Department of Transportation and Development
Engineering, Development Services,
and Transportation Maintenance

Clackamas County Roadway Standards

CLACKAMAS COUNTY







Adopted February 1, 2013
http://www.clackamas.us/transportation/

From the Director

The *Clackamas County Roadway Standards* (hereafter referred to as the "*Standards*") provides a "handbook" for both roadway design and construction of public and private roadway improvements in Clackamas County. The purpose of these Standards is:

1. To provide specific, consistent and acceptable road design and construction elements for applicants, developers and other private parties constructing or modifying road right-of-way facilities or on-site improvements which require County permits.

2. To establish uniform criteria that provides flexibility in guiding the County's design and construction of our own facilities.

3. To implement the *Clackamas County Zoning and Development Ordinance (ZDO)*, the *Clackamas County Comprehensive Plan (Comprehensive Plan)*, and the *Clackamas County Capital Improvement Plan* (*CIP*).

4. To allow for practical approaches to road design and construction challenges that provide the best fit solution given the realities of financial constraints and community context.

Roadway designs in Clackamas County shall strive to achieve sustainable outcomes when safety, convenience, aesthetics, resource protection, ease of maintenance, and community livability are considered.

These *Standards* provide the minimum criteria for design and construction of roadways, accesses, site development, and integrated drainage facilities under the jurisdiction of Clackamas County.

Presented as a working document, these *Standards* are intended to lead to a common understanding of design guidelines among applicants, County staff and other users of the *Standards*.

It is not the objective of this handbook to limit the creative efforts of Engineers in providing alternate solutions to specific problem areas or relieve the responsibility for professional engineering judgment. Practical designs that preserve the function and safety of the roadway system and promote sustainability by offering benefits to aesthetics, resource protection, ease of maintenance, and livability are encouraged.

These *Standards* will be periodically revised and updated.

It is with great pride that we present the revised *Clackamas County Roadway Standards*. These *Standards* are the culmination of a collaborative effort among County Engineering, Transportation Maintenance and Development Services staff, service providers, Engineers and the public at large.

CAM GILMOUR, DIRECTOR
CLACKAMAS COUNTY DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
FEBRUARY 1, 2013

DEFINITIONS

Access Drive: See *ZDO* Section 202.

Applicant: Property owner or person designated by the property owner to be the representative for an application for a development proposal, permit or approval, or their successors or assigns.

Average Daily Traffic ("ADT"): The number of vehicles traveling in both directions over a given time period greater than one day but less than one year, divided by the number of days in that time period. Commonly, traffic counts completed at various times of year are adjusted for time of year to account for seasonal and day of week variations. For the purposes of determining whether a roadway is "very low volume", ADT's shall be based upon a 20 year projected ADT.

Backfill: Replacement of excavated material with suitable material compacted as specified.

Breakaway: A structure that is designed to yield when impacted by a vehicle and has been tested and found acceptable in accordance with NCHRP Report 350.

Clear Zone: See *County Code* Section 7.03.020.

Clackamas County: The political subdivision of the State of Oregon providing statutory authority administered through its Board of County Commissioners ("BCC").

Compaction: The densification of a fill by mechanical means.

County: See "Clackamas County".

County Road Official: See *County Code* Section 7.03.020.

County Roadway: See "Road, county".

County Surveyor: See ORS 209.005 (2).

Cul-de-sac: A short street having one end open to traffic and the other temporarily or permanently terminated by a vehicle turnaround at or near the terminus.

Dead End: A road without an exit.

Dedication: The designation and gift of land by its owner. In the context of this document, it is the perpetual easement for right-of-way purposes to the public.

Department of Transportation and Development ("DTD"): Those County offices formed by the Board of Commissioners ("BCC") and administrating the Transportation and Development Ordinances and related issues within unincorporated Clackamas County.

Design Speed: The speed approved for the geometric and roadside design of the physical features of a road.

Developer: See "Applicant".

Ditch: An excavation dug in the earth used to convey water.

Drainage facilities: The physical elements used to convey, absorb, or store runoff such as pipes or channels, and detention or retention ponds or bioswales.

Driveway: A road which is on private property and which is maintained with private funds.

Driveway, shared access: A road which is on private property and which is maintained with private funds, generally considered to provide practical and legal access to two or three properties.

Easement: See *ZDO* Section 202.

Engineer: A Professional Engineer with Civil Engineering expertise holding a valid license from the State of Oregon.

Engineering: The County Department of Transportation and Development ("DTD") office of Engineering formed by the Board of Commissioners and administrating the DTD ordinances and related issues within unincorporated Clackamas County.

Engineering Geologist: A registered Professional Geologist holding a valid license from the State of Oregon.

Fixed Object: See *County Code* Section 7.03.020.

Frontage Improvements: See *County Code* Section 7.03.020.

Functional Classification: The hierarchy of roadways in descending order of mobility, traffic volume and design speed, and ascending order of access: Freeway/Expressway, Major Arterial, Minor Arterial, Collector, Connector, and Local. Functional classifications of individual roadways can be found on Maps V-2a and V2-b of the *Clackamas County Comprehensive Plan*. Descriptions of each functional classification can be found on Table V-2 and Table V-3 of the *Comprehensive Plan*.

Grade: See *ZDO* Section 202.

Interim section: That roadway cross-section affording full standard improvement adjoining the supporting property frontage and including the improvement across the roadway centerline to effect the improvement bringing the roadway to sufficient width to meet traffic demands.

Intersection: The point where a public roadway or private roadway intersects with a public roadway, private roadway or driveway.

Intersection Sight Distance ("ISD"): The distance that a motorist can see approaching traffic when entering or exiting a roadway at an intersection.

Landing: A generally flat road or driveway approach to any public or private road. Also, the generally flat area at the back of the sidewalk ramp, typically four feet wide for sidewalk ramps.

Land Surveyor: A Professional Land Surveyor holding a valid license from the State of Oregon.

Low Impact Development (LID): An innovative ecosystem based approach to land development and storm water management that results in fewer environmental impacts.

New Development: Development that requires land use approval. It also includes single family residences being constructed on lots which were previously unimproved.

Predevelopment: Existing conditions on site prior to a specific new development.

Public utility: See *ZDO* Section 202.

Public utility easement ("PUE"): An easement for the use of a Public Utility as defined in this section. The use of the PUE shall include telecommunications as per ORS 758.035

> "Commission's power to enforce joint use of facilities. (1) Every public utility, telecommunications utility, person, association or corporation having conduits, subways, street railway tracks, poles or other equipment on, over or under any street or highway shall for a reasonable compensation permit the use of the same by any public utility or telecommunications utility whenever public convenience or necessity requires such use and such use will not result in irreparable injury to the owner or other users of such equipment nor in any substantial detriment to the service to be rendered by such owners or other users."

Recoverable (Slope): A slope on which the driver of an errant vehicle can regain control of the vehicle. Slopes of 4H:1V or flatter in the foreslope and 3:1 in the backslope are considered recoverable.

Right-of-way ("ROW"): See ZDO Section 202.

Road: See ZDO Section 202.
Road, County: See ZDO Section 202.

Road, Private: See ZDO Section 202.

Road, Public: See ZDO Section 202.

Roadway: See ZDO Section 202.

Rural: Those unincorporated County areas outside the current designated Urban Growth Boundary (UGB).

Shoulder: The paved or compacted graveled portion of the roadway outside the traveled way that is available for emergency parking or non-motorized use.

Sidewalk: See ZDO Section 202.

Stopping sight distance ("SSD"): The minimum sight distance available on a roadway to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path.

Storm drainage system: A means to control storm water through natural or constructed elements by conveyance, absorption, or storage.

Street: See ZDO Section 202.

Temporary: Lasting for a limited time.

Traffic Engineer: A Professional Engineer with traffic engineering expertise or a Professional Traffic Engineer holding a valid license from the State of Oregon.

Traveled Way: See "Traveled portion of the roadway".

Traveled portion of the roadway: See *County Code* Section 7.03.020.

Trip generation: The number of vehicle trips generated by a particular land use.

Urban: Those areas within the current designated Urban Growth Boundary ("UGB") as designated by Metro.

Utilities: Any water, gas, sanitary or storm sewer, electrical, telephone, drainage way, wire, or television communication service and all persons, companies, districts or governmental agencies supplying the same.

Very low volume: A roadway with a 20 year projected volume of 400 ADT or less or an intersection with a 20 year projected entering volume of 400 ADT or less.

ABBREVIATIONS

AASHTO:	American Association of State Highway and Transportation Officials
ADA:	Americans with Disabilities Act
ADT:	Average daily traffic
APWA:	American Public Works Association
ASTM:	American Society for Testing and Materials
BCC:	Clackamas County Board of County Commissioners
CRC:	Clackamas Regional Center
DTD:	Clackamas County Department of Transportation and Development
FHWA:	Federal Highway Administration
ISD:	Intersection sight distance
ITE:	Institute of Transportation Engineers
MPH:	Miles per hour
MUTCD:	Manual on Uniform Traffic Control Devices
ODOT:	Oregon Department of Transportation
PI:	Point of intersection
PC:	Point of curvature
PT:	Point of tangency
SSD:	Stopping sight distance
TIS:	Traffic impact study
UGB:	Urban Growth Boundary
USPS:	United States Postal Service

STANDARD DRAWINGS

The Standard Drawings are available in two formats, electronic portable document format (pdf) online at http://www.clackamas.us/engineering/roadway.html and as dwg AutoCAD drawings by requesting online at the same address.

CHAPTER 1 - GENERAL CONSIDERATIONS

SECTION 110 - GENERAL PROVISIONS

a. These *Roadway Standards* will commonly be referred to as the "*Standards*".

b. The *Standards* are available online at http://www.clackamas.us/engineering/roadway.html. This website will contain the most recently adopted text, the Standard Drawings in both pdf and Autocad dwg formats, and any periodic updates to the *Standards*. Please consider the environment before printing.

c. The *Standards* apply to all proposed road and right-of-way facilities, both public and private under the jurisdiction of Clackamas County, except as otherwise required by federal design standards or as necessary due to a shortfall of available public funds. Additional requirements are also imposed upon federally funded projects, which may not coincide with the requirements of these *Standards*.

d. These *Standards* shall be used to implement and be used in conjunction with the *Clackamas County Comprehensive Plan* ("*Comprehensive Plan*") and the *Clackamas County Zoning and Development Ordinance* ("*ZDO*"). Specific sections include:

Comprehensive Plan Chapters:

Chapter 4 Land Use;
Chapter 5 Transportation (Transportation System Plan);
Chapter 10 Community Plans and Design Plans and

ZDO Sections:

1006 Water Supply, Sanitary Sewer, Surface Water, and Utilities Concurrency;
1007 Roads and Connectivity;
1008 Storm Drainage;
1014 Design Standards for Land Divisions;

1104 Completion of Improvements and Bonding

e. These *Standards* shall be used to implement and be used in conjunction with the policies and standards adopted by the Board of County Commissioners ("BCC").

SECTION 115 - APPLICABLE STANDARDS

115.1 General References

These *Standards* are intended to be consistent with the following. If conflicts arise, the most restrictive regulation shall apply.

a. *Clackamas County Comprehensive Plan*

b. *Clackamas County Zoning and Development Ordinance (ZDO)*

c. *Clackamas County Capital Improvement Plan (CIP)*

d. *Clackamas County Code* – Title 7.03 Road Use

e. *Clackamas County Code* – Title 9.03 Excavation and Grading

f. Local Drainage District or Clackamas County Storm Water Quality and Erosion and Sedimentation Control policies

g. Americans with Disabilities Act (ADA)

h. Other state and federal laws

115.2 Other Adopted References, Design Standards and Guidelines

If these *Standards* do not address a specific design issue, reference the following documents. The most recent editions of the following documents are adopted by the County by reference. Where conflicts exist, Engineering shall determine the appropriate design reference.

a. American Association of State Highway and Transportation Officials ("AASHTO") - *A Guide for Achieving Flexibility in Highway Design*

b. AASHTO - *Guide for the Development of Bicycle Facilities*

c. AASHTO - *Guide for the Planning, Design, and Operation of Pedestrian Facilities*

d. AASHTO - *Guidelines for Geometric Design of Very Low-Volume Local Roads*

e. AASHTO - *Highway Safety Manual*

f. AASHTO - *LRFD Bridge Design Specifications*

g. AASHTO - *A Policy on Geometric Design of Highways and Streets* (aka "Green Book")

h. AASHTO - *Roadside Design Guide*

i. AASHTO - *Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals*

j. American Society for Testing and Materials (ASTM)

k. The Asphalt Institute - *The Asphalt Handbook*

l. The Asphalt Institute - *Thickness Design - Highways and Streets.*

m. Federal Highway Administration (FHWA) - *Manual on Uniform Traffic Control Devices (MUTCD)*

n. FHWA - *Standard Highway Signs*

o. FHWA - *Roundabouts: An Informational Guide*

p. FHWA - *Traffic Analysis Toolbox Volume III: Guidelines for Applying Microsimulation Modeling Software*

q. Institute of Transportation Engineers (ITE) - *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities: An ITE Proposed Recommended Practice*

r. ITE - *Neighborhood Street Design Guidelines: An ITE Recommended Practice*

s. ITE - *Traffic Control Devices Handbook*

t. ITE - *Traffic Engineering Handbook*

u. ITE - *Trip Generation Manual*

v. ITE - *Trip Generation Handbook*

w. ITE - *Urban Street Geometric Design Handbook*

x. *International Building Code* (IBC)

y. *International Plumbing Code* (IPC)

z. National Association of City Transportation Officials - *Urban Bikeway Design Guide*

aa. Oregon Department of Transportation ("ODOT") - *Oregon Bicycle and Pedestrian Design Guide*

bb. ODOT - *Highway Design Manual*

cc. ODOT - *Hydraulics Manual*

dd. ODOT - *Oregon Supplement to the MUTCD*

ee. ODOT - *Oregon Temporary Traffic Control Handbook for Operations of Three Days or Less*

ff. ODOT - *Traffic Control Plans Design Manual*

gg. ODOT - *Traffic Line Manual*

hh. ODOT - *Traffic Manual*

ii. ODOT - *Traffic Signal Policy and Guidelines*

jj. ODOT - *Sign Policy and Guidelines*

kk. ODOT - *Oregon Standard Drawings*

ll. ODOT and American Public Works Association ("APWA") - *Standard Specifications for Construction*

mm. *Oregon Fire Code* Appendices B and D

nn. Oregon Fire Code Metro Code Committee *Fire Code Applications Guide*

oo. Transportation Research Board (TRB) - *Access Management Manual*

pp. Transportation Research Board (TRB) - *Highway Capacity Manual*

qq. Tri-Met design guidelines for transit related facilities

rr. United States Access Board - *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way*

It is the Engineer's and/or applicant's responsibility to comply with other federal, state, and local regulations, particularly with respect to wetland regulations and other development requirements.

