violation of the Municipal Land Use Law (N.J.S.A. 40:55D-1 et seq.). Any person responsible for such failure shall be subject to such penalties and enforcement procedures as are provided by that law and by any valid ordinance adopted pursuant

thereto which may be initiated by the administrative officer designated by the ordinance (N.J.S.A. 40:55D-18).

(b) In addition to any remedy provided by (a) above, any failure to comply with the requirements of these rules, where compliance is required, shall constitute a failure to meet the conditions of the construction permit and/or certificate of occupancy issued pursuant to the State Uniform Construction Code Act (N.J.S.A. 52:27D-119 et seq.). Notification from the approving authority or from the municipal engineer acting on behalf of the approving authority that any of the requirements of these rules that are conditions of the Construction Permit and/or Certificate of Occupancy have not been met shall subject any person responsible for such failure to the remedies provided under the State Uniform Construction Code Act.

Administrative correction.
See: 29 N.J.R. 1296(a).

5:21-1.10 Operative date

(a) These rules shall be operative on June 3, 1997. The requirements of any municipal ordinances or rules adopted by any instrumentality deriving authority therefrom in effect on that date which establish rules or requirements for any matter within the scope of these regulations shall be deemed to have been repealed and of no further force or effect.

(b) Any project for which preliminary subdivision or site plan approval has been given prior to June 3, 1997 shall continue to be subject to the municipal development ordinance under which it was approved.

(c) Any project for which application is made after June 3, 1997 shall be governed by these rules.

(d) These rules shall not be construed as requiring the revision or amendment of any application for site plan or subdivision approval which is pending on June 3, 1997. Such pending applications may, however, be amended provided that any such amendments shall meet the requirements of these rules.

1. For any project for which a completed application has been submitted on or before the operative date of these rules, but which has not yet received preliminary approval, the applicant shall have the option of amending the application in its entirety to comply with these rules or of requesting that the municipality continue to review the application under the municipal ordinances in effect at the time of application.

5:21-1.11 Validity

If any provision of these rules or the application thereof to any person or circumstances is held invalid, the invalidity shall not affect other provisions or applications of the rules which can be given effect, and to this end the provisions of the rules are severable.

APPENDIX 1-A

5:21-2.2 Application form and checklist (Reserved)

NEW JERSEY MUNICIPALITIES-
LIMESTONE AREAS†

County	Municipality	
Hunterdon	Alexandria Township	Hampton Borough
	Bethlehem Township	Holland Township
	Bloomsbury Borough	Lebanon Township
	Califon Borough	Tewksbury Township
	Clinton Township	Union Township
	Clinton Town	
Morris	Chester Township	Mount Olive Township
	Jefferson Township	Mt. Arlington Borough
	Mendham Township	Randolph Township
	Mendham Borough	Rockaway Township
	Minehill Township	Roxbury Township
	Montville Township	Washington Township
	Morris Township	Wharton Borough
Passaic	Bloomington Borough	Wanaque Borough
	Ringwood Township	West Milford Township
Somerset	Bedminster Township	Peapack/Gladstone Borough
	Far Hills Borough	
Sussex	Andover Township	Lafayette Township
	Andover Borough	Montague Township
	Branchville Borough	Newton Town
	Byram Township	Ogdensburg Borough
	Frankford Township	Sandyston Township
	Franklin Borough	Sparta Township
	Fredon Township	Stillwater Township
	Green Township	Vernon Township
	Hamburg Borough	Walpack Township
	Hampton Township	Wantage Township
	Hardyston Township	
Warren	Allamuchy Township	Independence Township
	Alpha Borough	Knowlton Township
	Belvidere Township	Liberty Township
	Blairstown Township	Lopatcong Township
	Franklin Township	Mansfield Township
	Frelinghuysen Township	Oxford Township
	Greenwich Township	Phillipsburg Township
	Hackettstown Town	Pohatcong Township
	Hardwick Township	Washington Township
	Harmony Township	Washington Borough
	Hope Township	White Township

† Listing established by the Department of Environmental Protection, Division of Science and Research (April 1995)

SUBCHAPTER 2. APPLICATION AND REVIEW PROCEDURES

5:21-2.1 Application and review procedures

The procedure for municipal review and action on applications for residential subdivisions and/or site plans shall not be affected by anything contained in these rules, and shall continue to be as set forth in the Municipal Land Use Law (MLUL), N.J.S.A. 40:55D-1 et seq. and in municipal ordinances adopted pursuant to the MLUL. This review shall include a review for compliance with these rules.

SUBCHAPTER 3. EXCEPTIONS, WAIVERS, AND SPECIAL AREA STANDARDS

5:21-3.1 Exceptions

(a) The municipal approving authority may grant such de minimis exceptions from the requirements of the site improvement standards as may be reasonable and within the general purpose and intent of the standards if the literal enforcement of one or more provisions of the standards is impracticable or will exact undue hardship because of peculiar conditions pertaining to the development in question.

(b) An application for an exception pursuant to this section shall be filed in writing with the municipal approving authority and shall include:

1. A statement of the requirements of the standards from which an exception is sought;
2. A statement of the manner by which strict compliance with said provisions would result in practical difficulties; and
3. A statement of the nature and extent of such practical difficulties.

(c) Exceptions shall become a part of the construction documents and shall be retained by the municipal approving authority.

(d) Within 30 days of granting a de minimis exception request, a municipal approving authority agreeing to an exception pursuant to this section shall send a copy of the document(s) constituting the de minimis exception resolution and/or document to the New Jersey Department of Community Affairs, Division of Codes and Standards, 101 South Broad Street, CN 802, Trenton, NJ 08625-0802. Such notice shall be clearly marked "Site Improvement Exception(s)."

(e) An application for an exception may also be made by an officer or agency of the municipality.

(f) Examples of de minimis exceptions include, but are not limited to, the following:

1. Reducing the minimum number of parking spaces and the minimum size of parking stalls;
2. Reducing the minimum geometrics of street design, such as curb radii, horizontal and vertical curves, intersection angles, centerline radii, and others;
3. Reducing cartway width; and
4. Any changes in standards necessary to implement traffic calming devices.

(g) The municipal approving authority's granting of a request for a de minimis exception shall be based on a finding that the requested exception meets the following criteria:

1. It is consistent with the intent of the Site Improvement Act;
2. It is reasonable, limited, and not unduly burdensome;

3. It meets the needs of public health and safety; and
4. It takes into account existing infrastructure and possible surrounding future development.

Administrative correction.
See: 29 N.J.R. 1296(a).