SECTION 120 - RESPONSIBILITY TO PROVIDE IMPROVEMENTS

a. Any development, which will impact the service level, safety, or operational efficiency of roads serving such land development and is required by other County code or ordinance to improve such roads, shall improve those roads in accordance with these *Standards,* the *ZDO*, the *Comprehensive Plan* and the *CIP*.

b. Any land development abutting and impacting existing roads shall improve the frontage of those roads in accordance with these *Standards*, the *ZDO*, the *Comprehensive Plan* and the *CIP*. The extent of improvements shall be based on an assessment of the impacts of the proposed land development on the road system.

c. Any land development that contains internal roadways shall construct or improve those roadways in accordance with these *Standards,* the ZDO, the *Comprehensive Plan* and the *CIP*.

d. Mass grading required in conjunction with roadway development is subject to these *Standards*.

SECTION 130 - REQUIREMENTS FOR IMPROVEMENTS

Public and private improvements, dedication of right-of-way, and granting of easements are conditioned through the development review and land use review process, described and administered under the *ZDO* or by Federal, State, or other local government regulations and are subject to the requirements of these *Standards*.

130.1 Public Improvements

Complete engineering plans for all proposed improvement work within public right-of-way or on private property that impacts public facilities or easements under jurisdiction of the County shall be submitted to the Department of Transportation and Development Engineering Division ("Engineering") for approval. Such plans shall be prepared under the supervision of, and display the stamp of, an Engineer.

130.2 Private Improvements

When improvements to private property are required through land use approvals or proposed by the owner that affects shared access, emergency access, surface water runoff, neighboring property, the work shall be subject to plan submittal and approval, in the form of a Development Permit. Such plans shall be prepared under the supervision of, and display the stamp of, an Engineer licensed in the State of Oregon.

130.3 Permits Required Prior to Construction

Construction of proposed improvements shall not precede plan approval and issuance of a permit. Work that commences prior to plan approval or issuance of a permit may not be accepted and may be subject to the code enforcement procedures of the County Code.

130.3.1 Approval of Permits

Approval of plans and issuance of permits by the County does not in any way relieve the Engineer of his/her responsibility to meet all requirements of the County or other affected jurisdictions, or the obligation to protect the life, health and property of the public. The design for any project must be revised or supplemented at any time it is determined by the County that the full requirements of the County may not have been met.

130.3.2 Development Permit

A Development Permit shall be issued for construction per Section 130.1 and 130.2. See Section 140 for submittal requirements.

130.3.3 Driveway Entrance (Road Entry) Permit

A Driveway Entrance Permit is required for newly proposed or modified residential, agriculture and logging access between individual lots of record and County and public right-of-way. All other types of entrances require a Development Permit per Section 130.3.2. *County Code* Sections 7.03.240-7.03.290 provides additional permit requirements.

130.3.4 Utility Placement Permit

A Utility Placement Permit is required for the placement of utility lines, poles, or other appurtenances in the right-of-way or public easements. *County Code* Sections 7.03.100-7.03.240 provides additional permit requirements.

SECTION 135 - NOTIFICATION

The contractor shall coordinate the proposed construction activities with the owner and the local public agencies, utilities and companies during construction to avoid damage to utilities and to prevent the interruption of services to residences and businesses.

Agency	Phone
Clackamas County	503-742-4400
One Call Utilities Locate Center	811
Oregon Department of Transportation (ODOT) Region One	503-731-8200
District 2A (West side)	503-229-5002
District 2B	971-673-6200
District 2C (East of Rock Creek junction)	503-665-4193
ODOT Region Two	503-986-2600

Refer to the local utility district for erosion control, sanitary sewer, storm water and waterline requirements.

SECTION 140 - SUBMITTAL REQUIREMENTS FOR PERMITS

140.1 Development Permits

Construction plans shall be prepared in accordance with the following requirements:

a. Plans shall be submitted on sheets 22" x 34" or 24" x 36" and as approved, on 11"x17" sheets. Traffic signal, signing and striping plans shall only be submitted on 11" x 17" sheets. Acceptable scales are 1" = 10', 20', 30', 40', or 50' horizontal (1:10 ratio) and 1" = 1', 2', 3', 4', or 5' vertical. The scale shall be shown for each plan. Engineer scale shall be required.

b. Illegible plans will be returned for revision without review. This includes plans that do not clearly identify existing versus proposed.

c. A north arrow shall be included on each sheet and generally point to the top or right side of the plan.

d. For truck turning movements provide an exhibit at 1" = 20', 40', or 50' scale. When truck turning analysis is required, only CAD based truck turning software is acceptable. Truck turning exhibits need not be part of the construction plans, but may be submitted separately for review and approval. The location and elevation of a temporary benchmark shall be shown on the plans, or if not within the proposed area of work, shall be referenced by number and location. When practicable elevations shall be based on the NAVD88 datum. Alternatively, another datum may be acceptable as the basis of elevations for engineering drawings.

e. Whenever practicable, utilize the Oregon Coordinate Reference System – PDX zone (OCRS-PDX) as the coordinate base for projects. Alternatively, another geodetic plane system may be acceptable as the basis for engineering drawings.

f. Plans shall have a vicinity map showing the location of the project, surrounding roadways, nearby driveways, and major intersections.

g. The stamp and signature of the Engineer responsible for preparation of the plans shall be on all sheets. If not final plans intended for approval, the stamp shall be marked "Preliminary" or similar per Oregon Administrative Rule (OAR) 820-010-0621. The Engineer shall date the stamp on each sheet on the day it was signed.

h. The stamp and signature of the Surveyor responsible for preparation of the existing topographic conditions shall appear on the existing conditions plan. The Engineer's stamp is not required on the existing conditions plan. The surveyor shall date the stamp on the day it was signed.

i. Detail sheets shall show all Standard Drawings and special drawings needed for the project. *Oregon Standard Drawings* should be incorporated into the plans.

j. Plans shall include existing and proposed locations of utility poles, pedestals, vaults, fire hydrants, signs, mailboxes, and any other structures within the right-of-way.

k. General notes shall be shown together on one page, preferably the first sheet in the set. The County's standard general notes are provided in Standard Drawings N100-N300.

l. Plans shall include any additional information the County deems necessary.

140.1.1 Plan View

Plan views shall contain the following items (as applicable):

a. Plan and profile views may be stacked one above the other if desired. Plan horizontal scale shall match the profile horizontal scale.

b. Right-of-way, property lines, right-of-way centerline, and easement lines.

c. Construction shall not occur within two feet of adjacent property lines unless approved by the County and adjacent property owner.

d. Right-of-way centerline stationing of existing and proposed roadways. Stations shall be based on existing stationing if available. Show existing stations and centerline-centerline intersection stations.

e. Subdivision name, roadway names, subject property tax lot numbers and adjacent property tax lot numbers.

f. Existing utilities and structures, including hydrants, pedestals, signs (public and private), mailboxes, light poles, structures, manholes, inlets, valves, meter boxes, power poles, fences, curb ramps, pavement striping, trees, etc.

g. Edges of pavement on both sides of the street, including shoulders, curb, sidewalk, ditch line, culverts and existing driveways. Plan and profile views shall include the above items extending **200 feet from project boundaries adjacent to and beyond the proposed improvement**.

h. Horizontal alignment and curve data for roadway centerline and non-parallel curb lines. Curve data shall include radius, length, and delta.

i. Curve data (radius, length, and delta angle) for all curb returns, with gutter elevations at the P.T., P.C., and quarter deltas. Top of curb elevations may be shown. Show the location of survey monument boxes per 150.3.

j. Minimum stationing callouts at 100 foot increments, with tick marks at 50 foot increments.

k. Location, station, and size of all existing and proposed storm drains, sanitary sewers and water systems. Stationing shall be based on roadway stationing, except where specifically required otherwise by sewer or water district.

l. Grading plans shall show existing and proposed contours, and high and low points. Contours shall be at a maximum two (2) foot interval.

m. Elevations shall be shown for ADA ramps at top and bottom of wing and top of ramp and elevations at landings in accordance with Standard Drawings S900 to S940. The steepest ramp cross slopes shall be shown on the plan.

n. Location and description of existing survey monuments.

o. Typical sections of all roadway sections and drainage channel sections.

p. The location of the saw cut line. Add this note: "Saw cut to be approved by Clackamas County prior to commencing this work. Provide approved hot liquid asphalt or emulsion oil and sand seal."

q. Pavement tapers as defined in Section 250.6.4.

r. Sight distance triangles.

s. Signing and pavement marking plan as necessary per Sections 270 and 280.

140.1.2 Profile View

Profile views shall contain the following items (as required):

a. Stationing, elevations, vertical curve data and slopes for proposed roadway centerline. Existing center line elevations shall be shown. Estimate and label existing vertical curve data. Gutter elevations shall be shown when gutter slope does not parallel the centerline profile.

b. Where superelevation is employed, both curbs shall be profiled. As an alternative, a superelevation diagram may be acceptable.

c. Existing ground line at proposed roadway centerline. Existing ground line shall extend a minimum of 200 feet beyond the proposed improvement.

d. All existing and proposed storm drains, sanitary sewers, and water systems. Include pipe size, material, length, slope, manholes, inlets, invert and rim elevations, and outfalls.

e. All existing and proposed storm, sanitary, and water lines, and utility crossings.

f. Existing and proposed flowlines of ditches and drainage ways. Flowlines shall extend a minimum of 200 feet beyond the proposed improvement or to the nearest acceptable outfall.

g. Vertical sight distance evaluation.

140.1.3 Half Street/Cross Section Views

Half street/cross section views shall contain the following items (as required):

a. Half street design shall include the information required in Sections 140.1.1 and 140.1.2.

b. Half street designs require cross sections that indicate the elevations at centerline, crown, saw cut line, and gutter line or existing edge of pavement at 25 feet on center. All cross slopes shall be labeled. The maximum allowed grade break within the transition between existing and proposed cross slopes is 2%.

c. Additional cross sections may be required by the County when warranted by the complexity of the road design.

140.1.4 Drainage Calculations

All drainage calculations shall be stamped and signed by an Engineer. Complete calculations shall be shown in a clear, concise manner and contain, at a minimum, the following:

a. Map of the drainage basin showing areas contributing to each inlet.

b. Design assumptions and parameters.

c. Nomographs and charts used to determine time of concentration and rainfall intensity.

d. Calculations for conveyance systems, water quality facilities and detention facilities, as required.

e. Downstream analysis as required.

f. Provide an executive summary that references the design elements included in the report.

For full criteria and requirements for drainage, see Chapter 4 of these *Standards*.

140.1.5 Other Requirements

Design elements and assumptions used for roadway design shall be included on the plans or submitted in memorandum form to the County. The following information shall be provided, as required:

a. Functional classification of roadway.

b. Design speed and posted speed.

c. Superelevation.

d. Cross sections.

e. Soils report (see Section 252 for requirements).

f. Pavement section design.

g. Structural plans and calculations shall be submitted for all proposed structures (i.e., retaining walls, box culverts, bridges, etc.) and may require a building permit. All structures, excluding bridges, on private property shall meet the requirements of the International Building Code (IBC). All bridges (public and private) and all structures in the public right-of-way will be reviewed per AASHTO requirements as determined by Engineering.

h. Other required technical data and reports.

i. Environmental reports and permits as required by law.

140.1.6 Other Reviewing Agencies

The design and construction of public and private improvements within the County may involve numerous federal, state and local agencies, utility districts, and private utilities. It shall be the Engineer's responsibility to coordinate the design, permit process, and construction with the applicable agencies, districts, and private utilities.

140.1.7 As-Built Plans

The applicant shall be responsible for providing a reproducible set of as constructed drawings for all improvements including all construction changes, added and deleted items, location of utilities, etc. The as-built plans shall be submitted to the County at the time of initial paving or building occupancy, and shall include at a minimum, the following.

a. As-built plans, both electronic and paper, shall include and address the requirements of Section 140.

b. As-built plans shall include field survey data by a Land Surveyor that provides the actual invert and rim elevations of all sanitary and storm sewer systems within the project.

c. As-built elevations that vary from plan elevations shall be shown on the plan by striking a line through the plan elevation and listing the field verified elevation adjacent to the plan elevation. Elevations shall be as-built at a tolerance of 0.05± feet.

d. Applicant shall submit one set of as-built plans stamped and signed by an Engineer. The as-built plans shall include the entire approved plan set. The applicant shall check with other departments, including Planning and the Utility districts, for their as-built plan requirements. Traffic signal plans and signing and striping plans shall be submitted as pdf in addition to paper and AutoCAD formats.

e. One set of AutoCAD files for the as-built civil drawings. If AutoCAD files are not available, provide a drawing file in DXF format for translation into AutoCAD. Combination files are acceptable with numerous civil sheets included in the drawing file. Provide a list of the filenames linking the drawing files to the civil sheet number. A hard copy description of the drawing configuration including paper space layout, layer assignments, pen assignments, XREFs and special plotting instructions is requested. A printed description included in the actual drawing file is recommended.

140.2 Utility Permits

Application for a permit to establish, place and operate utilities within the right-of-way shall be made on the official permit application, available from Engineering.

140.2.1 General Requirements

The utility company shall be responsible for the design and maintenance of utilities under their jurisdiction. Those responsibilities shall include:

a. Advanced coordination with other users of the roadway to ensure the compatibility of the new utility placement and shared uses.

b. Construction, location and maintenance in compliance with these standards.

c. Provisions for public safety and accident prevention for the service life of the installation.

d. All above ground appurtenances shall be located where they do not create undue interference or a clear zone hazard to traffic, whether vehicular, bicycle or pedestrian. Utilities shall not be located in areas of restricted sight distance, i.e., on sharp curves and steep grades. They shall not interfere with the proper function of traffic control signs, signals, lighting or other devices that affect traffic operation. Engineering shall approve any revisions to historic utility locations.

140.2.2 Submittal Requirements

The following items must be submitted along with applications:

a. Verification of insurance as required by this Chapter.

b. Performance Bond as required under Section 190.

c. Any drawings requested to illustrate the work described in the permit application.

d. A drawing that clearly depicts protection devices, such as guardrails or bollards, for review by Engineering to ensure compliance with the clear zone criteria of Section 245.

e. If an installation contractor is to be used, both the applicant/utility and the selected contractor must sign the permit.

The privileges granted and obligations created by virtue of the permit issued shall be binding not only upon the applicant, but also upon the successors and assigns of the applicant. The applicant shall give Engineering written notice of any such assignment or transfer within a reasonable time not to exceed 90 days after assignment.

140.2.3 Permit Review

The applicant shall consider and provide the following information in Utility Permit applications:

a. Consideration of where it is reasonable to construct, maintain and provide for the shared uses of the right-of-way.

b. Methods for which the utility is to be installed.

c. Traffic control plan(s).

d. Consideration for sustaining the structural integrity of the roadway, bridge or other affected structure.

e. Consider the use and appearance of the right-of-way.

f. To facilitate site review, Engineering may require the applicant to place markers such as lathe, stakes, paint, or other means of identification at the locations where the applicant proposes to work.

SECTION 150 - SURVEYING

150.1 General

These *Standards*, Section 170 of the ODOT *Standard Specifications for Construction* and ORS 209.140-155, define the requirements for protection of existing survey monuments during any construction and setting new survey monuments following construction of new roadways.

150.2 Existing Survey Monuments

a. Anyone who notices or causes an existing section corner, quarter corner or donation land claim corner monument or accessory, to be in danger of damage or destruction by any construction, shall notify the County Surveyor in writing, not less than ten (10) working days prior to construction. The County Surveyor shall reference the monument prior to construction and replace it following construction. The County Surveyor shall be reimbursed by the applicant for all expenses from said replacement.

b. In accordance with ORS 209.150 (or as subsequently amended), any person or public agency removing, disturbing or destroying any survey monument of record in the office of the county surveyor or county clerk shall cause a registered professional land surveyor to reference and replace the monument within 90 days of the removal, disturbance or destruction. The registered professional land surveyor referencing and replacing the monument shall do so in the same manner that is provided for public land survey corners according to ORS 209.140 and shall notify the county surveyor of that action within two business days. The costs of referencing and replacing the survey monument shall be paid by the person or public agency causing the removal, disturbance or destruction.

c. Any project that involves the reconstruction or realignment of all or a portion of a public road shall be required to comply with ORS 209.155.

150.3 New Survey Monuments

a. Centerline monuments shall be installed at all centerline intersections of roadways (including intersections with existing roadways), P.C.'s and P.T.'s of each curve, and at all centers of cul-de-sacs, turnarounds or as required by the County Surveyor to sufficiently monument the right-of-way or a required easement.

b. Monuments shall be set by a Land Surveyor.

c. When monuments are set by a Land Surveyor, they shall file a record of survey complying with ORS 209.250 and any additional requirements set forth by the County Surveyor.

d. The County requires centerline monument boxes to be used meeting the requirements of the County Surveyor. Requirements can be found at the Surveyor's website. Any monument box used that has not been approved by the County Surveyor will be required to be removed and replaced at the expense of the applicant.

SECTION 160 - DEDICATION OF PUBLIC RIGHT-OF-WAY AND EASEMENTS

160.1 Requirement for Public Easement

As a condition of approval for a development, the County may require that additional road right of way or other public easements be dedicated in support of the proposed development. The determination of the easement widths and types will be made upon review of the development with the requirements for dedications identified in the Conditions of Approval or as identified in the plat review process. The requirement to improve road widths and public use configurations reflect the County's long term transportation plan goals.

160.2 County Approval Required

State law and County policy require evidence of County approval before a dedication instrument of a public easement can be recorded. ORS 92.014 provides that:

a. A person may not create a street or road for the purpose of subdividing or partitioning an area or tract of land without the approval of the city or county having jurisdiction over the area or tract of land to be subdivided or partitioned.

b. Notwithstanding ORS 92.175, an instrument dedicating land to public use may not be accepted for recording in this state unless the instrument bears the approval of the city or county authorized by law to accept the dedication.

160.3 County Road Official Review

County approval of these dedications and resultant roadways will ensure the establishment of legal access and minimize future problems as expansion of the roadway system occurs. The County Road Official has a key role in reviewing

proposals to ensure adequate width and suitable alignment of roadway right-of-way are provided and in monitoring roadway improvement work for compliance with these *Standards*.

160.4 Permit Required

A Development Permit is required to ensure County acceptance of any required improvements with a dedication.

160.5 Minimum Width Requirements for Rights-of-Way and Easements

Before improvement of a public right-of-way will be permitted and initiated, the width of the existing road right-of-way shall be determined to be adequate to contain the proposed improvements.

Definition of standard road right-of-way widths by roadway functional classification are provided in Standard Drawings C110 to C140. However, our development community is aware that within the County road system, there are special districts and projects that require road designs specific to those areas. Details specific to these development areas can be found in the County's Comprehensive Plan.

a. In the case of the requirement to dedicate a Permanent Public Utility Easement (PUE) or combination of another easement that includes a PUE, an eight (8) foot wide easement along the entire abutting right-of-way of all front lot lines, as shown on Standard Drawings C110 to C140, shall be provided for County approved public utilities as defined in ORS 757. Note that storm and sanitary lines are not permitted within a PUE.

b. Additional easements for signing, slopes, and pedestrian facilities may be required by the County under the conditions of approval or during construction plan review.

160.6 Public Easement Dedication Process

a. Typical easements that may be required for dedication by plat or by a separate instrument (standard easement form) may include, but are not limited to:

    1. Permanent Right of Way Easement for Road Purposes

    2. Permanent Public Utility Easement

    3. Permanent Sign, Slope, Public Utility and Sidewalk Easement

    4. Permanent Storm Drainage Easement

b. Depending upon the conditions of approval, one or more of the above easement dedications may be required.

c. In addition to the aforementioned easements, the development may be required to provide proof of recorded access from a public road through the proposed development to an abutter parcel as noted in Section 220.2.

d. If proof of said pass-through access cannot be proved or has not previously been created, then the development parcel will be required to dedicate a Permanent Easement for Ingress and Egress for the benefit of the abutter parcel on the face of the plat. If created by separate document, this form may be obtained from the Right of Way Section of the Department of Transportation and Development (DTD) and reference the process below in Section 160.8.

160.7 Dedication of Public Right-of-Way and Easements on the Plat

a. Dedications of right-of-way and easements on a plat shall meet all requirements of Section 160.4.

b. Dedications of easements shall be shown on the plat and meet the requirements of *ZDO* Section 1007.

160.8 Dedication of Public Right-of-Way and Easements Outside of the Plat

a. Dedication of right-of-way and easements created by separate document outside of the plat shall follow Section 160.6.

b. Easement dedications outside of the plat that are required to allow for development shall be acquired and recorded prior to issuance of a Development Permit.

c. Prior to acceptance of right-of-way and public easements created by a separate document (easement form), plans shall be submitted to the DTD Planning and Zoning Division to determine if a land use application is required. The design and construction of the resultant roadway may proceed pursuant to the requirements of these *Standards* and in conformance with all applicable land use conditions.

d. The easement forms are available for use from the Right of Way Section of DTD.

e. When requested by DTD, each easement shall be accompanied by an appropriate Exhibit "A" and "B." Exhibit "A" is the written legal description of the easement area, and Exhibit "B" is the map depicting the area of the legal description. Both exhibits shall be stamped and signed by a Land Surveyor.

f. If the developer or owner's surveyor or engineering firm has not previously provided Exhibits "A" and "B" to the County, the Right of Way Section of DTD can provide copies of previously recorded exhibits that were acceptable to the County.

g. The developer (or owner) will be asked to provide documentation supporting the easement signer's authority to execute land rights documents on behalf of the corporation or other representative organization. The developer may also be required to provide a copy of the owner's current vesting deed.

h. Easement forms, with exhibits, shall be submitted to the County Right of Way Section for review and approval, prior to obtaining signatures on the easement(s) form.

i. Acceptance and recording of the easement dedication(s) will be provided free of charge by the County.

SECTION 170 - DESIGN MODIFICATIONS

Approval of non-compliant specifications and standards may be requested utilizing the following process. This process does not apply to land use "Conditions of Approval" which have a separate modification process outlined in the *ZDO*.

170.1 Modification Process - Minimum Requirements Defined

These *Standards* outline the minimum requirements for constructing improvements in the County.

Since a design modification is a request for a deviation below the minimum standard, the County shall ensure that the overall project is adequate. AASHTO's *A Policy on Geometric Design of Highways and Streets* specifically states that the bare design minimums should not strictly be used in design. Refer to Section 210 for additional discussion on the definition of minimum requirements.

Consequently, the County will consider the aggregate number of minimum criteria used in a design. If a design modification is granted, the County may require that the overall design of the project be mitigated with an increase above the minimum requirements in other areas of the project to improve safety and to comply with AASHTO's overall design objectives.

170.1.1 Modification Request Submittal

Requests to modify design standards should be submitted in writing to Engineering, generally prior to land use approval if a land use action is or will be at issue. Land use conditions of approval are commonly written so that there is little, if any, flexibility after land use approval. For this reason, it is imperative that standards that cannot be complied with be

identified and addressed prior to land use approval. If a design modification is requested after the land use conditions of approval are issued, additional application for a modification of the conditions of approval or a new land use application through the Planning Department may be required. This written request should include the following:

a. The desired modification(s);

b. The reason(s) for the request(s);

c. A comparison between the standard(s) and the modification(s) for performance, function, maintainability, safety, etc.

d. References to regionally or nationally accepted specifications and standards, record of successful use by other agencies, or other supportive information.

170.1.2 Criteria for Modification of Standards

The County may grant a modification to the adopted standards or specifications when the use thereof does not compromise public safety or the intent of the County's standards and any one of the following conditions are met:

a. The standard is deemed not applicable in the particular application.

b. Topography, right-of-way or other geographic conditions impose an environmental concern and an equivalent alternative, which can accomplish the same design intent, is available.

c. A minor change to a standard or specification is required to address a specific design or construction problem which, if not enacted, will result in an undue hardship.

d. The proposed modification fully meets the requirements for safety, function, appearance and maintainability based upon sound engineering and technical judgment.

e. Any necessary modification of land use conditions of approval has been obtained.

170.1.3 Review

The request to modify design standards shall be reviewed first by Engineering technical staff who shall make one of the following decisions:

a. Approve as proposed,

b. Approve with changes, or

c. Deny with an explanation.

Approval of a site-specific request shall not constitute a precedent for use at other locations.

170.1.4 Appeal

Applicants may appeal the County technical staff's decision to the Engineering Division Manager. The Engineering Division Manager's decision may be appealed to the County Road Official, whose decision shall be final.

SECTION 180 - CONSTRUCTION INSPECTION

180.1 General

The County shall be provided access to inspect all improvements required under a permit or land use decision. The costs for roadway inspection, plan review, and project coordination are assessed and included in the issuance of the

Development Permit or Utility Permit fee.

180.2 Inspector's Authority and Duties

An inspector will be assigned to each project to inspect materials and work performed. Such inspection may extend to any or all parts of the work and to the preparation and/or manufacture of the materials to be used.

The inspector is not authorized to:

a. Revise, alter, or relax the provisions of the specifications, the approved plans, or these *Standards*.

b. Direct how the work is to be performed.

The inspector has the authority to:

a. Inspect work performed and materials furnished, including without limitation, the preparation, fabrication, or manufacture of materials to be used.

b. Orally reject defective materials and to confirm such rejection in writing. The inspector may advise the applicant or contractor of any faulty work or materials; however, failure of the inspector to advise the applicant or contractor does not constitute acceptance or approval.

c. Require revisions to approved engineering plans when necessary due to conflicting field conditions.

d. Temporarily suspend the work for safety deficiencies and allow work to proceed after safety deficiencies have been corrected.

e. Exercise additional delegated authority.

180.3 Inspection Requirements

180.3.1 Inspection Access

The County shall be allowed access to all parts of the work, including the manufacturing facilities of producers and fabricators at all times; and shall be furnished with every reasonable facility for ascertaining whether or not the work, as performed, is in accordance with the requirements and intent of the plans and specifications.

180.3.2 Testing

All testing required by the County shall be at the applicant's expense.

180.3.3 Inspection Notification

The County does not furnish full-time inspection of new development roadway construction. For this reason, it is imperative that the applicant and/or the applicant's contractors provide prompt and complete notification to the County as to the progress of the construction of roadway and drainage improvements. A minimum of 48 hours notice shall be provided for inspection requests.

Notification shall be given to the County when the following work is to be scheduled:

a. Placement of erosion and sedimentation controls.

b. Stripping of vegetation and topsoil in fill areas.

c. Underground utility placement.

d. Compaction testing and proof roll of trench backfill and fill areas.

e. Engineered fill placement and rough grading of roadways.

f. Construction of concrete structures (curbs, inlets, manholes, sidewalks, driveways, etc.).

g. Fine grading and compaction testing/proof roll of subgrade.

h. Fine grading/compaction testing/proof roll of base rock.

i. Placement and compaction of pavement.

j. Finishing roadbed and slopes (backfilling curb or gutter, trimming out banks and drainage channels, etc.).

k. Bridges, culverts and walls.

l. Striping layout.

180.3.4 Failure to Notify

Failure to request inspection 48 hours in advance of the work schedule may invalidate the work performed and therefore require tests and inspection reports from a certified independent testing laboratory in order to determine whether or not compliance with the roadway construction specifications exists. Test results shall be furnished at no expense to the County. Work that is deemed noncompliant may be required to be removed and replaced.

180.3.5 Additional Fees - Utility Permits

When increased inspection is deemed necessary by Engineering, additional costs shall be paid by the applicant under the terms outlined in *County Code* Section 7.03.200. Examples of special circumstances that may trigger increased inspection include:

a. Extended hours of work/operation; or

b. Failure to comply with permit requirements; or

c. High traffic volumes in the vicinity of the work/operation; or

d. Special access requirements for the work/operation; or

e. Repeated re-inspection of the same improvement.

SECTION 190 - PERFORMANCE SURETY, WARRANTY AND ACCEPTANCE OF WORK

190.1 General

To ensure the acceptable completion of permitted roadway, access, drainage, private, or public improvements, a Performance Surety shall be required and integrated into the respective Development Permit or Utility Permit. A date of completion of the construction improvements shall be established and stated in this permit. If the work required by the Development Permit or Utility Permit is not completed and accepted by the County at the time the applicant requests the release of the plat or a certificate of occupancy, a surety shall be required. Substantial Completion shall be achieved prior to acceptance of any surety for guarantee of work. Requests for acceptances of a surety for guarantee of work without achieving Substantial Completion will be evaluated by Engineering using the criteria in Section 190.1.1 on a case by case basis if minimum fire, life and safety issues are met.

190.1.1 Substantial Completion for Subdivision of Land

Substantial Completion is achieved at the conclusion of the initial roadway improvement and shall meet the following conditions:

a. Off site right-of-way and easements have been accepted.

b. The sanitary sewer under the road is constructed and accepted.

c. The drainage system draining the road is constructed and inspected.

d. The water line is constructed and inspected and water is available for fire suppression.

e. The first lift of asphalt is constructed or the full gravel section has been placed and properly compacted if no asphalt is required.

f. Sign fees have been paid.

190.1.2 Substantial Completion for Certificate of Occupancy for Lots of Record including Commercial, Industrial and Multifamily

a. All right-of-way and easements have been accepted or provided.

b. The sanitary sewer is constructed and accepted.

c. The drainage system is constructed and inspected.

d. The water line is constructed and inspected and water is available for fire suppression.

e. All asphalt pavement is constructed or the full gravel section has been placed and properly compacted if no asphalt is required.

190.1.3 Surety

a. Performance Bonds shall be provided only through State regulated surety companies while assignment or commitment of savings or loan proceeds shall be through State regulated financial institutions.

b. A Cash Acknowledgment is a cash surety held directly by the County.

c. A Developer's Agreement shall accompany the surety.