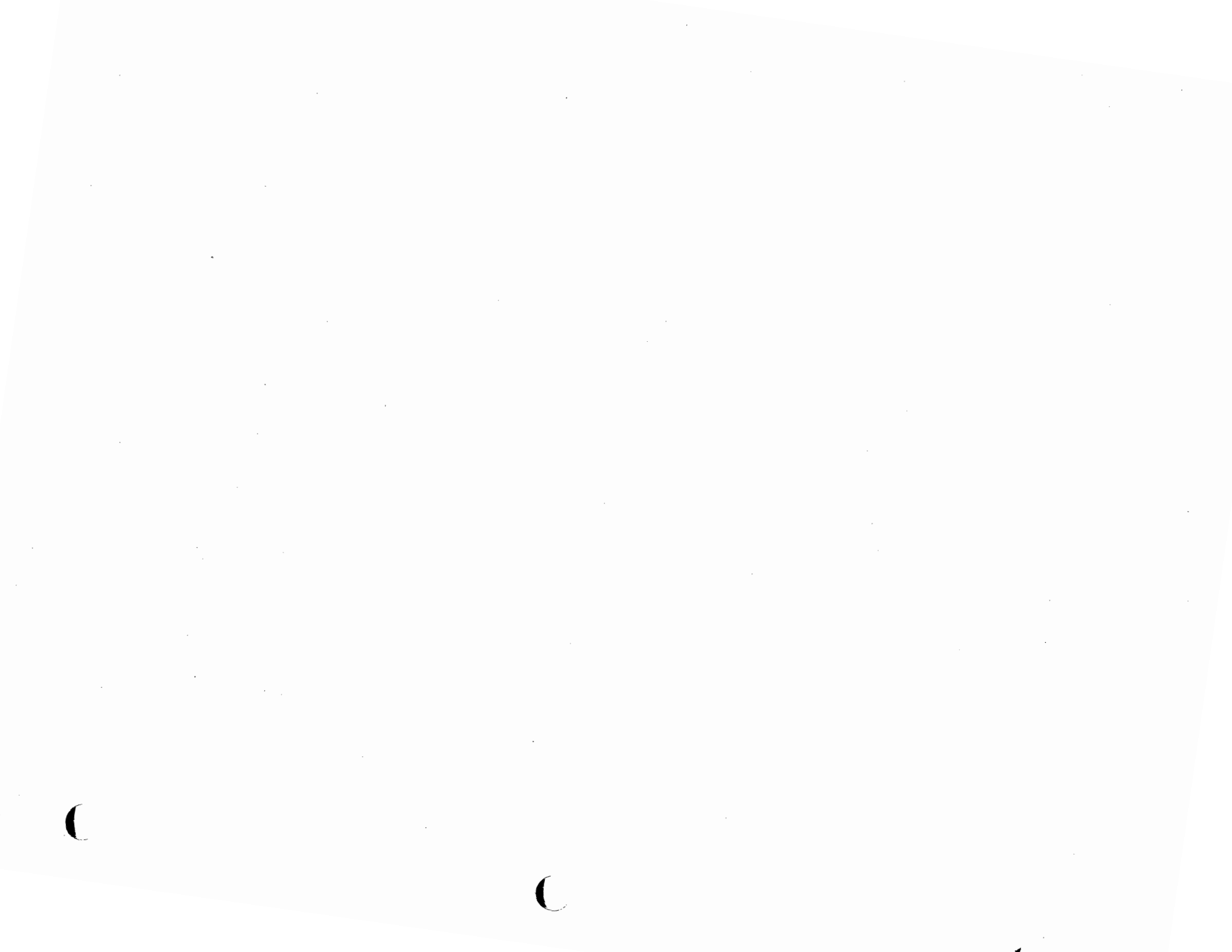
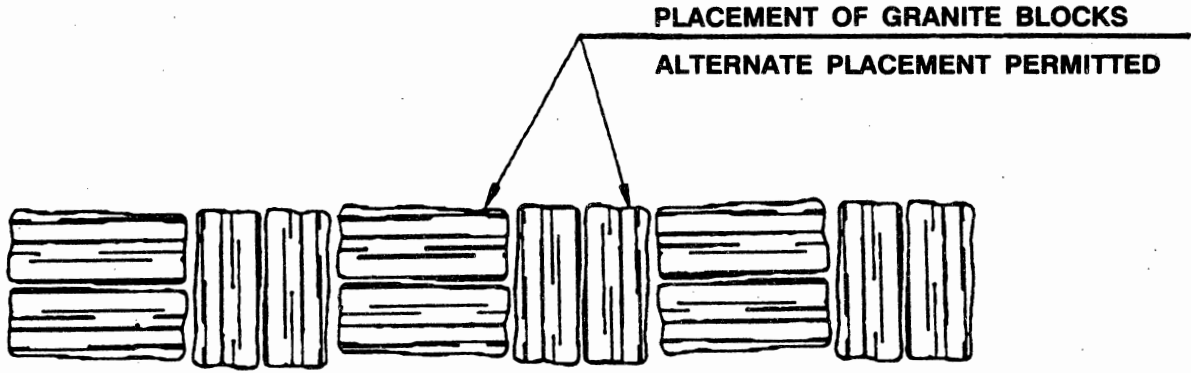
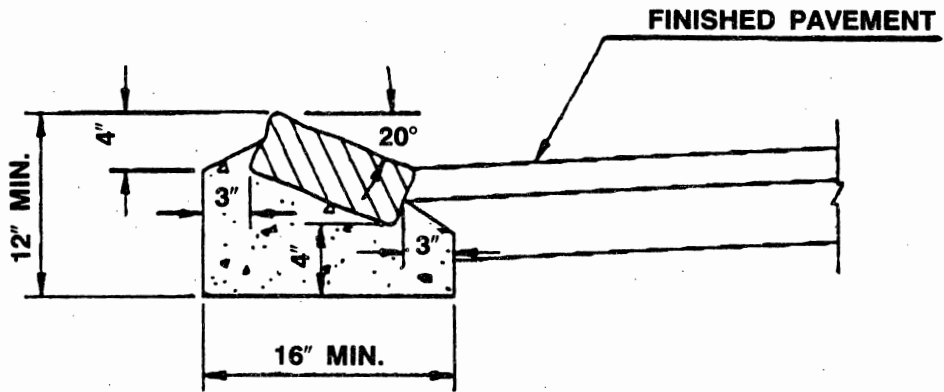


FIGURE 4.1
(4 of 4)



PLAN



SECTION

MOUNTABLE GRANITE BLOCK CURB



(b) The standard concrete curb section used shall be a maximum of 20 feet in length, with a scored joint every 10 feet. All concrete used for curbs or combination curbs and gutters shall be prepared in accordance with the requirements, by class of concrete, of the New Jersey Department of Transportation, *Standard Specifications for Road and Bridge Construction*, effective at the time of preparation. Where bituminous concrete pavement is used for the road surface, the curb and/or gutter shall be constructed first.

(c) Where drainage inlets are constructed but curbs are not required, curbing must be provided at least 10 feet on each side of the inlet, set back one foot from the extension of the pavement edge.

Administrative correction.
See: 29 N.J.R. 1296(a).

5:21-4.18 Sidewalks and bikeways construction standards

(a) The following apply to sidewalks and graded areas:

1. Sidewalks of concrete shall be four inches thick except at points of vehicular crossing, where they shall be at least six inches thick. At vehicular crossings, concrete sidewalks shall be reinforced with welded wire fabric mesh or an equivalent.

2. Concrete air-entrained sidewalks shall be Class C concrete, having a 28-day verification strength of 4000 p.s.i. Other materials may be permitted, depending on the design of the development.

3. Graded areas shall be planted with grass or treated with other suitable ground cover, and their width and cross slope shall correspond to that of sidewalks.

(b) The following apply to bikeways:

1. The paved width of the bicycle path shall be established by the municipal master plan.

i. Choice of surface materials, including bituminous mixes, concrete, compacted gravel, soil cement, stabilized earth, and wood planking shall depend on use and users of the path.

ii. Gradients of bike paths should generally not exceed five percent.

2. Bicycle-safe drainage grates shall be used in the construction of all residential streets.

Administrative correction.
See: 29 N.J.R. 1296(a).

5:21-4.19 Street grade, intersections, pavement, and lighting construction standards

(a) The following apply to street grade:

1. Minimum street grade permitted for all streets shall be 0.5 percent.

2. Maximum street grade shall vary by road hierarchy with flatter grades required for roads with higher ADTs, in accordance with the requirements shown in Table 4.6. Where terrain makes it necessary, the allowable maximum grade may be increased by up to two percent, but shall not exceed a maximum grade of 16 percent.

(b) The following apply to intersections:

1. Street intersections shall be as nearly at right angles as possible and in no case shall be less than 75 degrees.

2. New intersections along one side of an existing street shall, if possible, coincide with any existing intersections on the opposite side of each street. Use of "T" intersections in subdivisions shall be encouraged. To avoid corner-cutting when inadequate offsets exist between adjacent intersections, offsets shall be at least 150 feet between right-of-way centerlines.

3. Intersections shall be rounded at the curbline with the street having the highest radius requirement, as shown in Table 4.6 below, determining the minimum standard for all curb lines.

4. Intersections shall be designed with a flat grade wherever practical.

5. The minimum centerline radius, minimum tangent length between reverse curves, and curb radii shall be as shown in Table 4.6 below.

6. Sight triangles shall be in accordance with 1990 AASHTO's "A Policy on Geometric Design of Highways and Streets" standards and based on the speed limits established by the government agency having jurisdiction. Sight triangle easements shall be required and shall include the area on each street corner that is bounded by the line which connects the sight or "connecting" points located on each of the right-of-way lines of the intersecting street. The planting of trees or other plantings, or the location of structures exceeding 30 inches in height that would obstruct the clear sight across the area of the easements, shall be prohibited, and a public right-of-entry shall be reserved for the purpose of removing any object, material or otherwise, that obstructs the clear sight.

TABLE 4.6
STREET GRADE AND INTERSECTION DESIGN CRITERIA

Intersection standard	Street Hierarchy				
	Special purpose street alley	Special purpose street: Cul-de-sac	Rural, residential access, and neighborhood	Minor collector	Major collector
Minimum Grade	0.5%	0.5%	0.5%	0.5%	0.5%
Maximum Grade	15%	12%	12%	10%	8%
Maximum Grade Within 50 feet of Intersection [†]	5%	5%	5%	5%	5%
Minimum Center- Line Radius	100 ft	100 ft	100 ft	150 ft	300 ft
Minimum Tangent Length between Reverse Curves	0 ft	50 ft	50 ft	100 ft	150 ft
Curb Radii	20 ft	25 ft	25 ft	30 ft	35 ft

Note: [†] As measured from the nearest right-of-way level.