190.1.4 Surety Forms

All sureties and Developer's Agreements shall be submitted on forms provided by the County and are subject to review and approval by County Counsel.

190.1.5 Surety in Effect

Sureties shall be in full force and effect at the time of plat approval or issuance of a certificate of occupancy and through County acceptance of the improvements resulting in release of the surety.

190.1.6 Surety Amount

a. The financial amount established for the surety shall be equal to 125% of the estimated value of the improvement.

b. An Engineer's estimate is required. A contractor's bid is not acceptable. The surety shall cover the County's cost for completing the work on behalf of the applicant.

c. The minimum amount for bond sureties shall be $10,000. The minimum amount for all other sureties including the Cash Acknowledgment shall be $4,000.00.

d. Sureties shall be accompanied with a 25% contingency for the first two years and an additional 10% contingency per year for up to two additional years.

190.1.7 Cash Sureties Required for Work in Existing Roadways

a. A Cash Acknowledgment is required for work permitted in existing roadways prior to issuance of the Development Permit. The guarantee shall be in the amount of 125% of the required improvements. This is to ensure that the road remains in serviceable condition at all times.

b. This section is intended to protect primarily arterials and collectors. However, if the extent of the proposed work on a local street is significant enough to warrant concern, the county may require a Cash Acknowledgment for the local street as detailed in this section.

c. If an existing roadway is left in disrepair and is a hazard to the traveling public, the County reserves the right to repair the road by redeeming the Cash Acknowledgment without executing the remaining sureties that may be in place for the development.

d. If the Cash Acknowledgment is redeemed to repair a road during the course of a project, an additional surety may be required by the County.

190.2 Maintenance and Warranty Period

a. When Substantial Completion is achieved, the owner's or developer's maintenance and warranty period begins with a period of at least one year or at least 90% of subdivision build-out of the homes. At this time, the required surety, as detailed above, shall be valued at 125% of the remaining construction, including sidewalks and estimated remaining lift of asphalt, and 25% of all items previously constructed and approved by the County.

b. The warranty period may be extended if the required improvements show signs of failure during a final inspection.

190.3 Acceptance of Work

Prior to County acceptance of the improvements and release of all sureties, the following shall occur:

a. The County shall conduct a final inspection of the roadway, accesses, drainage, and other private or public improvements.

b. The County shall make a determination of final completion in conformance with plans, specifications, and County standards.

c. The owner or developer shall perform a thorough cleaning of the roadway surface and storm drain system.

d. The final lift of asphalt or concrete roadway surface and all sidewalks shall be completed.

e. Any deficiencies resulting in non-acceptance of the work permitted in the Development Permit shall be identified in writing on a final punch list and presented to the permit holder with a date named for correction and completion. Upon correction of the noted deficiencies and the determination that all work is in conformance with County Standards, the work will be accepted, and all sureties shall be released.

190.4 Acceptance of Roads for County Maintenance

When a public road built to County standards is accepted, the final punch list is deemed complete, and the warranty period is over, all sureties shall be released. The County will then accept the road for maintenance as indicated by the road's classification.

190.5 Nonperformance of Development Permit

Failure to complete the project within the times outlined in the Development Permit shall be construed as nonperformance and a violation of the project's Conditions of Approval. The surety shall be demanded in order to bring the project to completion. If compliance is not achieved, the file shall be forwarded to the Code Enforcement Division for enforcement.

190.6 Utility Permits

For requirements related to Utility Permits, see *County Code* Section 7.03.130.

SECTION 195 - PROHIBITED ACTIVITIES DURING CONSTRUCTION IN RIGHT-OF-WAY

The use of public rights-of-way for construction vehicle and materials staging is not authorized by the *Standards* and poses a potentially deleterious effect of the proposed use, because it contributes to congestion, reduces sight distance, and occupies shoulders intended for emergencies and other purposes. To protect the public from such effects, the applicant shall be required to submit a construction vehicle management and materials staging plan for review and approval by Engineering, before the issuance of a Development Permit. The plan shall show that the construction vehicles and materials will not be staged or queued-up on improved public streets and shoulders without specific authority from Engineering for that purpose.

CHAPTER 2 - ROADWAY DESIGN

SECTION 210 - GENERAL

a. Roadways in Clackamas County shall be designed as follows:

   1. For the safe and efficient travel of all users of the transportation system.

   2. To meet or exceed the minimum design guidelines contained herein and/or the most recent versions of the manuals and standards of Section 115.

   3. To flexibly consider roadway context with regard to the mix of users, adjacent land use, type of traffic, traffic volume, and speed of traffic to be carried.

   4. To implement the *ZDO*, *Comprehensive Plan* and *CIP*. Planned improvements should comply with these documents.

b. Proposed development shall be provided access through safe and efficient transportation improvements. Determinations of minimally adequate traffic safety may include consideration of the safety and adequacy of off-site public roadways through which traffic to and from development flows.

c. Considerations will be made to best accommodate interrelationships of existing and proposed roadways, topographic conditions and the land use to be served by the roadway.

d. Community Planning Areas exist that have exceptions to these *Standards*. These areas include unincorporated communities, Sunnyside Village, Clackamas Regional Center, Mt. Hood Community Plan and Urban Growth Management Areas, as examples.

e. These *Standards*, except as noted, may be altered on a case by case basis through the modification process of Section 170.

SECTION 215 - FUNCTIONAL CLASSIFICATION & REGIONAL STREET DESIGN GUIDELINES

The functional classification of existing and planned roadways has been established by the *Comprehensive Plan*, Chapter 5 - Transportation. Design standards for new roadway construction and existing roadway improvements are based on these functional classifications. The functional classification of a roadway determines how the roadway will be designed by defining roadway cross section, design speed and access control.

Functional classifications of individual roadways can be found on Maps V-2a and V-2b of the *Comprehensive Plan*. Descriptions of each functional classification can be found on Table V-2 of the *Comprehensive Plan*.

Roadway design shall consider the Regional Street Design Type Guidelines as described per *Comprehensive Plan* policy 12.0 as illustrated in Table V-4 and Map V-3.

Community Planning Areas exist that have exceptions to these *Standards*.

All other roadway design shall comply with these *Standards*.

SECTION 220 - ACCESS MANAGEMENT

220.1 General

a. Access management is required to ensure safety and efficiency of traffic flow for users of the transportation network and to balance those needs with livability, economy and community values. Overall, access

management should balance the needs of local business, residents, through traffic, local traffic, pedestrians and bicyclists on a particular roadway.

b. The location and number of roadway intersections and access points shall be planned, coordinated and controlled by Engineering. Roadway and driveway entrances to existing and planned roadways shall conform to the access requirements of these *Standards*.

c. By the nature of the roadway functional classification system, higher speed arterial streets require the highest access management restriction tending toward less access. Lower speed collector streets and connector streets require less restrictive access management. Local streets require very few access management restrictions and tend towards very frequent access.

d. The *Comprehensive Plan* provides various standards for access within certain Community Planning Areas, Chapter 10. Within those plan areas, access shall be determined according to the *Comprehensive Plan*.

e. Consolidating access points onto arterials and improving traffic flow and safety will be the primary consideration when reviewing access proposals for approval.

f. All access that is allowed or allowed by modification per Section 170 is subject to access movement restrictions in order to preserve the safety or mobility of the subject roadway. Access movement restrictions may necessitate the installation of roadway medians, which may result in substantial cost including off-site roadway widening. These improvement costs shall be borne entirely by the applicant proposing such access.

g. With development, requested access may be denied and/or reduced from existing conditions if adequate safety, spacing, classification and mobility requirements cannot be met or if there is a reasonable alternate such as a shared access or access to an equal or lower classification street is available.

220.2 Crossover Access Easements

Except along local and connector roadways, crossover access easements and shared access shall generally be required within the UGB between adjacent compatible commercial, multifamily and industrial parcels to reduce access points, reduce traffic volumes, improve safety, improve convenience to on-site users, and to reduce impacts to environmentally sensitive areas.

These easements shall generally be required even if adjacent uses are allowed direct individual access to an adjacent roadway.

220.3 Roadway Intersection Management

a. Proposed new subordinate public and private roadways shall comply with the following requirements at their intersections with existing or proposed primary roadways. Roadways of a given functional classification may access roadways of another classification as indicated in Table 2-1.

Table 2-1. Public Intersection Access

Functional Classification of Existing Primary Roadway	Functional Classification of Proposed Subordinate Roadway				
	Major Arterial	Minor Arterial	Collector	Connector	Local/Private Roadways
Major Arterial	Yes	Yes	Yes	No*	No*
Minor Arterial		Yes	Yes	Yes	No*
Collector			Yes	Yes	Yes
Connector				Yes	Yes
Local					Yes

*May be allowed as a modification per Section 170.

b. Intersection spacing and location shall be considered as follows:

1. For proposed public or private roadways, intersection spacing shall be measured along the existing primary roadway from the proposed roadway centerline to the centerline of an existing or planned roadway or major driveway with an ADT of greater than 400. The proximity of minor driveways with ADT of less than 400 are not a consideration of new public and private roadway intersection spacing unless a safety issue would result. In that case, turning movement restriction of the driveway shall be first considered.

2. For proposed private driveways, intersection spacing shall be measured along the existing primary roadway from the proposed driveway centerline to the centerline of an existing or planned roadway and any existing driveway.

3. Planned roadways are those adopted by the *Comprehensive Plan*.

4. If a safety issue would result, intersections shall not be created within the influence area of existing or planned intersections.

c. Proposed new subordinate public and private roadways shall only access an existing or proposed roadway at the minimum centerline spacing illustrated in Table 2-2.

Table 2-2. Minimum Public Roadway to Public Roadway Intersection Access Spacing (feet)

Functional Classification of Existing Primary Roadway	Minimum Full Spacing of Intersecting Roadways				Minimum Restricted Spacing of Intersecting Roadways*			
	Major & Minor Arterial	Collector	Connector	Local & Private Roadways	Major & Minor Arterial	Collector	Connector	Local & Private Roadways
Major Arterial	1000	1000	500	250	N/A	N/A	300	300
Minor Arterial	1000	500	250	250	N/A	N/A	300	150
Collector		150	100	100		N/A	N/A	N/A
Connector			100	100			N/A	N/A
Local & Private Roadways				100				N/A

Notes:

Does not apply to driveways.

Alternative spacing may be allowed as a modification per Section 170.

*Access movements may be restricted to right-in/right-out or similar as necessary to preserve function of major roadway.

220.4 Driveway Access to Arterial Roadways

Driveway access to arterial roadways is restricted. If available, access shall generally be provided from streets with a lower functional classification except where Engineering determines that safety dictates an alternative access scenario. Access to major arterials is more restricted than access to minor arterials. If access is approved, it is very likely to be restricted to a right-in/right-out configuration or similar. Full access is not guaranteed to arterial roadways. The following access scenarios are prohibited unless it is demonstrated that no other alternative is feasible:

a. Access within 400 feet of an existing or planned signalized intersection along a major arterial.

b. Access within 300 feet of an existing or planned signalized intersection along a minor arterial.

c. Access within 400 feet of an existing or planned public roadway intersection along a major arterial.

d. Access within 300 feet of an existing or planned public roadway intersection along a minor arterial.

e. Conflicting access movements within the 95th percentile queue of any traffic movement at an existing intersection or major driveway. A traffic study complying with Section 295 will be required if this is a likely issue.

f. Proposed single family residential driveways.

g. Driveways that require the design vehicle to back onto the arterial from the driveway or to back from the arterial into the driveway.

Modifications may be granted per Section 220.8.

220.5 Driveway Access to Collector Roadways

Access to collector roadways is less restricted than to arterial roadways. If available, access should be provided from streets with a lower functional classification except where Engineering determines that safety dictates an alternative access scenario. The following access scenarios are strictly prohibited unless it is demonstrated that no other alternative is feasible:

a. Access within 300 feet of a signalized intersection along a collector.

b. Access within 150 feet of an existing or planned public roadway intersection.

c. Conflicting access movements within the 95th percentile queue of any traffic movement at an existing intersection or major driveway. A traffic study complying with Section 295 will be required if this is a likely issue.

d. Proposed single family residential driveways.

e. Driveways that require the design vehicle to back onto the collector from the driveway or to back from the collector into the driveway.

Commercial, industrial, multifamily and institutional uses may have exclusive driveway access to a collector with a minimum intersection spacing of 150 feet.

Modifications may be granted per Section 220.8.

220.6 Driveway Access to Connector Roadways

If available, access should be provided from streets with a lower functional classification except where Engineering determines that safety dictates an alternative access scenario. Access for proposed single family residential driveways is allowed. No driveway shall be allowed within 25 feet of the right-of-way lines at an intersection.

Commercial, industrial and institutional developments proposing access to roadways with a local road functional classification that serve existing residential neighborhoods located within the UGB are discouraged and any anticipated adverse impact upon the livability of these neighborhoods shall be quantified and mitigated proportionately to their impacts.

Modifications may be granted per Section 220.8.

220.7 Driveway Access to Local Roadways

Access for proposed single family residential driveways is allowed. No driveway shall be allowed within 25 feet of the right-of-way lines at an intersection.

Commercial, industrial and institutional developments proposing access to roadways with a local road functional classification that serve existing urban residential neighborhoods shall evaluate and quantify any anticipated adverse impact upon the livability of these neighborhoods and mitigate those impacts proportionately.

Modifications may be granted per Section 220.8.

220.8 Modification Considerations

All access requests not meeting these standards for access shall include a scaled site plan and a traffic report if required by Engineering. The scope of the development will determine the information required and shall comply with Sections 170 and 295. The evaluation of the access request will consider the impacts that traffic generated by the proposed development will have on through traffic, traffic patterns, traffic queuing, and safety in the area.

If approved, access may be restricted to right-in/right-out movements or other movement restrictions, and then only if meeting the maximum access standards of Table 2-3 and spacing standards of Table 2-4.

220.9 Maximum Access by Modification

If access is approved to a roadway under the procedures of Section 220.8, Table 2-3 illustrates the maximum number of driveways that may be approved with the associated weekday ADT generated by the development and functional classification of the existing roadway. The allowed number of access points will be based upon a traffic study complying with Section 295. Depending upon the individual situation, turning movements may be restricted to right-in/right-out or similar at the discretion of Engineering.

Table 2-3. Commercial, Industrial, Multifamily Maximum Number of Private Driveway Access

Functional Classification of Existing Roadways	Estimated Development ADT		
	ADT < 2500	2500 > ADT > 5000	5000 > ADT
Major Arterial*	0	1	2
Minor Arterial*	1	2	2
Collector	Access Determined by Table 2-4		
Connector			
Local			

Notes: All proposed driveways must meet access spacing of Table 2-4.

*No access allowed unless no alternate access is available.

Table 2-4. Commercial, Industrial, Multifamily Minimum Private Access Spacing*

Functional Classification	Full Access Spacing (feet)	Restricted Access Spacing (feet)
Major Arterial	500	500
Minor Arterial	500	300
Collector	150	150
Connector	100	N/A
Local	100	N/A

*If access is approved by Engineering per Section 170, access movements may be restricted as necessary.

N/A = Access restrictions not commonly employed.

220.10 Minimum Vehicular, Pedestrian, Bicycle and Emergency Access

Minimum access should be considered per the Comprehensive Plan Chapter 5 Policies 20.0 and 21.0.

SECTION 225 - ROADWAY DEVELOPMENT

225.1 Future Extension of Roadways

a. When required by *ZDO* Section 1014.03 and the Comprehensive Plan, a proposed development shall construct a County standard roadway, or roadway acceptable to the County, to the boundaries of the development to permit future development or division of adjoining land, in order to promote connectivity.

b. A roadway master plan may be required prior to approval of the location of a roadway stubbed to the current development boundary to ensure connectivity of the future roadway system and to retain the development potential of adjacent land. This master plan shall consider topographical and geographical information and assume maximum development consistent with existing zoned densities. This plan shall consider Comprehensive Plan Chapter 5 Policies 17.0, 18.0 and 19.0.

c. New public streets that are stubbed to adjacent property with future potential extension may require the construction of a temporary turnaround, depending on the length of the dead end street.

d. New public streets that cannot be extended shall end in a County approved cul-de-sac or turnaround.

225.2 Termination of Roadways/Dead End Streets (Cul-De-Sacs, Turnarounds & Hammerheads)

Dead end streets may be allowed when deemed appropriate by Engineering and shall meet the following minimum criteria:

a. Dead end roads are allowed on local and private roads only.

b. Dead end public roads shall terminate in a cul-de-sac. Alternate designs may be considered on a case by case basis depending on topography, length, ADT, or other design constraints.

c. Dead end streets are allowed only where topography or pre-existing development precludes roadway connections and should be avoided wherever possible.

d. A roadway ending in a dead end shall be as short as possible, having a maximum length of 400 feet, serving not more than 18 dwelling units.

e. The length of the roadway ending in dead end shall be measured along the centerline of the roadway from the near side right-of-way of the nearest cross street to the farthest point of the dead end right-of-way.

f. Dead end streets longer than 400 feet may be approved if no other means are available for development of the property and special provisions are made for: public facilities, pedestrian and bicycle circulation and emergency service access and vehicle turnaround.

g. For dead end streets less than one hundred fifty (150) feet in length, sidewalk is required on one side only, but shall include the entire turnaround area.

h. Cul-de-sacs shall conform to Standard Drawing C300.

i. For alternate termination designs see Standard Drawing C350.

225.3 Opening or Upgrade of Unimproved or Substandard Public Right-Of-Way

a. An existing public right-of-way may be opened, upgraded, or improved for vehicular access under the provisions and issuance of a Development Permit.

b. Applicants for the improvement shall bear all costs inclusive of survey, engineering, construction and maintenance.

c. Subsequent to this investment, no proprietary rights or exclusive use to the funded improvement will or could be granted within the public right-of-way.

d. Case-by-case County interpretation of construction standards is necessary to define the extent of construction within the fixed alignment, location and width of available existing right-of-way consistent with the proposed use or impact.

225.4 Access to Existing Lots of Record (Single Family Dwelling)

On a case by case basis, the County may consider permitting construction of improvements within existing public rights-of-way to provide access to existing lots of record or for temporary or restricted access.

a. The improvement must have an unobstructed width of 20 feet to meet emergency vehicle access requirements.

b. The minimum constructed width for a travel surface shall be 12 feet

c. Turnouts for emergency/passenger vehicles shall be provided every 400 feet.

d. The access design shall be approved by the local fire district.

e. The minimal structural standard shall be per Standard Drawing R100.

f. The applicant shall dedicate additional right-of-way or easements along the property frontage and at the terminus as deemed necessary by Engineering to comply with County standards.

g. If satisfactory access cannot be constructed within the available public right-of-way, the applicant has the option of acquiring additional right-of-way as required or may seek an alternative private access.

225.5 Off-Site Access Standards

On a case by case basis, the County may require construction of improvements within existing off-site (beyond a development site's frontage) public rights-of-way in order to provide adequate safe access to newly created lots or parcels or for other development resulting from a land use decision. If Engineering determines that off-site roadway improvements are necessary to achieve minimally adequate and safe traffic flow, such improvements may be required before Engineering can recommend approval of a proposed development.

a. A determination of adequacy may include, but is not limited to, one or more of the following considerations:

1. Right-of-way width(s)

2. Roadway configuration and geometry

3. Sight distance (refer to Section 240.3)

4. Emergency service access

5. Traffic volume

6. Functional classification

7. Crash history

8. Off-site roadway capacity issues that create or exacerbate safety issues

b. The County will determine the required width for any off-site improvements to provide adequate access to the proposed development. Sufficient right-of-way shall be provided for the required improvements.

c. Minimum travel width for new development for simultaneous two-way traffic is 20 feet to meet vehicle access requirements.

d. Positive drainage shall be provided to an acceptable outfall having the capacity to accommodate the contribution.

225.6 Existing Roadway Deficiencies and Improvements

Consistent with *ZDO* Sections 1007 and 1014, Title 7 of the *Clackamas County Code*, and respective conditions of approval, the following improvements may be required via the Development Permit or Driveway Entrance Permit processes.

a. The County cross-section standards, as provided in Standard Drawings C110 to C140 or design equivalents, shall be applied in the course of the development or redevelopment along the site frontage of the adjoining land or to an off-site roadway as established in site specific land use conditions of approval.

b. The applicant's Engineer may make value engineering assessments of the existing base and pavement of roadways slated for improvement and shall use, to the fullest extent possible, the existing public investment by use of structural section equivalents as approved by Engineering.

c. When the existing roadway right-of-way width is less than the design standard width, sufficient additional right-of-way or easements shall be dedicated for roadway purposes along the site frontage of the adjoining land (see Section 160.4).

d. Frontage improvements shall be designed and constructed to the "interim section" definition of these *Standards*.

e. If an existing County or public road terminates along a development's frontage without the benefit of a cul-de-sac or turnaround and the roadway cannot be extended, the development shall construct a full County cul-de-sac or approved turnaround.

225.7 Creation of a Private Roadway

Site topography or other constraints may preclude development of a public roadway to standards allowing for County acceptance and maintenance. In certain circumstances, creation of a private roadway may be the only reasonable method and alternative to provide access to proposed lots or parcels. If connectivity and access to adjacent properties is not an issue, private roadways, as addressed in Section 1007 of the *ZDO,* may be permitted.

a. Design and construction of a private roadway shall be consistent with the design standards for County roads, except as noted in these *Standards* regarding widths, cross-section and design speed, and in no case shall improvements be less than minimums set out in Standard Drawing R100.

b. Issuance of a Development Permit shall be required for, and plan approval shall precede, further site development.

c. Provisions shall be made to ensure private responsibility for future maintenance of these private roadways.

d. Private roadways and their respective easements shall be distinguished from public roadways and any reservations, restrictions, and maintenance agreements related to the created private roadways shall be described in the land division plat or deed records.

SECTION 230 - RESIDENTIAL, AGRICULTURAL, & LOGGING DRIVEWAY DESIGN

230.1 General

The following standards shall apply to the design of residential, agricultural and logging driveways approaching public or private roadways. These standards do not apply to remodels or additions to existing structures, unless the driveway entry must be rebuilt or relocated or an entry permit is required by Engineering.

230.2 Standard Drawings

All entrances shall be constructed in conformance with the applicable standards depicted in Standard Drawings D250 through D700. The County shall determine the specific driveway detail, based upon the existing and planned improvements.

230.3 Driveway Vertical Geometry

a. For residential driveways, the average driveway grade shall not exceed 12%, and no grade shall exceed 15% for gravel driveways or 20% for paved driveways.

b. All grades in excess of 12% shall be approved by the emergency service providers.

c. The grade break for all driveways shall be a maximum of 9%. Grade breaks in excess of 9% shall require vertical curves with a minimum K value of one.

d. Vertical transitions shall be designed for the design vehicle to not "bottom out" at minimum. The functionality of the intersecting roadways shall be considered to ensure that vehicles on major roadways are not excessively slowed or endangered by driveway operations.

e. For residential driveways, vertical clearance shall not be less than 14 feet.

f. Steep uphill driveways having greater than a ten percent grade shall be constructed with diagonal water bars (berms) to assure that water from uphill properties is directed into the ditch line. In drainage situations which will not be remedied by valley gutters or water bars, it is the responsibility of the owner to construct ditches, etc., to prevent damage to the roadway or danger to the traveling public.

230.4 Driveway Horizontal Geometry

a. Standard driveway throat widths vary from a minimum of 12 feet to a maximum of 35 feet at their intersections with public or private roadways.

b. Horizontal clearance shall not be less than 20 feet for residential driveways

c. Minimum improved surface shall be 12 feet wide. For residential driveways, minimum centerline curve radius shall be 50 feet.

d. Turnaround geometrics shall conform to Standard Drawing C350 or C300, as applicable.

230.5 Driveway Structural Capacity

Roadway base, bridges, and culverts shall be capable of supporting a 75,000 pound fire truck. Bridges and some culverts require a building permit.

230.6 Emergency Services

a. All driveways shall be designed to provide for emergency service access.

b. Residential driveways in excess of 150 feet in length shall be provided with an emergency vehicle turnaround area at or near the driveway termination.

c. Residential driveways with a travel surface less than 20 feet wide and in excess of 400 feet in length shall have a turnout per Standard Drawing C350 at locations approved by the local emergency service provider.

d. For residential driveways, Engineering may require turnouts per Standard Drawing C350 above and beyond emergency service provider requirements.

230.7 Driveway Drainage

Surface water runoff shall not be allowed to flow along or across an access or entrance from private property onto the travel surface of the roadway.

230.8 Driveway Culverts

a. All driveways on non-curbed roadways shall have culverts for proper road drainage unless Engineering determines that they are not required.

b. Culvert installations are generally not required on paved and curbed roads. The installation of driveway culverts to control surface runoff shall be required as deemed necessary by Engineering.

c. Culverts shall provide a minimum 12 inch inside diameter. Larger culverts are required based upon the design calculations and under the following conditions:

1. Culverts shall be designed to convey storm water from the contributing basin for the 25 year storm at full build-out of the basin.

2. When the existing storm sewer culverts above and below the proposed driveway entry are a larger diameter than l2-inch;

3. When there is evidence that severe erosion has occurred in the roadside ditch;

4. When there is other evidence to show that a larger diameter would be appropriate.

d. Bedding requirements for concrete and metal culvert pipe shall never be below the Class C Bedding Specification contained in the *Oregon Standard Specifications for Construction*.

e. Storm sewer culvert shall have enough aggregate and/or pavement cover to support HS-25 loading per Standard Drawing D250.

f. Notwithstanding the requirements of this subsection, ORS 368.251 to 368.281 shall govern storm sewer culverts and the accompanying entry structure.

g. Culverts shall be maintained in good condition so the flow of storm water is not impeded.

230.9 Intersection Angle

The intersection angle at intersecting roadways shall be kept as near to 90 degrees as possible, and in no case shall it be less than 80 degrees or more than 100 degrees unless otherwise approved by Engineering.

230.10 Permit Requirements

A Driveway Entrance Permit or Development Permit, whichever is applicable, shall be obtained from Engineering. A permit fee will be charged at the time of application.

230.11 Inspection Requirements

a. All new residential driveways subject to a Driveway Entrance Permit will be afforded a County pre-approval site inspection.

b. The applicant will be provided an inspection marker and will be asked to mark the precise location of the proposed driveway.

c. Upon approval, a Driveway Entrance Permit with construction details will be issued.

d. Modifications to the access after final inspection require additional permitting and inspection and is subject to additional fees.

230.12 Intersection Sight Distance Requirements

Intersection sight distance requirements of Section 240 shall be met.

230.13 Maintenance Requirements

The maintenance of existing driveway entries within the right-of-way, including culverts, aggregate, and driving surface, shall be the responsibility of the owner of the property being served by the driveway. Maintenance must be performed so that the entry is not a hazard.

SECTION 240 - SIGHT DISTANCE

240.1 General

Sight distance shall be determined and approved generally in accordance with the procedures as stated in the current AASHTO "*A Policy on Geometric Design of Highways and Streets*" or AASHTO's "*Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400)*". Adequate sight distance requirements shall apply at all intersections except as modified below.

240.2 Sight Distance - Standard

Adequate intersection sight distance ("ISD") shall be provided at all intersections per Tables 2-6, 2-7, and 2-8 except as modified below:

a. Very low volume local, connector and collector roadways with a 20 year entering volume of less than or equal to 400 ADT and meeting the eligibility requirements of Table 2-9 shall comply with Table 2-9, as applicable.

b. Existing lots of record, not subject to land use permit conditions, shall maximize ISD and safety by removing visual obstructions located on the applicant's property or located in the road right-of-way when establishing driveway location.

c. If adequate ISD cannot feasibly be achieved, lesser sight distance may be acceptable per Section 240.7 and Section 170.

d. Adequate stopping sight distance ("SSD") shall be provided along all roadways and at intersections per Table 2-10 except very low volume local roads, which shall comply with Table 2-9.

e. Adjustments to the sight distance tables of these *Standards* for street grade, design vehicle, or other factors, with regard to ISD and SSD requirements, shall be made per AASHTO guidelines.

f. When designing or completing roadway improvements, the applicant shall provide evidence that the proposed improvements will not create situations where sight distance is made inadequate for other off-site driveways,

intersections, or other sections of roadway. If sight distance for existing off site driveways, intersections or sections of roadway is already inadequate, the applicant shall provide evidence that sight distance is not worsened by the applicant's improvements.

240.3 Existing Off-site Public Roadway Intersections

Proposed developments subject to land use approval that impact off-site public roadway intersections (public road intersecting another public road) may be subject to ISD and SSD adequacy requirements at those off-site intersections if safety issues would result from the proposed development. A development may be found to impact off-site intersection(s) if the development's only access or all directions of access to the nearest collector or arterial road is/are via intersection(s) turning movement(s) with inadequate ISD or approach movements with inadequate SSD per Section 240.7. The applicant may be responsible for submitting data that substantiates trip movements. The following may apply:

a. Developments that add a minimum of 15 daily trips to the inadequate movement(s) at the off-site intersection(s) may be required to mitigate that/those intersection(s) along at least one route from the site access to the nearest collector or arterial roadway per the standards of Section 240.7 or be denied access; or

b. Developments that add between five and 14 daily trips to the inadequate movement(s) at the off-site intersection(s) may be required to mitigate that/those intersection(s) along at least one route from the site access to the nearest collector or arterial roadway per the standards of Table 2-10 and measured per Section 240.4 or be denied access; or

c. Developments that add less than five daily trips to the inadequate movement(s) at the off-site intersection(s) will only be required to mitigate that/those intersection(s) along at least one route from the site access to the nearest collector or arterial roadway per the standards of Table 2-10 and measured per Section 240.4 if any of the off-site intersections are experiencing a crash history related to the inadequate ISD, inadequate SSD or if the development is anticipated to create a significant safety issue.