(c) Pavement design for residential access, neighborhood, rural, parking loop, minor collector, and major collector shall follow the specifications shown in Figures 4.2 and 4.3 below. Subgrade categories are shown in Table 4.7 below.

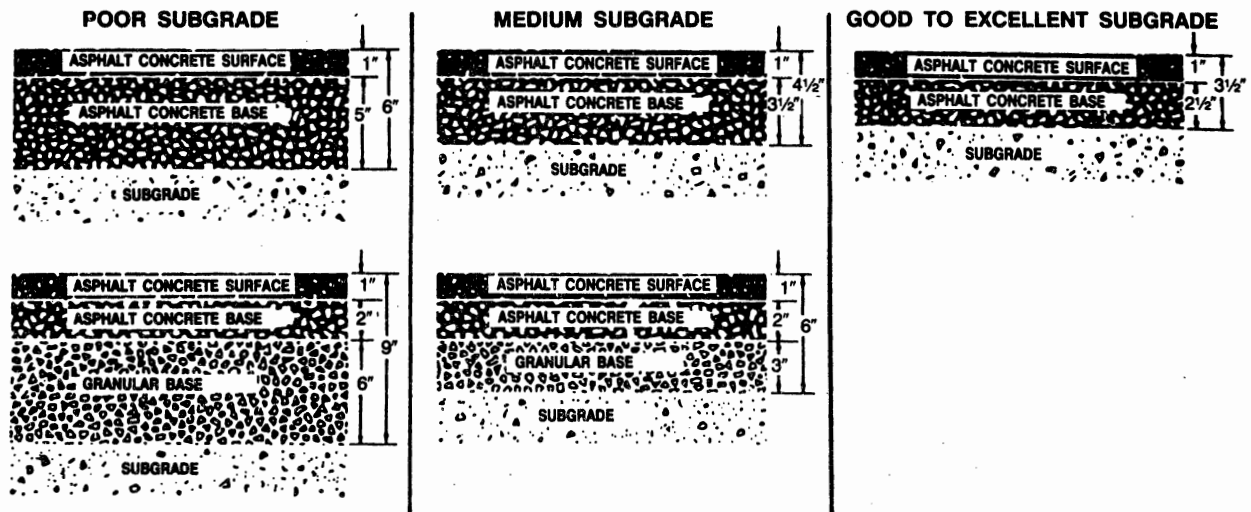
(d) Alternative pavement design shall be allowed provided it conforms with one of the following: AASHTO Method of Flexible Pavement Design, Caltrans Method of Flexible

Pavement Design, Asphalt Institute Method, AASHTO Method of Rigid Pavement Design, Fatigue Strength Method of Design, Multilayer Elastic Analysis, or the National Crushed Stone Association Design, incorporated herein by reference.

(e) Lighting (Reserved)

FIGURE 4.2

PAVEMENT SECTIONS FOR LOCAL STREETS
(Residential Access, Neighborhood, Rural or Parking Loop)

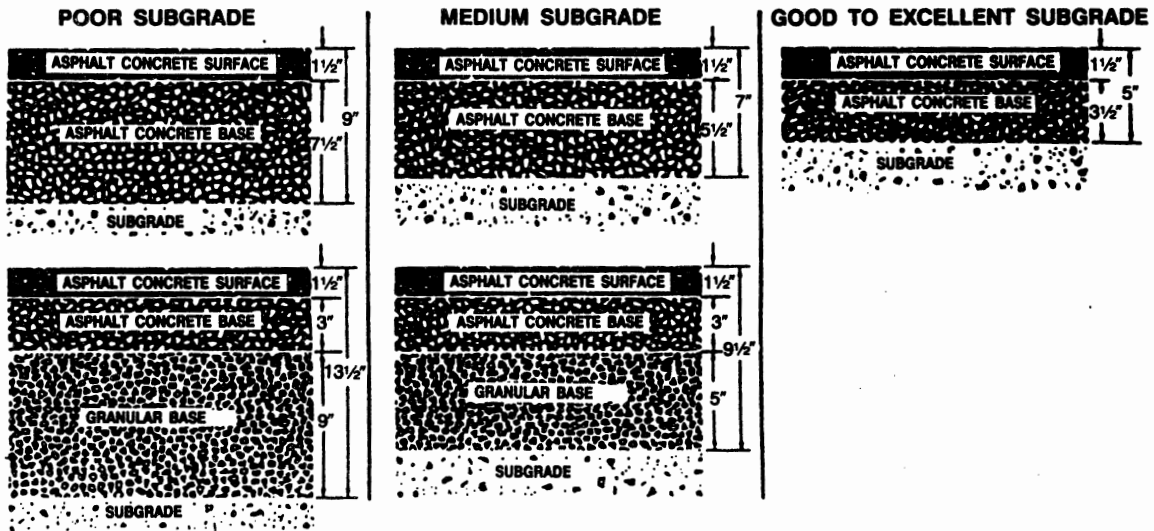


Source: New Jersey Society of Municipal Engineers, Asphalt Handbook for County and Municipal Engineers (Trenton, NJ NJSME, 1991).

NOTES:

1. The granular base shall be dense graded aggregate conforming to subsection 901.08 or soil aggregate designated I-5 conforming to subsection 901.09 and shown in Table 901-2 of the N.J. Department of Transportation standard Specifications for Road and Bridge Construction (1989).
2. All subgrades shall be considered "poor" unless the applicant proves otherwise through CBR testing or field evaluation of soil classification. Test results shall be reviewed by the Municipal Engineer.
3. Subgrade compaction shall be approved by the Municipal Engineer.

FIGURE 4.3
PAVEMENT SECTIONS FOR COLLECTOR STREETS
(Minor and Major)



Source: New Jersey Society of Municipal Engineers, Asphalt Handbook for County and Municipal Engineers (Trenton, NJ NJSME, 1991).

NOTES:

1. The granular base shall be dense graded aggregate conforming to subsection 901.08 or soil aggregate designated I-5 conforming to subsection 901.09 and shown in Table 901-2 of the N.J. Department of Transportation standard Specifications for Road and Bridge Construction (1989).
2. All subgrades shall be considered "poor" unless the applicant proves otherwise through CBR testing or field evaluation of soil classification. Test results shall be reviewed by the Municipal Engineer.
3. Subgrade compaction shall be approved by the Municipal Engineer.

TABLE 4.7
SUBGRADE CATEGORIES
A. BASED ON STRENGTH TEST

Subgrade category	California Bearing Ratio (Cbr)	Resilient Modules Mr Value
Good to excellent	+10	Above 15,000
Medium	+5 to 9	7,500 to 13,500
Poor	2 to 4	3,000 to 6,000

B. BASED ON SOIL CLASSIFICATION

Subgrade category	Material	Unified System ^a	AASHTO System ^a
Good to excellent	Gravels and sands	GW, GP, GM, GC, SW, SP, SM, SC	A-1, A-2-4, A-2-5, A-2-6, A-2-7, A-3
Good or poor	Silts and clays	ML, CL, OL, MH, CH, OH	A-4, A-5, A-6, A-7-5, A-7-6

Notes: ^a Refers to categories of soil types and properties.

Sources: Per the Rutgers Model Subdivision and Site Plan Ordinance by David Listokin and Carole W. Baker, January 1987—Original strength test and soil classification information derived from the Asphalt Institute, ****Thickness Design—Full-Depth Asphalt Pavement Structures for Highways and Streets****, MS-1, 8th Edition, August 1970 in Robert F. Baker et al. (editor), Handbook of Highway Engineering. Inclusion of SW, SP, SC soil classifications based on information from the Portland Cement Association's Thickness Design for Concrete Highway and Street Pavements.

Revised CBR strength test and Mr value information are from the Asphalt Handbook for County and Municipal Engineers, November 1991 (Second Edition), published by the New Jersey Society of Municipal Engineers.

Administrative correction.
See: 29 N.J.R. 1296(a).

5:21-4.20 Curves

(a) Vertical and horizontal curves shall be designed in accordance with 1990 AASHTO's "A Policy on Geometric Design of Highways and Streets" standards, incorporated herein by reference.