240.4 Intersection Sight Distance Measurement

ISD shall typically be measured from a driver's eye height of 3.5 feet and 14.5 feet from the edge of the nearest travel lane to an object height of 3.5 feet above the roadway surface. Standard Drawing T300 illustrates several standard sight distance measurements. Sight distance measurements shall be modified under the following conditions:

a. Where a significant percentage of trucks will intersect a roadway, sight distance measurements may also dictate compliance with the truck sight distance measurements of AASHTO.

b. At the intersection of a local roadway and a private driveway serving up to two single family residential homes, sight distance may be measured 10 feet from the edge of the nearest travel lane except where backing maneuvers are likely to occur.

c. Sight lines shall be measured with a clearance of a minimum of six inches from any vertical or horizontal obstructions.

240.5 Stopping Sight Distance Measurement

SSD shall be measured from a driver's eye height of 3.5 feet to an object height of 2.0 feet above the roadway surface and measured along the center of a travel lane.

240.6 Sight Distance Design Speed

Design speed, for the purpose of determining sight distance, shall generally be based upon the guidance of Section 250.1.2. Engineering may, at its own discretion, base the appropriate design speed in the vicinity of a horizontal curve on the advisory speed posting plus 10 MPH. If desired or required, a speed study shall be completed by the applicant in conjunction with County staff direction.

240.7 Intersection Sight Distance – Modification Criteria

If the standards of Section 240.2.a cannot reasonably be met, then a modification may be sought pursuant to Section 170. If the modification cannot be approved, access will be denied.

a. The standards of Table 2-5 may be applied under the following cases:

1. Intersections cannot meet the standards of Section 240.2 or

2. Section 240.3 dictates compliance with Section 240.7.

b. ISD requirements shall be measured per Section 240.4.

Table 2-5 Modified ISD Requirements

Functional Class of Major Roadway	Major Roadway ADT	Intersecting Side Street/Driveway ADT	VLV[1]	SSD90[2]
Local, Connector	Total Entering Volume < 400		Applies	N/A
Local, Connector, Collector, Arterial	< 400	< 20	N/A	Applies
Local, Connector, Collector, Arterial	< 400	> 20	N/A	Applies
Local, Connector, Collector, Arterial	400 to 1000	< 20	N/A	Applies
Local, Connector, Collector, Arterial	> 1000	< 20	ISD per Section 240.2	
Local, Connector, Collector, Arterial	> 400	> 20		

[1] Very Low Volume - ISD distance requirements based on Table 2-9 (Very Low Volume Intersection)
[2] Stopping Sight Distance (90th Percentile Speed) - ISD distance requirements based on Table 2-10 (Stopping Sight Distance) and AASHTO equations associated with 90th percentile speed, curve speed + 20, or design speed + 5 mph
N/A = Not applicable
All ISD measurements shall be made per Section 240.4

Table 2-6 Intersection Sight Distance (ISD) - Left Turn from Stop

Design Speed (MPH) of Major Roadway	Intersection Sight Distance (feet)
15	170
20	225
25	280
30	335
35	390
40	445
45	500
50	555
55	610
60	665
65	720
70	775
75	830
80	885

Note: ISD shown is for a stopped passenger car to turn left onto a two-lane roadway with no median and minor street/driveway approach grades of 3 percent or less. For other conditions, the time gap must be adjusted and required sight distance recalculated per AASHTO.

Table 2-7 Intersection Sight Distance (ISD) - Right Turn from Stop and Crossing Manuever

Design Speed (MPH) of Major Roadway	Intersection Sight Distance (feet)
15	145
20	195
25	240
30	290
35	335
40	385
45	430
50	480
55	530
60	575
65	625
70	670
75	720
80	765

Note: ISD shown is for a stopped passenger car to turn left onto a two-lane roadway with no median and minor street/driveway approach grades of 3 percent or less. For other conditions, the time gap must be adjusted and required sight distance recalculated per AASHTO.

Table 2-8 Intersection Sight Distance (ISD) - Left Turn from Major Road

Design Speed (MPH) of Major Roadway	Intersection Sight Distance (feet)
15	125
20	165
25	205
30	245
35	285
40	325
45	365
50	405
55	445
60	490
65	530
70	570
75	610
80	650

Note: ISD shown is for a stopped passenger car to turn left onto a two-lane roadway with no median and minor street/driveway approach grades of 3 percent or less. For other conditions, the time gap must be adjusted and required sight distance recalculated per AASHTO.

Table 2-9 Intersection Sight Distance for Very Low-Volume Local and Connector Roads

Design Speed (MPH) of Major Roadway	Intersection Sight Distance (feet)		
	0-100 ADT	100-250 ADT	250-400 ADT
15	65	65	65
20	90	95	95
25	115	125	125
30	135	165	165
35	170	205	205
40	215	250	250
45	260	300	300
50	310	350	350
55	365	405	405
60	435	470	470

Note: ADT is based upon 20 year projected entering volume.
Applies to local/local, connector/connector, connector/local, collector/connector, collector/local road intersections only with a 20 year projected ADT of 400 or less.
Intersections with a collector must be found to be functioning as local roadways by Engineering.

Table 2-10 Stopping Sight Distance

Design Speed (MPH)	Stopping Sight Distance (feet)
15	80
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730
75	820
80	910

SECTION 245 - ROADSIDE & CLEAR ZONE

245.1 General

Roadside and clear zone standards strive to ensure that the roadside remains free of fixed objects and is sufficiently flat in the event that a vehicle runs off the roadway, enabling the vehicle to recover under ideal conditions. Clear zones shall be determined and approved generally in accordance with the procedures as stated in the current AASHTO *Roadside Design Guide* except as modified below.

245.2 Clear Zone Measurement

The clear zone width is measured from the edge of the travel lane of the roadway, or the fog line, if present. If a bike lane is present, the clear zone is measured from the bike lane line.

245.3 Clear Zone Standards

Minimum clear zone widths are defined by Table 2-11 and are made enforceable by Section 7.03.090 of the County Code.

Table 2-11. Roadway Clear Zone

Functional Classification	INSIDE THE UGB					OUTSIDE THE UGB				
	Posted Speed or Design Speed (MPH)					Posted Speed or Design Speed (MPH)				
	55	45-50	35-40	30	25 and under	55 or Basic Rule	45-50	35-40	30	25 and under
Major Arterial	15'	15'	10'	10'	10'	15'	15'	10'	10'	10'
Minor Arterial	N/A	15'	10'	10'	7'	15'	15'	10'	10'	10'
Collector	N/A	N/A	10'	7'	7'	15'	10'	10'	7'	7'
Connector	N/A	N/A	10'	7'	*	10'	10'	10'	7'	7'
Local	N/A	N/A	N/A	N/A	*	10'	10'	7'	7'	7'

Notes:

Clear zone is measured from edge of travel lane or fog line.

N/A = Not applicable

* = See AASHTO Green Book discussion on lateral offset for requirements

245.4 Clear Zone Requirements

Fixed objects located along the edge of the traveled portion of the right-of-way should be outside the clear zone.

Fixed objects are defined by AASHTO's *Roadside Design Guide*.

245.4.1 Fixed Objects Allowed in Clear Zone

The following objects are permitted within the clear zone under the following conditions:

a. Trees with a diameter less than or equal to six inches.

b. Mailboxes erected pursuant to AASHTO's *Roadside Design Guide* and USPS requirements. Mailboxes shall be placed on breakaway posts.

c. Fences and walls approved by Engineering.

d. Existing fences and walls determined not to be a hazard by Engineering.

e. Breakaway illumination poles.

f. Parked vehicles where parking is legally allowed.

g. Other objects approved or installed by the County.

245.4.2 Embankments and Ditches

New construction of foreslopes and backslopes shall be based upon Standard Drawings C110 to C140. Foreslopes should be "recoverable". Slopes that are "critical" per the AASHTO *Roadside Design Guide* are not permitted with new construction.

245.4.3 Vegetation

Vegetation shall not be allowed over a height of 30 inches and overhanging tree limbs shall have a minimum vertical clearance of 10 feet within the clear zones as defined by Table 2-11. Measurement shall be taken from pavement surface. Overhanging tree limbs shall have at least 14 feet of vertical clearance above the pavement surface over the traveled portion of the roadway.

245.4.4 Above Ground Appurtenances

a. Above ground appurtenances constructed as component parts of any underground utility line shall normally be located outside the clear zone and/or within one foot of the right of way line as practicable.

b. Above ground appurtenances, when permitted within County road rights of way, shall be provided with a vegetation-free area extending one foot beyond the appurtenance in all directions.

245.5 Clear Zone Exceptions

If objects are proposed to remain in the clear zone and cannot meet the standards of subsections 245.1 through 245.4.3 and Table 2-11, the County may allow the obstructions to remain if they can be adequately delineated or protected and approved.

SECTION 250 - GEOMETRIC DESIGN

The design of public and private roadways shall be largely based upon these *Standards*, the manuals and standards of Section 115 and the Standard Drawings.

The County reserves the right to restrict specific combinations of horizontal and\or vertical alignments which contain steep grades, minimum K values, minimum centerline radii, and broken back curves.

250.1 General

250.1.1 Roadway Cross Section

a. Standard Drawings C110 to C140 are to generally be used for the design of roadways under the jurisdiction of the County. These figures illustrate the required right-of-way width, paved widths, shoulder widths, lane configurations, easement widths, sidewalk widths, planter strips widths, curbs, bike lane widths, and design speeds for each functional classification.

b. Roadway cross sections shall consider the Regional Street Design Type Guidelines as described per *Comprehensive Plan* Chapter 5 Policy 12.0 as illustrated in Table V-4 and Map V-3.

c. Community Planning Areas exist that have exceptions to these *Standards*.

d. An urban street section shall generally be used on all roadways within the Urban Growth Boundary (UGB) and within unincorporated communities except as allowed by Engineering.

e. A rural road section shall be used on all roadways outside the UGB, unless located within an unincorporated community.

250.1.2 Design Speed

a. The design speed for all roads shall be determined by Engineering.

b. The minimum design speed for all public roads shall be 25 MPH.

c. Design speed shall generally be determined or assumed as one of the following:

1. Intended posted regulatory speed plus 5 MPH.

2. Existing posted regulatory speed plus 5 MPH.

3. 85th percentile speed.

d. Design speeds on private roads lower than 25 MPH shall be granted by the conditions of approval for land use or shall require approval by Engineering and shall be posted for the associated speed.

250.1.3 Design & Control Vehicle

a. Engineering shall determine the appropriate design and control vehicle for a facility.

b. A "design vehicle" frequently uses a facility and must be accommodated without encroaching into opposing traffic lanes.

c. A "control vehicle" infrequently uses a facility but encroachment into opposing traffic lanes, multiple-point turns or minor encroachment into the roadside is acceptable.

d. The Engineer shall provide evidence that the design vehicle and control vehicle are accommodated in their designs.

250.2 Curbs

a. When curbing is a requirement of new development, it shall be developed according to the criteria stated in the *ZDO*. Curbs shall conform to Standard Drawings S100 to S180, as specified by Engineering.

b. A modification may be approved in the case of approved shared use paths. In such cases, it shall be demonstrated that surface water quality and storm water discharge considerations can be better achieved by collection in shallow, grass-lined swales paralleling the roadway and provisions for maintenance can be arranged. Additional pavement width along shoulders or on separated facilities shall be shown to demonstrate sufficient accommodations for pedestrian and bicycle traffic.

250.3 Pedestrian Improvements

250.3.1 Sidewalks

a. The need for sidewalks is determined by *ZDO* Section 1007.

b. Sidewalk is required within the UGB and unincorporated communities. Sidewalk is not required outside the UGB except within unincorporated communities.

c. Sidewalks required as part of a development shall generally only be required upon the development's site frontage and internal roadways.

d. A minimum sidewalk width is required. These minimums are found in *ZDO* Section 1007 and based upon the roadway classification and zoning adjacent to the property.

e. On roadways with an anticipated ADT of less than 400 where sidewalks would otherwise be required, sidewalks may be provided on only one side.

f. Sidewalks shall conform to Standard Drawings S900 to S960.

g. Sidewalk design shall adhere to ADA requirements.

h. Other modifications may be made in specified districts only.

i. Sidewalks shall generally be designed per the *Oregon Bicycle and Pedestrian Design Guide* and AASHTO *Guide for the Planning, Design,* and *Operation of Pedestrian Facilities.*

250.3.2 Separated Asphalt Paths

a. As an alternative to sidewalk, asphalt paths may be allowed in appropriate circumstances according to the criteria of the *ZDO* and as part of conditions of approval of a land use action, typically as a temporary measure. These circumstances will consider relative anticipated use of the facility, topography, preservation of significant trees, safety, right-of-way, and schedule of upcoming capital projects.

b. Separated asphalt paths shall have a minimum unobstructed width of five feet, but should generally exceed this minimum based upon the anticipated life and use of the path. Requirements will generally be based upon the width standards of *ZDO* Section 1007 as they relate to sidewalk widths except where not feasible, not desirable, or where the path is temporary.

c. Separated asphalt paths shall generally be designed per the *Oregon Bicycle and Pedestrian Design Guide* and AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities* or as established by conditions of approval of a land use action.

250.3.3 Shared Use Paths

a. As an alternative to sidewalk and bike lanes, shared use paths may be allowed in appropriate circumstances according to the criteria of the *ZDO* and as part of conditions of approval of development.

b. The location of planned shared use paths is provided by Map V-7a and Map V-7b of the *Comprehensive Plan*.

c. The required shared use path width varies from an unobstructed minimum width of eight to twelve feet depending upon anticipated use.

d. These circumstances will consider relative anticipated use of the facility, topography, preservation of significant trees, safety, and right-of-way.

e. Shared use paths shall generally be designed per the *Oregon Bicycle and Pedestrian Design Guide*, AASHTO *Guide for the Development of Bicycle Facilities* and AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities* or established by conditions of approval of a land use action.

f. Design of shared use paths shall adhere to ADA requirements as required.

250.3.4 Landscape Strips

a. All sidewalks, separated asphalt paths and shared use paths shall be located adjacent to a landscape strip unless otherwise approved.

b. The landscape strip shall contain the elements as recommended in the *Oregon Bicycle and Pedestrian Design Guide*.

c. Landscape strip width shall be determined per Standard Drawings C110-140 or by the *Comprehensive Plan*.

d. Landscape strips shall include landscaping elements of Section 255.

250.3.5 Right-of-way and Easements

All roadway improvements including sidewalks, asphalt paths, and shared use paths shall exist within the public right-of-way or a dedicated easement.

250.3.6 Vertical Clearance

The minimum vertical clearance above a sidewalk, asphalt path, or shared use path is eight feet.

250.3.7 Sidewalk Cross Slope

Sidewalk cross slopes shall be based upon Standard Drawings S900 to S940.

250.3.8 Curb Ramps

a. Two curb ramps are typically required at each intersection corner in order to minimize crossing distances.

b. Curb ramps are to be placed as near as possible to continue the natural path of pedestrians using the adjacent sidewalk.

c. Curb ramp plans shall be based upon Standard Drawings S900 to S940.

d. Design of curb ramps shall adhere to ADA requirements.

250.3.9 Bulb Outs (Curb Extensions)

Bulb outs are typically used to span parking areas on arterials and collectors to make pedestrians more visible, reduce pedestrian crossing length and shall be considered in the following instances:

a. At intersections with adjacent established on-street parking along arterial and collector roadways.

b. In areas of moderate to high pedestrian volumes.

c. At midblock crossing locations with adjacent established on-street parking along arterial and collector roadways.

d. As required by the Sunnyside Village Community Plan or similar community or design plan area standards in the *Comprehensive Plan*.

e. In locations determined by Engineering.

250.3.10 Midblock Crossings

Midblock crossings should be considered based upon an engineering study and considered in the following cases:

a. On arterial or collector roadways within the UGB with a posted speed of 35 MPH or less.

b. On arterial or collector roadways within the UGB at locations where existing intersections, proposed intersections, or existing crossing opportunities are at least 600 feet apart.

c. In locations of existing or anticipated moderate to high pedestrian volumes.

Midblock crossings should be designed and constructed with the following features:

a. Generally pursuant to the recommendations of Table 9.5 of ITE's *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities: An ITE Proposed Recommended Practice*.

b. With a raised concrete median per Section 250.10 when crossing three or more lanes of traffic.

250.4 Bicycle Improvements

Bicycle facilities should be designed and constructed per the *Oregon Bicycle and Pedestrian Design Guide*, the AASHTO *Guide for the Development of Bicycle Facilities* and with consideration given to NACTO's *Urban Bikeway Design Guide*.

Separated bicycle facilities shall be provided on all collector and arterial roadways.

The location of planned bicycle facilities is established by *Comprehensive Plan* Map V-7a in the urban area and V-7b in the rural area.

250.4.1 Bicycle Lanes

a. Bicycle lanes shall conform to Standard Drawings C110 to C140.

b. Bicycle lanes shall be installed on both sides of collector and arterial roadways, where planned.

c. Roadway improvements to accommodate bicycle lanes, required as part of a development, shall generally only be required upon the development's adjacent frontage.

250.4.2 Shared Use Paths

See Section 250.3.3.

250.4.3 Other Bicycle Facilties

See the *Oregon Bicycle and Pedestrian Design Guide*, the AASHTO *Guide for the Development of Bicycle* Facilities, and NACTO's *Urban Bikeway Design Guide*.

250.5 Transit Improvements

The designer shall evaluate existing transit amenities and work with transit providers to determine if transit feature improvements are necessary based upon established transit agency guidelines. Each project shall provide reasonable accommodations for the incorporation of public transit per transit design guidelines.

250.6 Horizontal Alignment

250.6.1 Horizontal Curves

The horizontal alignment of County, public and private roadways shall conform to the following requirements:

a. The centerline alignment of roadway improvements shall be common to the centerline of the right-of-way or access easement unless otherwise approved by Engineering.

b. The centerline of a proposed roadway extension shall be aligned with the existing centerline.

c. Horizontal curves shall meet the minimum radii requirements shown in Table 2-13. The minimum horizontal curve radii are determined by the following formula:

$$R = \frac{V^2}{15\,(e+f)}$$

where
R = minimum centerline radius (ft)
V = design speed (MPH)
e = rate of roadway superelevation (ft/ft)
f = side friction factor

Table 2-13. Minimum Centerline Horizontal Curve
Low Speed Urban Roadways

Design Speed (MPH)	Minimum Horizontal Curve (feet) *
15	50
20	107
25	198
30	333
35	510
40	762
45	1039

Notes:
*Assumes standard crown section of -0.025. For other sections, consult AASHTO
Urban conditions emax = 0.04, see AASHTO Exhibit 3.15

d. Very low volume local roads with ADT under 400 may use a centerline radius of 178 ft per AASHTO's *Guidelines for Geometric Design of Very Low-Volume Local Roads*. Exceptions for very low-volume local roads can be found in Section 250.6.3.

e. Residential driveways that serve no more than 3 lots, and are less than 400 feet in length or have topographic constraints may use a 50 foot centerline radius for a 12 foot width or 40 foot centerline radius for a 20 foot width. Engineering and emergency service provider approval is required.

250.6.2 Design Intent for Horizontal Curves

Minimum radii may be used only as approved by Engineering. The following excerpts from AASHTO's *A Policy on Geometric Design of Highways and Streets* and ITE's *Urban Street Geometric Design Handbook* clarify the use of minimum radii and are adopted by Engineering as general design controls:

a. AASHTO Chapter 3 - Elements of Design, "General Controls for Horizontal Alignment", Pages 3-111 to 3-112:

   1. "Winding alignment composed of short curves should be avoided because it usually leads to erratic operation."

   2. "In an alignment developed for a given design speed, the minimum radius of curvature for that speed should be avoided wherever practical."

   3. "Abrupt reversals in alignment should be avoided. Such changes in alignment make it difficult for drivers to keep within their own lane."

   4. "The broken-back or flat-back arrangement of curves (with a short tangent between two curves in the same direction) should be avoided… "

b. AASHTO Chapter 3 - Elements of Design, "General Design Controls", Page 3-165:

   1. "Sharp horizontal curvature should not be introduced at or near the top of a pronounced crest vertical curve. This condition is undesirable because the driver may not perceive the horizontal change in alignment, especially at night."

   2. "…sharp horizontal curvature should not be introduced near the bottom of a steep grade approaching or near the low point of a pronounced sag vertical curve."

c. AASHTO Chapter 5 - Local Roads and Streets, "Local Urban Streets", Page 5-12:

"[Local urban] street curves should be designed with as large a radius curve as practical, with a minimum radius of 100 feet."

d. ITE, Chapter One 1.6.3:

"Although local streets may be planned, constructed and operated with the primary purpose of providing access to adjacent property, some local streets also may serve a limited amount of through traffic due to street network deficiencies. In these situations, the designer should utilize geometric design and traffic control features more typical of collector streets to encourage the safe and efficient movement of all street users."

250.6.3 Exceptions for Very Low Volume (≤400 ADT) Local Streets with a Speed of 25 MPH or less

The following are allowed under the listed circumstances on a limited basis:

a. Horizontal curves on local roadways within residential areas may have a minimum centerline radius of one hundred (100) feet as limited in this section.

b. Horizontal curves on local roadways within residential areas may conform to the geometry of Standard Drawing C400 and notes of Standard Drawing C450 as limited in this section.

c. A single 20 MPH maneuver is allowed on a County road on a limited basis when physical constraints or property boundary limitations exist.

d. A 100 foot tangent length shall be provided between low speed maneuvers. The tangent length provides the driver adequate time to recognize the maneuver and slow down to accomplish the turn.

250.6.4 Roadway and Marking Transitions

For traffic safety, shifts in roadway alignment, widening, or narrowing shall be accomplished through roadway transitions as described below.

Roadway transitions shall be based upon the following:

$$L = S \times W \qquad (S \geq 45 \text{ MPH})$$

$$L = \frac{WS^2}{60} \qquad (S < 45 \text{ MPH})$$

where L = minimum taper length (ft)
S = design speed (MPH)
W = offset (shift) width (ft)

Exclusive right turn lanes shall have a minimum 10 (length) to 1 (offset) widening taper.

250.6.5 Shoulder and Bike Lane Transitions

Within bike lanes or shoulders, roadway width transitions shall have a minimum 10 (length) to 1 (offset) taper.

250.7 Vertical Alignment

The vertical alignment of the County's public and private roadways shall conform to the following requirements:

250.7.1 Minimum Roadway Gradient

a. The minimum tangent roadway gradient shall be 1% along the crown and vertical curb line.

b. A minimum of 0.5% may be designed with concrete curb and gutter with Engineering approval.

250.7.2 Maximum Roadway Gradient

The maximum roadway gradient shall be:

a. Major and minor arterial roadways, see Standard Drawing C140.

b. Collector roadways, see Standard Drawing C130.

c. Connector roadways, see Standard Drawing C120.

d. Local roadways, see Standard Drawing C110.

e. Grades in excess of these maximums may be approved by Engineering on a case-by-case basis per Section 170.

250.7.3 Intersection Landing

a. At intersections, a landing shall be provided on the secondary or subordinate approach or on a stop-controlled approach.

b. Landings should be 20 feet in length for private driveways, 50 feet in length for local roadways and one hundred 100 feet in length for all other roadways.

c. Landings should be measured from the edge of pavement of the intersected roadway at full development and shall have an average grade of not greater than 5%.

250.7.4 Vertical Curves

a. Vertical curves shall be used when design grade breaks of more than 1% are necessary.

b. Vertical curves shall conform to the values in Table 2-14 and calculated as below.

$$K = \frac{L}{A}$$

where A = algebraic difference in grades (percent)
L = length of vertical curve (feet)

Table 2-14. Design Controls for Stopping Sight Distance for Crest and Sag Vertical Curves

Design Speed (MPH)	K-Crest	K-Sag
15	3	10
20	7	17
25	12	26
30	19	37
35	29	49
40	44	64
45	61	79
50	84	96
55	114	115
60	151	136
65	193	157

c. The minimum vertical curve length shall be fifty (50) feet.

d. K-Sag values may be reduced to K-Crest values if adequate street lighting is present along the entire sag vertical curve.

250.7.5 Half Street Road Widening

a. Half street designs require cross section data that illustrate the elevations at centerline, saw cut line, and gutter line at 25 feet on center.

b. Stations, offsets, and cross slopes shall be shown on the plans. Cross slope grade breaks created by the new gutter line shall be provided.

c. The maximum grade break between existing and proposed cross slopes shall be 2%.

d. Cross sections through existing driveways shall be provided.

250.7.6 Superelevation

a. Design elements for superelevation shall be based on AASHTO standards.

b. Superelevation is not allowed on roadways with a design speed of 35 MPH or less.

c. The maximum rate of roadway superelevation for urban conditions shall be 4% ($e_{max} = 0.04$).

d. The use of superelevation in the urban area is discouraged and shall be approved by Engineering before used.

250.8 Intersections

250.8.1 Minimum Curb Radii

a. Minimum curb radii at intersections within the UGB are shown in Table 2-15.

b. Minimum curb radii at intersections outside the UGB are based upon an engineering assessment and approved by Engineering.

c. The minimum right-of-way radii shall be sufficient to maintain at least the same distance from right-of-way to edge of pavement or curb as the lower classified roadway.

d. Access ramps shall be provided at all corners of all intersections and shall conform to Standard Drawings S900 to S940.

e. Curb radii shall be designed to accommodate the design and control vehicle per Section 250.1.3.

f. Curb radii shall be approved by Engineering based upon an assessment of design and control vehicle considerations as well as pedestrian and design speed considerations.

Table 2-15. Minimum Urban Area Turning Radii - Edge of Pavement or Curb Radius

Functional Classification	Major Arterial	Minor Arterial	Collector	Connector	Local
Major Arterial	35	35	30	25	25
Minor Arterial		35	30	25	25
Collector			25	20	20
Connector				20	20
Local					20

Notes:
If a bike lane or on-street parking exist on both roadways, then the above radii may be reduced by five (5) feet.
Larger radii may be needed to accommodate the design and control vehicle, designers shall identify each for the roadway and ensure that movements can be made with the associated minimum turning radii.

250.8.2 Intersection Angle

The intersection angle at intersecting roadways shall be kept as near to 90 degrees as possible, and in no case shall it be less than 80 degrees or more than 100 degrees unless otherwise approved by Engineering.

250.8.3 Roadway/Lane Offset

New lanes, roadways or driveways intersecting an existing intersection should not be significantly offset from the existing alignment. Minor offsets may be approved where low speed maneuvers are predominant or where otherwise acceptably safe operations would occur.

250.8.4 Tangent Section

In order to improve the safety at intersections, new intersections should conform to the following tangent requirements unless otherwise approved by Engineering. The following tangent sections should be provided per Table 2-16.

Table 2-16. Minimum Tangent of Intersecting Roadway
(Measured in feet from nearest intersecting curbline or edge of pavement)

Major Roadway	Intersecting Roadway					
	Major Arterial	Minor Arterial	Collector	Connector	Local	Private Access
Major Arterial	100	100	75	50	50	20*
Minor Arterial		100	75	50	50	20*
Collector			50	20	20	20*
Connector				20	20	20*
Local					20	20*

Notes:
*Private Access tangents shall be based upon relative ADT of the planned driveway and will be determined on a case by case basis as part of the land use review process.

250.8.5 Residential Intersection Design

Four-legged intersections should be considered for neighborhood traffic circles per Section 265.

250.8.6 Roundabouts

a. Roundabout intersections shall generally be designed in accordance with FHWA's *Roundabouts: An Informational Guide*

b. Roundabouts are strongly encouraged over the use of signalized intersections or other high capacity intersections, where appropriate.

c. Roundabouts shall be considered per Section 260.1.2 at all arterial/arterial or arterial/collector intersections prior to the approval of a traffic signal.

d. Roundabouts shall be designed to allow a fire truck and school bus to circulate through the roundabout without using the truck apron.

250.8.7 Intersection Sight Distance

Intersection sight distance shall be evaluated and designed per Section 240.

250.8.8 Turn Lane Design

a. The need for left or right turn lanes shall be based upon a traffic study per Section 295.19.1.

b. Required queue storage shall be based upon a traffic study per Section 295.17.

c. Left turn lanes, when provided, shall have a storage queue of at least 50 feet.

d. Tapers shall be designed per Section 250.6.4.

e. Design of left or right turn lanes should be based upon ODOT's *Highway Design Manual*, Figures 9-6 and 9-7.

250.9 Roadway Grading

a. Roadway grading shall conform to clear zone requirements of Section 245 and cross section requirements of Standard Drawings C110 to C140.

b. Slopes along and adjacent to the roadway shall be as specified in Standard Drawings C110 to C140. The maximum slopes outside the clear zone as detailed in Section 245 are as follows:

   1. Cut Slope - 2 to 1

   2. Fill Slope - 2 to 1

c. Flatter slopes are preferred and may be required by the County if soils are unstable as determined by a geotechnical analysis.

d. Side slopes exceeding four feet in height shall be constructed in conformance with design and specifications prepared by an Engineering Geologist or Geotechnical Engineer. All side slopes shall be stabilized by grass sod, seeding, riprap, or other acceptable ground cover vegetation.

e. Side slopes extending outside the public right-of-way will require slope easements.