(b) Sight easements on vertical and horizontal curves shall be required and determined based on the sight distance requirements contained in the 1990 AASHTO's "A Policy on Geometric Design of Highways and Streets" standards, taking into consideration the speed limits established by the government agency having jurisdiction. Residential access, residential neighborhood, and rural street design should be based on a speed limit of 25 miles per hour. Minor and major collector street design should be based on a speed limit of 30 miles per hour.

(b) When plans for future development necessitate oversizing of the water supply system, the municipality or utility authority may enter into an agreement with the developer to address the fair share of the costs.

(c) The demand rates for all uses shall be considered in computing the total system demand. Where fire protection is provided in accordance with (e) below, the system shall be capable of providing the required fire demand plus the required average daily residential demand as indicated in Table 5.1 below, or the peak hour flows indicated in Table 5.2 below, whichever is greater.

(d) Average daily residential consumption shall be computed in accordance with the housing unit type and size data shown in Table 5.1. The peak daily flows shall be computed by applying a peaking factor of three times the average daily residential consumption. The municipality may require deviations in the peaking factor value provided appropriate documentation and justification for the deviation from the standards is provided.

SUBCHAPTER 5. WATER SUPPLY

5:21-5.1 Water supply system

Water supply systems, where installed, shall conform to the standards contained in this subchapter.

5:21-5.2 Capacity

(a) The water supply system shall be adequate to handle the necessary flow, based on complete development of the tract.

(e) The design of the on-site water distribution system shall be adequate to provide fire protection as per ISO standard, *Fire Suppression Rating Schedule*, or per AWWA M31, "Manual of Water Supply Practices—Distribution System Requirements for Fire Protection," ISO method on pages 3-9, incorporated herein by reference.

Administrative correction.
See: 29 N.J.R. 1296(a).

5:21-7.5 Stormwater management: system design— detention facilities

(a) Development shall use the best available technology to accommodate stormwater management by natural drainage strategies where possible and practicable. Detention facilities, when required or selected, shall be designed, constructed, and maintained according to the following standards.

(b) Design engineers shall coordinate structural detention requirements with nonstructural practices, such as cluster land-use development, open space acquisition, stream encroachment, and flood-hazard controls.

(c) Detention and all other stormwater facilities shall conform to the New Jersey Department of Environmental Protection's Stormwater Management Rules, at N.J.A.C. 7:8-3.4. Design engineers shall also adhere to, when applicable, the stormwater design requirements in the following rules:

1. Coastal Zone Management Rules, N.J.A.C. 7:7E;
2. Dam Safety Standards, N.J.A.C. 7:20;
3. Soil Erosion and Sediment Control Standards, N.J.A.C. 2:90-1;
4. Flood Hazard Area Regulations, N.J.A.C. 7:13;
5. Pinelands Regulations, N.J.A.C. 7:50-6.81 through 6.88; and
6. Freshwater Wetlands Protection Act Rules, N.J.A.C. 7:7A.

(d) Where detention facilities are deemed necessary, they shall accommodate site runoff generated from two-year, 10-year, and 100-year storms as routed to the basin, considered individually, unless the detention basin is classified as a dam, in which case the facility also must comply with the Dam Safety Standards, N.J.A.C. 7:20.

1. These design storms shall be defined as either a 24-hour storm using Type III rainfall distribution when using U.S. Soil Conservation Service procedures (such as TR-20 or TR-55 tabular method), or the design storm resulting in the greatest storage volume to achieve the required outflow using a design method such as the Modified Rational Method. Runoff greater than that occurring from the 100-year, 24-hour storm will be passed over an emergency spillway.

i. A map of approximate geographic boundaries for S.C.S. rainfall distributions presented on page B-2 of the June 1986 edition of TR-55 shows all of New Jersey in the Type III region. Although the May 1982 version of TR-20 does not include a standard S.C.S. 24-hour, cumulative Type III distribution rainfall table like it

does for Type I, IA, and II, there is a test version (Version 2.04TEST) of the program available from the S.C.S. which does. The Type III distribution also can be manually added to a TR-20 model by using a RAINFL table.

2. Detention facilities shall be designed to accommodate runoff from the development of the site for the two-, 10-, and 100-year storm events so that pre-development peak flow rates that impact on downstream properties, watercourses, and/or drainage systems are not increased.

3. Where there is not a regional stormwater plan, as specified below in (d)4, then the design engineer shall design detention facilities such that the post-project construction peak runoff for the two-year storm event is 50 percent of the pre-project construction peak runoff rate. The post-project construction peak runoff rates for the 10 and 100-year storm events shall be 75 and 80 percent, respectively, of the pre-project construction peak runoff rates. It should be noted that these percentages only apply to the portion of the post-project runoff from the site under development. Offsite runoff may be computed at 100 percent of the pre-project rate.

4. If a Phase II stormwater management plan for the region or watershed exists, consistent with stormwater rules administered by the New Jersey Department of Environmental Protection, N.J.A.C. 7:8, then the design engineer may design stormwater management systems to conform to the plan. For some parts of the watershed, this may mean a detention basin is unnecessary.

5. If the development site is not part of a Phase II regional or watershed stormwater management plan, then the design engineer may model the watershed, consistent with regulations administered by the Department of Environmental Protection, and design stormwater management facilities to conform to that plan. This analysis shall include impacts of existing development and all potential future development in the drainage area. For some parts of the watershed, this may mean detention is unnecessary.

(e) Design engineers shall locate detention facilities (either "wet" or "dry") so as not to interfere or adversely affect existing surface waters on the site or adjacent to the site. Excavation for detention facilities shall be designed to be the maximum practical distance above seasonally high groundwater elevation. In the case of "wet" detention facilities, storage may only be presumed to be available above the elevation of the seasonal high groundwater. If the facility is designed as an infiltration basin, the bottom of the basin shall be a minimum of two feet above the elevation of the seasonally high water table.

(f) The following list of general structural criteria shall be used to design stormwater detention basins.

1. Detention components: principal basin control structure (quantity control), as follows:

i. Principal basin control structures will consist of orifice and/or weir control devices. Design engineers shall design orifices based upon the following equation:

$$Q = C A (2gH)^{0.5}$$

where

- Q = the flow rate in cubic feet per second
- C = 0.6 (The orifice flow coefficient "C" may vary, depending on entrance conditions. Design engineers may use other coefficients with appropriate references.)
- A = cross-section area of flow in square feet
- H = the vertical distance in feet between the center of the orifice and the water surface
- 2g = 64.4 feet per second²

To minimize the chance of clogging, orifices intended solely for runoff quantity control will be at least six inches in diameter (or its equivalent). All joints are to be watertight. In addition, trash racks and/or anti-vortex devices shall be required. When weirs are used alone or in conjunction with orifices, design engineers shall use the following equation:

$$Q = C_w L(h)^{1.5}$$

where

- Q = the flow rate in cubic feet per second
- C_w = 3.2 (design engineers may use other coefficients with appropriate references)
- L = length of the weir in feet
- h = the vertical distance in feet between water surface elevation and the crest of the weir.

All weirs shall be constructed as part of a reinforced concrete structure with appropriate grates.

ii. Eight-inch-thick, anti-seep collars are to be installed along outlet pipes. Reinforcement steel shall be No. 5 bars at 12 inches both ways, with two inches of cover on both faces (minimum).

iii. Where necessary for stability of the outlet pipe, a concrete cradle shall be provided.

iv. All principal basin control structures shall be precast or reinforced concrete. All joints are to be watertight.

v. Suitable lining shall be placed upstream and downstream of principal basin control structures, as necessary, to prevent scour and erosion. Such lining shall conform to Standards for Soil Erosion and Sediment Control in New Jersey, N.J.A.C. 2:90, promulgated by the N.J. State Soil Conservation Committee.

2. Detention components: emergency spillways, as follows:

i. Vegetated emergency spillways shall have side slopes not exceeding three horizontal to one vertical.

ii. Maximum velocities in emergency spillways shall be checked based on the velocity of the peak flow in the spillway resulting from the routed Emergency Spillway Hydrograph. The design of the emergency spillway will be based on the 100-year inflow to the basin, except for class IV dams, which shall comply with the Dam Safety Standards, N.J.A.C. 7:20 The design of the emergency spillway assumes the principal spillway is malfunctioning and will not allow any discharge or flow. Where maximum velocities exceed those contained in Table 7.5 below, suitable lining shall be provided.

iii. Where maximum velocities exceed the allowable velocities for soil stability as determined in the Standards for Soil Erosion and Sediment Control in New Jersey, N.J.A.C. 2:90, promulgated by the N.J. State Soil Conservation Committee, suitable lining should be provided. Design engineers also may check maximum velocities in emergency spillways based on the velocity of the peak flow in the spillway resulting from the routed Emergency Spillway Hydrograph. Where maximum velocities exceed those contained in Table 7.5 below, suitable lining shall be provided. Linings shall meet specifications required in Hydraulic Engineering Circular No. 15—Design of Stable Channels with Flexible Linings, published by the U.S. Department of Transportation, Federal Highway Administration or Standards for Soil Erosion and Sediment Control in New Jersey, N.J.A.C. 2:90, promulgated by the State Soil Conservation Committee, New Jersey Department of Agriculture.

TABLE 7.5

PERMISSIBLE VELOCITIES FOR EMERGENCY SPILLWAYS WITH UNIFORM STANDS FOR VARIOUS WELL-MAINTAINED GRASS COVERS

Ground Cover	Slope Percent	Permissible Velocities On:	
		Erosion-resistant soils (fps)	Easily eroded soils (fps)
Kentucky bluegrass	5-10	6	4
Lawn grass mixture	0-5	5	4
	5-10	4	3
Weeping lovegrass			
Alfalfa	0-5	3.5	2.5
Crabgrass			

Note: fps = feet per second
 Source: Soil Conservation Service, U.S. Department of Agriculture (Washington, D.C.: Government Printing Office, 1959). Cited in ULI-ASCE-NAHB, Residential Storm Water Management: Objectives, Principles, and Design Considerations (Washington, D.C.: Government Printing Office, 1975).

3. Detention components: dams, as follows:

i. Dam refers to any artificial dike, levee, or other barrier with appurtenant works that is constructed to impound water on a permanent or temporary basis and raises the water level five feet or more above the usual, mean, low-water height when measured from the downstream toe-of-dam to the emergency spillway crest, or, in the absence of an emergency spillway, the top of the dam.

ii. Design engineers shall design all dams in accordance with Dam Safety Standards, N.J.A.C. 7:20, administered by the New Jersey Department of Environmental Protection.

4. Detention basin berms and embankment ponds, as follows:

i. A detention basin berm is a water impoundment made by either constructing an embankment (a facility referred to as an embankment pond), or excavating a pit or dugout that does not qualify as a dam. Detention basin berms constructed by the second method are referred to as excavated ponds.

ii. Site conditions shall be such that runoff from the design storm can safely pass through: a natural or constructed emergency spillway designed to accept the entire 100-year flow; a combination of a principal spillway and the emergency spillway designed to ensure passage of the 100-year flow when either the principal spillway and/or the emergency spillway flows are impeded by debris; or a principal spillway designed so as to allow it to continue to function reliably, passing the 100-year flow, when impeded by debris.

(1) Drainage area of the pond shall be protected against erosion so that expected sediment does not shorten the planned effectiveness of the structure.

(2) When necessary, embankment ponds shall have foundation cutoff walls of relatively impervious material under the berm. The cutoff walls shall extend up to abutments as required and be deep enough to extend into a relatively impervious layer, or provide for a stable structure when combined with seepage control. The cutoff trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations. Cutoff wall side slopes shall not be steeper than one horizontal to one vertical. The cutoff walls shall extend up to the normal water line and the minimum depth shall be at least three feet.

(3) Design engineers shall include seepage controls if pervious layers are not intercepted by the cutoff, seepage creates swamping downstream, such control is needed to insure a stable embankment, or special problems may require drainage for a stable berm. Seepage may be controlled by foundation, abutment, or embankment drains; reservoir blanketing; or a combination of these measures.

(4) The minimum top width for a berm shall be six feet. The minimum top width of dams should be 10 feet.

(5) All slopes must be designed to be stable. If needed to protect the slopes of the berm, special measures such as rock rip-rap, sand gravel, fabrics, geofabrics, geomembranes, or special vegetation shall be provided, as specified by the standards in: Guide

for Design and Layout of Vegetative Wave Protection for Earth Dam Embankments, Technical Release No. 56, and Riprap for Slope Protection Against Wave Action, Technical Release No. 69. Both reports are published by the U.S. Department of Agriculture, Soil Conservation Service, and are incorporated herein by reference.

(6) The minimum elevation of the top of the settled embankment shall be one foot above the water surface in the detention basin, with the emergency spillway flowing at the design depth. The minimum difference in elevation between the crest of the emergency spillway and the settled top width of the structure shall be two feet for all berms having more than a 20-acre drainage area or more than 20 feet in effective height. Design engineers shall increase the design height of the structure by the amount needed to insure that after settlement the height of the berms equals or exceeds the design height. This increase shall not be less than five percent, except where detailed soil testing and laboratory analysis shows that a lesser amount is adequate.

(7) Design engineers shall place a pipe conduit with needed appurtenances under or through the berm except where rock, concrete, or other types of mechanical spillways are used or where the rate and duration of flow can be safely handled by a vegetated or earth spillway.

iii. The design elevation of the top of all embankments and berms shall be one foot or greater than the maximum water surface elevation in the basin, when stormwater from the 100-year flood passes over the emergency spillway. The design height, defined as the vertical distance from the top to the bottom of the deepest cut, shall be constructed to insure that the top elevation will be maintained following all settlement.

(1) When the design discharge of the principal spillway is considered in calculating peak outflow through the emergency spillway, the crest elevation of the inlet shall be such that the full flow will be generated in the conduit before there is discharge through the emergency spillway. The inlets and outlets of the principal spillway shall be designed to function satisfactorily for the full range of flow and hydraulic head anticipated. The capacity of the pipe conduit shall be adequate to discharge long-duration, continuous, or frequent flows without flow through the emergency spillways. The pipe diameter shall be no less than six inches. If the pipe conduit diameter is larger than 10 inches, its design discharge may be considered when calculating the peak outflow rate through the emergency spillway.

(2) Pipe conduits under or through the berm shall be capable of withstanding external loading without yielding, buckling, or cracking. Flexible pipe

strength shall not be less than that necessary to support the design load with the maximum of five percent deflection. The inlets and outlets shall be structurally sound and made of materials compatible with those of pipe. All pipe joints shall be made watertight by the use of couplings, gaskets, or caulking.

iv. Acceptable pipe materials are corrugated polyethylene, reinforced concrete, and ductile iron. When necessary for stability, concrete and ductile pipe shall be laid in a concrete bedding. Corrugated polyethylene pipe exposed to direct sunlight shall be made of ultraviolet-resistant materials and protected by coating or shielding, or provisions for replacement should be made as necessary. Connections of corrugated polyethylene pipe to less flexible pipe or structure must be designed to avoid stress concentrations that could rupture the plastic. Design engineers shall follow specifications in Table 7.6 below for polyvinyl chloride (PVC) pipe.

TABLE 7.6

ACCEPTABLE PVC PIPE FOR USE IN EARTH BERMS†

Normal pipe size (inches)	Schedule for standard dimension ratio (SDR)	Maximum depth of fill over pipe (feet)
4 or smaller	schedule 40	15
	schedule 80	20
	SDR 26	10
6, 8, 10, 12	schedule 40	10
	schedule 80	15
	SDR 26	10

† Polyvinyl chloride pipe, PVC 1120 or PVC 1220, conforming to ASTM D1785 or ASTM D2241.

Design engineers shall provide for seepage control if the conduit is of smooth pipe larger than eight inches in diameter.

v. Seepage control along pipes extending through embankments shall be controlled by use of a filter and drainage diaphragm, unless it is determined that antiseep collars will adequately serve the purpose.

(1) The drain is to consist of sand meeting fine concrete aggregate requirements (at least 15 percent passing through the No. 40 sieve, but no more than 10 percent passing through the No. 100 sieve). If unusual soil conditions exist, design engineers shall make a special design analysis. The drain shall be a minimum of two-feet thick and extend vertically upward and horizontally at least three times the pipe diameter, and vertically downward at least 18 inches beneath the conduit invert. The drain diaphragm shall be located approximately parallel to the centerline of the embankment. The drain shall be outletted at the embankment downstream toe, preferably using a drain backfill envelope continuously along the pipe where it exits in the embankment. Protecting drain fill from the surface erosion will be necessary.

(2) When antiseep collars are used in lieu of a drainage diaphragm, they shall have a watertight connection to the pipe. Maximum spacing shall be approximately 14 times the minimum projection of the collar measured perpendicular to the pipe. Collar material shall be compatible with the pipe materials. The antiseep collar(s) shall increase by 15 percent the seepage path along the pipe. When antiseep collars are used in lieu of the drainage diaphragm, the design engineers shall use the following criteria to determine the size and number of antiseep collars.

Let V = vertical projection and minimum horizontal projection of the antiseep collar in feet.

Let L = length in feet of the conduit within the zone of saturation, measured from the downstream side of the riser to the toe drain or point where the phreatic line intercepts the conduit, whichever is shorter.

Let n = number of antiseep collars. The ratio of the length of the seepage (L+2nV) is to be at least 1.15.

(A) Antiseep collars should be equally spaced along part of the barrel within the saturated zone at distances of not more than 25 feet.

vi. Closed circuit spillways designed for pressure flow must have adequate antivortex devices. To prevent clogging of the conduit, an appropriate trash guard shall be installed at the inlet or riser.

vii. Emergency spillways convey the design flow safely past earth embankments when the principal or auxiliary spillway is disabled. Design engineers shall provide for an emergency spillway for each basin.

(1) Emergency spillways shall provide for passage of the design flow at a safe velocity to a point downstream where the berm will not be endangered. The maximum permissible velocity in the exit channel shall be four feet per second, where only sparse vegetative cover can be expected; where excellent vegetative cover and a vigorous sod can be expected and maintained, the maximum permissible velocity is 6 feet per second.

(2) If chutes or drops are used for the principal or emergency spillways, they shall be designed according to standards in the U.S. Department of Agriculture, Soil Conservation Service's *Engineering Manual for Conservation Practices* (1984), or the U.S. Department of Agriculture's *National Engineering Handbook*, section 5, "Hydraulics;" section 11, "Drop Spillways;" and section 14, "Chute Spillways," incorporated herein by reference. The minimum capacity of a structural spillway shall be that required to pass the peak flow expected from the design storm.

viii. For excavated basins, provisions shall be made where needed for a principal spillway, emergency spillway, and embankment in accordance with the embankment and berm criteria described in this section.

(1) Where soil conditions and safe maintenance practices allow, side slopes of the excavated basin shall be stable and no steeper than three horizontal to one vertical.

ix. The material placed in the fill shall be free of detrimental amounts of sod, roots, frozen soil, stones more than six inches in diameter (except rock fills), and other objectionable material.

(1) Drainfill shall be kept from being contaminated by adjacent soil materials during placement by either placing it in a cleanly excavated trench, or by keeping the drain at least one foot above the adjacent earthfill.

(2) Selected drainfill and backfill material shall be placed around structures, pipe conduits, and antiseep collars at about the same rate on all sides to prevent damage from unequal loading. Fill material shall be placed and spread beginning at the lowest point in the foundation and then bringing it up in continuous horizontal layers thick enough that the required compaction can be obtained. The fill shall be constructed in continuous horizontal. If openings or sectionalized fills are required, the slope of the bonding surfaces between the embankment in place and the embankment to be placed shall not be steeper than the ratio of three horizontal to one vertical. The bonding surface shall be treated the same as that specified for the foundation to insure a good bond with the new fill.

(3) The distribution and gradation of materials shall be such that no lenses, pockets, streaks, or layers of material shall differ substantially in texture or gradation from the surrounding material. If it is necessary to use materials of varying texture and gradation, the more impervious material shall be placed in the center and upstream parts of the fill. If zoned fills of substantially differing materials are specified, the zones shall be placed according to lines and grades shown on the drawings. The complete work shall conform to the lines, grades, and elevations shown in the drawings or as staked in the field.

(4) The moisture content of the fill material shall be adequate for obtaining the required compaction. Material that is too wet shall be dried to meet this requirement, and material that is too dry shall be wetted and mixed until the requirement is met. Construction equipment shall be operated over each layer of fill to insure that the required compaction is obtained. Special equipment shall be used if needed to obtain the required compaction. If a minimum

required density is specified, each layer of fill shall be compacted as necessary to obtain that density.

(5) Fill adjacent to structures, pipe conduits, and drainfill or antiseep collars shall be compacted to a density equivalent to that of the surrounding fill by hand tamping or by using manually directed power tampers or plate vibrators. Fill adjacent to concrete structures shall not be compacted until the concrete has had time to gain enough strength to support the load.

x. All permanent and temporary stabilization should be applied pursuant to the Standards for Soil Erosion and Sediment Control in New Jersey, N.J.A.C. 2:90.

xi. In a principal spillway, pipe materials shall conform to the appropriate specifications. Antiseep collars shall be made of materials compatible with that of the pipe and shall be installed according to the manufacturer's instructions. It may be firmly and uniformly bedded throughout its length, and shall be installed to the line and grade shown on the drawings.

xii. The mix design and testing of concrete shall be consistent with the size requirements of the job. Mix requirements or necessary strength shall be specified. The type of cement, air entrainment, slump, aggregate, or other properties shall be specified as necessary. All concrete is to consist of a workable mix that can be placed and finished in an acceptable manner. Necessary curing shall be specified. Reinforcing steel shall be placed as indicated on the plans and shall be held securely in place during concrete placement. Subgrades and forms shall be installed to line and grade, and the forms shall be mortar tight and unyielding as the concrete is placed.

xiii. Foundation and embankment drains, if required, shall be placed to the line and grade shown on the drawings. Detailed requirements for drain material and any required pipe shall be shown in the drawing and specifications for the job.

xiv. Concerning excavated basins, the compacted excavation shall conform to the lines, grades, and elevations shown on the drawings or as staked in the field.

xv. Concerning embankment and excavated berms, construction operations shall be carried out so that erosion and air and water pollution are minimized, and held within legal limits. All work shall be conducted in a skillful manner. The completed job shall present a workmanlike appearance.

(1) Measures and construction methods that enhance fish and wildlife values shall be incorporated as needed and practical. Ground cover to control erosion shall be established as needed and practical. Fencing shall be provided as needed.

5. Detention facilities in flood hazard areas, as follows:

i. Detention development must comply with all applicable regulations under the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.

6. The following safety provisions shall apply to stormwater management basins and parts thereof.

i. Trash racks shall be installed at the intake to the outlet from the stormwater management basin if the intake has a diameter of 12 inches or greater.

ii. Trash racks shall be designed to have parallel bars with no greater than six-inch spacing. The spacing shall be designed so as not to adversely affect the hydraulic performance of the outlet pipe or structure.

iii. The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack.

iv. Any outlet structure with an overflow grate must have the grate secured but removable for emergencies and maintenance. Grate spacing shall be no greater than two inches across the smallest dimension.

v. Trash racks and overflow grates shall be constructed and installed to be rigid, durable, and corrosion resistant and shall be designed to withstand a perpendicular live loading of 300 lbs/ft sq.

vi. Every outlet structure of a basin shall have escape provisions in or on the structure. Free-standing outlet structures may be excluded at the discretion of the approving authority.

vii. Safety ledges shall be constructed on the slopes of all new retention basins with a permanent pool of water deeper than two-and-one-half feet. Ledges shall be comprised of two steps, each four to six feet in width, one located approximately two-and-one-half feet below the permanent water surface, and the second located one to one-and-one-half feet above the permanent water surface.

viii. In new stormwater management basins, maximum interior slopes for earthen dams, embankments, or berms shall not exceed three horizontal to one vertical.

ix. Municipalities or other specified agencies may grant a variance or exception from these safety standards if they determine in writing that such variance or exception will not constitute a threat to the public safety.

7. Stormwater management facilities shall be regularly maintained to insure they function at design capacity and to prevent health hazards associated with debris buildup and stagnant water.

i. Maintenance and upkeep responsibility depend on ownership of the facilities. If the drains, basins, and/or other features of the stormwater system in the residential development are part of a public drainage system, then the municipality or an appropriate public entity is responsible for maintenance and upkeep. If part or all of the residential stormwater management system is privately owned, then the privately owned portion of the system must be privately maintained, unless the municipality or other appropriate public agency agrees to assume responsibility for the facilities. The terms of the agreement shall be in a form satisfactory to the municipal attorney and may include but are not limited to maintenance easements, personal guarantees, deed restrictions, covenants, and bonds.

ii. In cases where there is common ownership of property that is not part of a publicly owned drainage system, a homeowner's association or similar permanent entity may be established as the agent responsible for upkeep, absent an agreement with the municipality or other appropriate public entity.

Administrative correction.
See: 29 N.J.R. 1296(a).

5:21-7.6 Stormwater management: water quality

(a) In addition to addressing water quantity generated by development, a stormwater management system shall also prevent, to the greatest extent feasible, an increase in nonpoint pollution.

(b) Stormwater management shall provide for the control of a water quality design storm. The water quality design storm shall be defined as the one-year frequency S.C.S. Type III, 24-hour storm or 1.25 inches of rainfall falling uniformly in two hours.

(c) The water quality design storm shall be controlled by best management practices. These include, but are not limited to, the following:

1. In "dry" detention basins, provisions shall be made to ensure that the runoff from the water quality design storm is retained, such that not more than 90 percent will be evacuated prior to 18 hours. The retention time shall be considered a brim-drawdown time and therefore shall begin at the time of peak storage. The retention time shall be reduced in any case that would require an outlet size diameter of three inches or less. Therefore, three-inch-diameter orifices shall be the minimum allowed. This minimum is only for water-quality outlets. If this minimum outlet size does not allow for the detention time required, then additional techniques shall be used to remove total suspended solids.

2. In permanent ponds or "wet" basins, the water quality requirements of this ordinance shall be satisfied where the volume of permanent water is at least three times the volume of runoff produced by the water quality design storm.

Administrative correction.
See: 29 N.J.R. 1296(a).

gating agency of the standard, the standard identification, the edition of the standard (where no edition is listed, the edition in effect at the time of reference shall govern), the title of the standard, the section(s) of this code that reference the standard.

SUBCHAPTER 8. REFERENCED STANDARDS

5:21-8.1 Referenced standards

(a) The following is a list of the standards referenced in this chapter. The standards are listed by the promul-

- American Association of State Highway and Transportation Officials (AASHTO), 444 North Capitol Street, N.W., Suite 249, Washington, D.C. 20001. Tel. (202) 624-5800.

Standard reference number	Title	Referenced in N.J.A.C. section number
†M33-93	Preformed Expansion Joint Filler for Concrete (Bituminous Type)	Figure 4.1 (Concrete Vertical Curb)
†M43-88	Sizes of Aggregate for Road and Bridge Construction	Figure 6.1
†M213-92	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)	Figure 4.1 (Concrete Vertical Curb)
†M294-93	Corrugated Polyethylene Pipe, 12- to 36-in. Diameter	5:21-7.3(d)3
†T99-93	The Moisture-Density Relations of Soils Using a 5.5-lb. (2.5 kg) Rammer and a 12-in. (305 mm) Drop	5:21-7.3(d)3
1990 Edition	A Policy on Geometric Design of Highways and Streets	5:21-4.19(b)6 5:21-4.20(a) 5:21-4.20 (b)

† Included in Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 17th Edition, 1995.

- American Concrete Pipe Association, Suite 105, 8618 Westwood Center Drive, Vienna, Virginia 22182. Tel. (703) 821-1990. Concrete Pipe Association of New Jersey, P.O. Box 1013, Dover, New Jersey 07802-1013. Tel. (201) 328-8723.

Standard reference number	Title	Referenced in N.J.A.C. section number
(Minimum Depth of Coverage over Concrete Pipe)	Published in Concrete Pipe Association of New Jersey Newsletter, "The Pipeline," September/October 1985; table derived from information provided by the American Concrete Pipe Association	Table 7.4

- American Society for Testing and Materials (ASTM), 100 Barr Harbor, West Conshohocken, Pennsylvania 19428. Tel. (610) 832-9500.

Standard reference number	Title	Referenced in N.J.A.C. section number
A48-92	Standard Specification for Gray Iron Castings	5:21-6.2(c)9.v 5:21-7.4(f)
C33-93	Standard Specification for Concrete Aggregates	Figure 6.1
C76-90	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe	5:21-6.2(c)5.i 5:21-7.3(d)1.i
C361-90	Standard Specification for Reinforced Concrete Low-Head Pressure Pipe	5:21-6.2(c)9.iv
C443-85a (1990)	Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets	5:21-6.2(c)9.iv 5:21-7.3(d)1.iii
C478-90b	Standard Specification for Precast Reinforced Concrete Manhole	5:21-6.2(c)9.iv 5:21-7.4(d)

<u>Standard reference number</u>	<u>Title Sections</u>	<u>Referenced in N.J.A.C. section number</u>
C507-90	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe	5:21-7.3(d)1.ii
C700-91	Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated	5:21-6.2(c)5.iv
C877-91	Standard Specification for External Sealing Bands for Noncircular Concrete Sewer, Storm Drain, and Culvert Pipe	5:21-7.3(d)1.iv
C923-89	Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals	5:21-6.2(c)9.vi 5:21-7.4(d)
D448-86	Standard Classification for Sizes of Aggregate for Road and Bridge Construction	Figure 6.1
D1784-90	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds	5:21-6.2(c)5.ii.(1)
D1785-91	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120	Table 7.6
D2241-89	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)	Table 7.6
D2321-89	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications	5:21-6.2(c)5.ii.(2) 5:21-6.2(c)5.ii.(4) 5:21-7.3(d)3
D2444-92	Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)	5:21-6.2(c)5.ii.(2)
D3034-89	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings	5:21-6.2(c)5.ii
D3139-89	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals	5:21-5.3(i)3
D3212-92	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals	5:21-6.2(c)5.ii.(3)
D3350-93	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials	5:21-7.3(d)3
F477-90	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe	5:21-6.2(c)5.ii.(3)
4.	American Society of Civil Engineers (ASCE), 345 East 47th Street, New York, New York 10017. Tel. (212) 705-7496 or (800) 548-2723.	

Standard
reference number
WEF Manual of Practice No. 9
ASCE Manual on Engineering
Practice No. 37
1970 (Sixth Printing 1991)
(Prepared jointly with the Water

Title
Design and Construction of Sanitary
and Storm Sewers

Referenced in
N.J.A.C. section
number
5:21-6.2(a)
5:21-6.2(c)8
5:21-6.2(c)9

<u>Standard reference number</u>	<u>Title</u>	<u>Referenced in N.J.A.C. section number</u>
Environment Federation) WEF Manual of Practice FD-20 ASCE Manuals and Reports of Engineering Practice No. 77 (1993) ©1992	Design and Construction of Urban Stormwater Management Systems	5:21-7.3(e)

5. American Water Works Association (AWWA), 6666 West Quincy Avenue, Denver, Colorado 80235. Tel. (303) 794-7711 or (800) 926-7337.

<u>Standard reference number</u>	<u>Title</u>	<u>Referenced in N.J.A.C. section number</u>
ANSI/AWWA C104/A21.4-90	American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water	5:21-5.3(i)1 5:21-6.2(c)5.iii
ANSI/AWWA C105/A21.5-93	American National Standard for Polyethylene Encasement for Ductile- Iron Pipe Systems	5:21-5.3(i)1
ANSI/AWWA C110/A21.10-93	American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm) for Water and Other Liquids	5:21-5.3(i)1
ANSI/AWWA C111/A21.11-90	American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings	5:21-5.3(i)1 5:21-7.3(d)2
ANSI/AWWA C115/A21.15-88	American National Standard for Flanged Ductile-Iron Pipe with Threaded Flanges	5:21-5.3(i)1
ANSI/AWWA C150/A21.50-81	American National Standard for the Thickness Design of Ductile-Iron Pipe	5:21-5.3(i)1
ANSI/AWWA C151/A21.51-91	American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids	5:21-6.2(c)5.iii 5:21-7.3(d)2
ANSI/AWWA C301-92	AWWA Standard for Prestressed Concrete Pressure Pipe, Steel- Cylinder Type, for Water and Other Liquids	5:21-5.3(i)2
ANSI/AWWA C502-85	AWWA Standard for Dry-Barrel Fire Hydrants	5:21-5.4(b)1
ANSI/AWWA C900-89	AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution	5:21-5.3(i)3
ANSI/AWWA C901-88	AWWA Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½ in. through 3 in., for Water Service	5:21-5.3(i)6
AWWA M31 ©1992 Second Edition	Manual of Water Supply Practices—Distribution System Requirements for Fire Protection	5:21-5.2(e)

6. Asphalt Institute, Research Park Drive, Post Office Box 14052, Lexington, Kentucky 40512-4052. Tel. (606) 288-4960.

<u>Standard reference number</u>	<u>Title</u>	<u>Referenced in N.J.A.C. section number</u>
MS-1, 8th Edition August 1970	Thickness Design—Full-Depth Asphalt Pavement Structures for Highways and Streets	Table 4.7

7. Institute of Transportation Engineers (ITE), Suite 410, 525 School Street, S.W., Washington, D.C. 20024-2729. Tel. (202) 554-8050.

- | <u>Standard
reference number</u>
©1989 | <u>Title</u> | Referenced in
N.J.A.C. section
number |
|--|--|--|
| Pub. No. IR-016C
5th Edition
Fourth Printing
January 1991 | Residential Street Design and Traffic
Control
Trip Generation | 5:21-1.5(d)2

5:21-4.1(b)
Table 4.1 |
| 8. Insurance Services Office, Inc. (ISO), 7 World Trade Center, New York, New York 10048. Tel. (212) 898-6000. | | |
| <u>Standard
reference number</u>
©1980
Edition 6-80 | <u>Title</u>
Fire Suppression Rating Schedule | Referenced in
N.J.A.C. section
number
5:21-5.2(e) |
| 9. National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, Massachusetts 02269. Tel. (617) 770-3000. | | |
| <u>Standard
reference number</u>
Standard 291-1995

Standard 1963-1993 | <u>Title</u>
Fire Flow Testing and Marking of
Hydrants

Fire Hose Connections | Referenced in
N.J.A.C. section
number
5:21-5.4(b)2

5:21-5.4(b)1 |
| 10. New Jersey Department of Agriculture, State Soil Conservation Committee, John Fitch Plaza, CN 330, Trenton, New Jersey 08625. Tel. (609) 292-5540. | | |
| <u>Standard
reference number</u>
April 1987 | <u>Title</u>
Standards for Soil Erosion and
Sediment Control in New Jersey | Referenced in
N.J.A.C. section
number
5:21-7.5(c)
5:21-7.5(f)3.ii |
| 11. New Jersey Department of Environmental Protection (NJDEP), Bureau of Revenue, Maps and Publications Sales Office, 428 East State Street, Trenton, New Jersey 08625. Tel. (609) 777-1038. | | |
| <u>Standard
reference number</u>
February 1981

June 1989

September 1993

Revised September
1995

August 1995 | <u>Title</u>
New Jersey Stormwater
Quantity/Quality Management Manual
Ocean County Demonstration Study—
Stormwater Management Facilities
Maintenance Manual
Stormwater and Nonpoint Source
Pollution Control
Best Management Practices Manual
Technical Manual for Land Use Regulation Program,
Bureaus of Inland and Coastal Regulations,
Stream Encroachment Permits
Pinelands Comprehensive
Management Plan
(New Jersey Pinelands Commission) | Referenced in
N.J.A.C. section
number
5:21-7.6(c)4

5:21-7.6(c)4

5:21-7.6(c)4

Table 7.2
5:21-7.6(c)4.iii

5:21-5.3(a)
5:21-6.2(a) |
| 12. New Jersey Department of Transportation (NJDOT), 1035 Parkway Avenue, Trenton, New Jersey 08625. Tel. (609) 530-2000. | | |
| <u>Standard
reference number</u>
1989

May 1992 | <u>Title</u>
Standard Specifications for Road and
Bridge Construction

Design Manual—Roadway
(DOT's Division of Roadway Design,
Bureau of Roadway Design
Standards) | Referenced in
N.J.A.C. section
number
5:21-4.17(b)
Figure 4.1
Figure 4.2
Figure 4.3
5:21-7.4(a)
5:21-7.2(c)2
5:21-7.2(c)3
Figure 7.1
Figure 7.2 |

- | <u>Standard
reference number</u> | <u>Title</u> | Referenced in
N.J.A.C. section
<u>number</u> |
|--|---|---|
| 13. New Jersey Society of Municipal Engineers (NJSME), 196 West State Street, Trenton, NJ 08608. Tel. (609) 393-0102. | | Referenced in
N.J.A.C. section
<u>number</u> |
| <u>Standard
reference number</u>
Second Edition
November 1991 | <u>Title</u>
Asphalt Handbook for County and
Municipal Engineers | N.J.A.C. section
<u>number</u>
Figure 4.2
Figure 4.3
Table 4.7 |
| 14. Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077-1083. Tel. (847) 966-6200. | | Referenced in
N.J.A.C. section
<u>number</u> |
| <u>Standard
reference number</u>
©1984 | <u>Title</u>
Thickness Design for Concrete
Highway and Street Pavements | N.J.A.C. section
<u>number</u>
Table 4.7 |
| 15. United States Army Corps of Engineers, Water Resources Support Center, The Hydrologic Engineering Center, 609 Second Street, Davis, California 95616. Tel. (916) 756-1104. | | Referenced in
N.J.A.C. section
<u>number</u> |
| <u>Standard
reference number</u>
†Technical Paper No. 82
May 1981 | <u>Title</u>
The New HEC-1 Flood Hydrograph
Package | N.J.A.C. section
<u>number</u>
5:21-7.2(c) |
| 16. United States Department of Agriculture (USDOA), Soil Conservation Service, Post Office Box 2890, Washington, D.C. 20013. Tel. (202) 205-0026. | | Referenced in
N.J.A.C. section
<u>number</u> |
| <u>Standard
reference number</u>
†Technical Release 20
PB83-223768
May 1982 | <u>Title</u>
Computer Program for Project
Formulation—Hydrology | N.J.A.C. section
<u>number</u>
5:21-7.2(c)
5:21-7.5(d) |
| †Technical Release No. 55
PB87-101580
2nd Edition
June 1986 | Urban Hydrology for Small
Watersheds | 5:21-7.2(c)
5:21-7.2(c)2
5:21-7.2(c)5
5:21-7.5(d)
5:21-7.5(f)5.ii |
| †Technical Release No. 56
PB85-239622
December 1974 | Guide for Design and Layout of
Vegetative Wave Protection for Earth
Dam Embankments | |
| †Technical Release No. 69
PB85-245165
February 1983 | Riprap for Slope Protection Against
Wave Action | 5:21-7.5(f)5.ii |
| †PB85-175164/LT
July 1984 | Engineering Field Manual
for Conservation Practices
National Engineering Handbook | 5:21-7.5(f)5.vii
5:21-7.5(f)5.vii |
| †PB 243 644/LT
†PB 243 645/LT
†PB 279 759/LT | Section 5—Hydraulics
Section 11—Drop Spillways
Section 14—Chute Spillways | |
| 17. United States Department of Commerce (USDOC), Bureau of the Census, Washington, D.C. 20233. Tel. (202) 482-2000. | | Referenced in
N.J.A.C. section
<u>number</u> |
| <u>Standard
reference number</u>
1975-1980
(Data tabulated by Rutgers
University) | <u>Title</u>
Public Use File—New Jersey | N.J.A.C. section
<u>number</u>
Table 4.4
Table 5.1 |
| 18. United States Department of Transportation (USDOT), Federal Highway Administration (FHWA), 820 First Street, S.E., Washington, D.C. 20002. Tel. (301) 322-4961. | | Referenced in
N.J.A.C. section
<u>number</u> |
| <u>Standard
reference number</u>
AC ¹⁵⁰ _{5320-5B}
July 1970 | <u>Title</u>
Airport Drainage | N.J.A.C. section
<u>number</u>
5:21-7.2(c)1 |

Standard reference number	Title	Referenced in N.J.A.C. section number
†Hydraulic Engineering Circular No. 15 Report No. FHWA-EPD-86-111 PB86-184835 October 1975	Design of Stable Channels with Flexible Linings	5:21-7.5(f)3.ii
†Report No. FHWA-TS-79-225 PB83-259903 August 1979	Design of Urban Highway Drainage, The State of the Art	Table 7.3
†Hydraulic Design Series No. 4 Report No. FHWA-EPD-86-103 May 1965 (Reprinted March 1983)	Design of Roadside Drainage Channels	5:21-7.2(c)1
†Hydraulic Design Series No. 5 Report No. FHWA-IP-85-15 PB86-196961 September 1985	Hydraulic Design of Highway Culverts	5:21-7.1(g)
‡1988 Edition	Manual on Uniform Traffic Control Devices for Streets and Highways	5:21-4.13(a)

19. Urban Land Institute, Suite 500 West, 1025 Thomas Jefferson Street, N.W., Washington, D.C. 20007-5201. Tel. (800) 321-5011.

Standard reference number	Title	Referenced in N.J.A.C. section number
ULI-ASCE-NAHB 1975	Residential Storm Water Management: Objectives, Principles, and Design Considerations	Table 7.5

† Documents obtainable from the National Technical Information Service, Springfield, Virginia 22161. Tel. (703) 487-4650.

‡ Documents obtainable from the United States Government Printing Office, Superintendent of Documents, Post Office Box 371954, Pittsburgh, Pennsylvania 15250-7954. Tel. (202) 512-1800.

Administrative correction.
See: 29 N.J.R. 1296(a).