250.10 Raised Concrete Medians

a. Raised medians shall generally be required in the following cases:

   1. On arterial roadways within the UGB with five or more travel lanes.

   2. On roadways where right-in/right-out driveway access maneuvers are required

b. Raised medians should be considered in the following cases:

   1. On arterial or collector roadways within the UGB with three or more travel lanes.

   2. On roadways where improved access management is desirable.

   3. On roadways where right-in/right-out driveway access maneuvers are desired.

c. Medians should be designed and constructed with the following features:

   1. Landscaping per Section 255 if required.

   2. With a minimum width of eight feet when designed to serve as a pedestrian refuge.

   3. With a minimum width of 1.5 feet when not designed to serve as a pedestrian refuge.

   4. Landscaping with a mature height of 2.5 feet should not be planted within 50 feet of an intersection.

   5. To contain a "shy" distance from adjacent traffic of varying width depending upon the design speed of the roadway.

SECTION 252 - STRUCTURAL SECTION

Roadways shall be constructed, reconstructed and repaired with asphaltic concrete over a crushed rock base or Portland Cement Concrete over a crushed rock base. All construction work and material shall be in accordance with Section 110 of these *Standards*.

a. In weak soil conditions, where the strength of the standard base rock section is inadequate, Cement Treated Base (CTB) may be used as an alternative as approved by the County Engineering Division

b. In conditions where the road surface is not structurally sound, is damaged by construction activities, or is damaged by construction traffic, Full Depth Reconstruction (FDR) may be used as an alternative as approved by the County Engineering Division.

252.1 Subgrade Evaluation

a. Soil testing may be required by Engineering on a case by case basis to determine soil strength and design of the roadway structural section.

b. Soil tests are needed on undisturbed samples of the subgrade materials that are expected to be within three (3) feet of the planned subgrade elevation.

c. Samples are needed for each 500 feet of roadway and for each visually observed soil type.

d. Soil tests are required from a minimum of two locations.

e. The results of the soil testing shall be included in a soils report prepared and stamped by an Engineering Geologist or Geotechnical Engineer licensed to practice in the State of Oregon.

f. This soils report shall also address subgrade drainage and ground water considerations for year-round conditions, percolation data in areas of proposed drywells or french drains, and recommendations for both summer and winter construction.

252.2 Asphaltic Concrete

a. The standard asphaltic concrete structural section shall be in accordance with Standard Drawing C100.

b. Asphalt concrete is to be ½ inch or ¾ inch dense HMAC. Material and installation shall conform to *Oregon Standard Specifications for Construction*. No single lift shall be less than 2 inches or greater than 2 ½ inches in thickness.

c. The final lift of asphaltic concrete shall not be placed on local streets until 90% of the lots associated with a development are complete or two years have elapsed after the installation of the first lift of asphalt, whichever occurs first. Any and all defects in the base life shall be repaired and approved by the County prior to placing the final lift.

d. At the option of the Engineer or where Engineering determines that unusual weak soil conditions exist, or in higher elevations with frequent freeze/thaw cycles, or high volumes of truck traffic exist, the pavement and aggregate thickness shall be determined by the Asphalt Institute Method. If it is determined that the street section identified in Standard Drawing C100 is inadequate, the Engineer shall provide a design.

e. Design values used in the asphaltic concrete design shall be supplied by an Engineer. Traffic data shall be obtained and include the following: Design period, traffic volumes, rate of growth, percent of trucks, and relationship to land use.

f. Design of asphalt concrete pavement structures shall conform to the guidelines determined by Engineering of the Asphalt Institute publication, *Thickness Design - Highways and Streets*.

g. The Equivalent Axle Load (EAL) for design of roadways shall be determined by a traffic analysis considering traffic growth, truck distribution determined on the basis of local traffic data and load equivalency factors as set forth in the above-referenced manual, MS-1. For collectors and local roadways, the EAL may be determined using simplified procedures which relate the EAL to the average daily number of 18,000 lb. single axle loads estimated for the design lane during the design period. Pavement shall be designed as established by Engineering.

h. Testing and evaluation of the subgrade soil strength shall be required for all pavement designs. Testing methods shall include but not be limited to:

1. The Asphalt Institute Publication, Method of Test for Resilient Modulus of Soil, Manual Series No. 10 or

2. AASHTO T-193 (CBR Method), or

3. AASHTO T-190 (R-Value Method)

i. If the CBR value of the subgrade exceeds twenty (20) or the R value of the subgrade exceeds sixty (60), then CBR and R-Value methods shall not be used.

j. Test methods and results shall be incorporated in a soils report in accordance with the requirements of Section 250.10 of these *Standards*.

252.3 Portland Cement Concrete ("PCC")

The PCC structural section shall be determined using the guidelines and requirements of the Portland Cement Association ("PCA"). The following design parameters shall be used:

a. The design shall be determined by Engineering.

b. Design shall be determined by projected estimated axle loading (EAL) of the road.

c. Minimum thickness of PCC shall be seven inches.

d. Jointing plans will be required one week prior to start of construction, delineating intersection and utility structure jointing for final review and approval by Engineering.

e. Design values used in the PCC design shall be prepared by an Engineer. Traffic data shall be obtained and shall relate to a 20 year projection.

252.4 Cement Stabilized Roadway (CSR) by Full Depth Reclamation (FDR) or Cement Treated Base (CTB)

252.4.1 General

This work consists of in-place construction of cement stabilized roadway utilizing pulverized existing pavement and base materials mixed with Portland cement as per design specifications, and shaping the roadway to design/plan grades and cross slopes, including cure sealing or paving and the relocation of excess sub-grade material where required. The first till pulverizes for shaping to compacted design base grades (minus cement volume) and the second till incorporates (mixes) the cement into the prepared compacted roadway to final design base grades and seals the CSR for curing via fog seal, chip seal or an asphalt base lift per design/plan specifications.

This section details the requirements for full depth reclamation (FDR). Cement treated base (CTB) will follow the same standards with the exception that there is no existing road surface to pulverize. The CTB requirements cover the remediation of both base rock and sub-grade. If the CTB shall be overlain with a full depth of base rock as per these standards, a chip seal or vapor barrier is not required.

252.4.2 Materials, Preparation & Equipment

a. The aggregate shall conform to the requirements of the *Oregon Standard Specifications for Construction* Section 02630.10.

b. The Portland cement shall conform to the requirements of the *Oregon Standard Specifications for Construction* Section 02010.

c. The water shall conform to the requirements of *Oregon Standard Specifications for Construction* Section 00340.

d. Portland cement shall be applied at the rate determined by an engineered design in percent of the dry weight of the material within a depth to be treated to achieve a seven day strength between 300 psi and 400 psi. The design shall indicate the optimum moisture content.

e. The Engineer shall obtain samples of the material to be pulverized to determine the design. Cores will be taken at 7 days and tested as per ASTM C39/C39M-12a and ASTM C42/C42M-12 to confirm that the strength of the CTB is within the correct range.

f. The asphalt used in the curing seal shall be either CRS-1 or CRS-2 emulsified asphalt as designated. The emulsified asphalt shall conform to the requirements of the *Oregon Standard Specifications for Construction* Section 00710. Cover aggregate for the cure seal shall conform to the requirements of Section 00710 and shall be ¼ - #10 size.

g. A traveling single or multiple transverse shaft mixer shall be capable of mixing to a depth of 12-inches in one pass. The cutting and mixing rotor shall be capable of adjustment to conform to the slope of the pavement. The mixer must have a working water system to bring the CSR to optimum moisture content.

h. Cement shall be spread using a mechanical spreader capable of uniformly distributing the cement across the width of the spread. The cement spreading equipment shall be in good working condition and shall be equipped with a metering device and travel speed indicator capable of accurately metering and uniformly spreading the required amount of Portland cement on the grade.

i. Equipment used to compact CSR shall be self-propelled 12 ton minimum, vibratory steel wheel, tamping foot, and/or pneumatic tire rollers. Rollers shall be capable of compacting the material to a firm, even surface. The tamping foot roller shall be placed immediately behind the tilling operation and before the initial grader operation.

252.4.3 Construction

a. The CSR shall be constructed so that the work will result in a finished sealed or continuously watered, curing CSR section conforming to specifications regardless of the daily or seasonal variations in weather, temperature and humidity under which the work is permitted to proceed. CSR shall not be constructed during periods of rain. CSR shall not be constructed out of frozen bases. Construction shall not occur when descending air temperatures fall below 40° F. Cement shall not be applied during windy conditions.

b. On the first till the existing road base and pavement materials shall be pulverized to a depth, as specified in the engineered design/plans to a condition such that all material will pass a 2-inch sieve.

c. Roads Without Curbs: The surface of the pulverized material shall then be brought to the uniform grades and cross sections, as shown in the plans for the final CSR grades (minus the cement volume) and compacted to specifications.

d. Roads With Curbs: The plans will show the first till depth noted above, as the depth of the existing asphalt and rock sections combined or 12" maximum . This material is to be stock piled and the subgrade (not tilled) is dug out and removed (to accommodated the depth of the new asphalt section, the cement and redistributed stockpiled material; so that the final finished asphalt grade matches the designed/plan curb exposure). The stockpiled material is then evenly redistributed, and brought to uniform grades and cross sections, as shown in the plans for the final CSR grades and compacted to specifications. Any material to be hauled off must go to an approved dump site.

e. The County makes no representation as to the type and size of the material that may be encountered in the existing roadway. The contractor shall notify the County immediately if the type and size of material (solid objects 3" > dia.) exceeds that which can be cement treated without excessive damage to the tiller.

f. In those areas which show excessive deflection or exhibit pumping under the wheel loads of the construction equipment, the pulverized material shall be removed and the sub-grade shall be over excavated to a firm depth as directed by the Engineer. Backfill the over excavation to the top of the existing sub-grade with 2"-0 size aggregate compacted in 9-inch maximum, loose depth, thickness lifts. Each lift shall be compacted to at least 95 percent of the maximum dry density determined by inspection. After backfilling of the over excavation, the remainder of the depth shall be backfilled with stockpiled pulverized material and brought to a uniform grade and cross section.

g. Cement shall be uniformly applied at the designated rate. The equipment and method used shall ensure the uniformity of cement distribution throughout the material to be treated. Water shall be added at the tiller during mixing operations to bring the mix to within – 0 to +1 ½ percent of the optimum moisture/density point. This moisture content shall be maintained until the mixing is completed.

h. The second tilling/mixing of the cement, water, and aggregate materials shall be started immediately but no later than two hours after the application of the cement. Mixing shall continue until a homogeneous mixture is obtained.

i. The CSR mixture shall integrate the pulverized material to a depth of 12 inches or design/plan depth.. This CSR mixture shall then be brought to a uniform profile and cross section as noted in the plans. Shaping and compaction of the CSR mixture shall be completed within two hours after mixing has been completed.

j. Special attention shall be taken around utility structures, survey monument boxes and next to curbs to ensure that the material is thoroughly pulverized, mixed with cement, moistened and compacted to the specified depth. Material that is inaccessible to the mixer shall be bladed or shoveled into the pulverizing and mixing process after which it shall be returned to its original position. Vibratory plate compactors shall be used to achieve compaction of the mixture in areas which are inaccessible to the rollers.

k. Special attention shall be given to ensure that the material next to all joints is thoroughly pulverized, mixed with cement, moistened and compacted to the specified depth.

l. Longitudinal and transverse joints adjacent to partially hardened CSR shall be constructed by cutting back with the mixer into the previously constructed work. The amount of the overlap shall be sufficient to cut back into solid materials.

m. Longitudinal and transverse joints adjacent to existing asphalt, concrete or hardened CSR shall be formed by saw cutting back into the work to form a straight vertical face. When completed, the face of the joint must be free of loose and shattered material.

252.4.4 Curing

Immediately after the grading, compaction and finishing of the cement treated base has been completed and during the same day while it is still moist, the surface shall be sealed with a fog or chip seal. The fog or chip seal shall be applied in accordance with applicable portions of Section 00710 of the *Oregon Standard Specifications for Construction* at the rates of 0.26 gallons per square yards of emulsified asphalt and 0.006 cubic yards (truck measure) per square yard for the cover aggregate. An asphalt surface course may be chosen as a sealing course on high volume roads that must remain in constant service when the County determines that the chip seal does not have sufficient strength to carry the anticipated traffic. If an asphalt surface course is chosen to seal the CSR, it may be installed no sooner than Day 2. If the fog/chip seal or asphalt concrete surface sealing course is not placed within forty eight hours (Day 2) following start of the mixing operation, then the CSR shall be allowed to cure, while maintaining moisture, for a period of 7 days (Day 7) before placing any asphalt concrete surface course.

252.4.5 Micro-Cracking

a. If specified by the Engineer and approved by Engineering, micro-cracking may be used as part of the design. Micro-cracking shall occur between Day 2 and Day 3.

b. Micro-cracking consists of 3 full passes, up and back, of a 12 ton vibratory roller with maximum vibrations for the full extend of the CSR.

252.4.6 Performance

a. The cement treated mixture shall be compacted to 98 percent of the maximum dry density as established by AASHTO T 134. Final finishing shall be accomplished by rolling accompanied by light watering and reshaping to provide a finished surface free of hairline cracking and free of ridges exceeding 0.04 foot in height.

b. If the specified compaction is not obtained, the contractor shall notify the County and Engineer. The contractor may be required to use a modified compaction procedure or apply additional compactive effort.

c. If approved materials meeting the specifications cannot be compacted to the required density regardless of compactive effort or method, the Engineer may reduce the required density or direct that alternate materials be used. In no case shall CSR construction proceed until the contractor is able to compact the material to the satisfaction of the Engineer.

d. When directed by the Engineer, the surface of the CSR shall be tested with a 12-foot straight edge provided by the contractor. No point shall vary by more than 0.04 foot from the testing edge when applied in any direction to the pavement surface. The completed surface of the CSR shall be within plus or minus .04 foot of the grade required to allow for placement of the specified thickness of asphalt concrete to the designated finished grade height.

252.4.6 Traffic Control Considerations

The CSR construction shall be scheduled so that at the completion of the day the work may be opened to local traffic. The surface of the CSR shall be protected by placement of the asphalt concrete surface course or by placement of the cure seal. If a cure seal is placed, it shall be placed a minimum of two hours in advance of opening the road to traffic. The asphalt surface shall be below 140 degrees before opening the road to traffic. When approved by Engineering, the road should be closed to through traffic, especially to through truck traffic, for 7 day cure period per Section 290.4 of these Standards.

SECTION 255 - LANDSCAPING

255.1 Shrubs, Plants and Grasses

a. Shrubs, plants and grasses shall comply with the requirements of Engineering.

b. Landscaping shall be designed to minimize water consumption and generally utilize Oregon native plants.

c. Landscape strips shall be planted with a sufficient quantity and density of shrubs, plants and grasses to minimize weed growth.

d. In some instances under proper design, Engineering may approve installations without irrigation.

255.2 Street Trees

These standards are intended to ensure that new trees planted within the right of way are of the highest quality, require low maintenance, and will not compromise public safety.

255.2.1 Street Tree Selection

Tree species shall be approved by Engineering.

255.2.2 Street Tree Quality at Time of Planting

a. The trees shall have a straight trunk perpendicular to the ground with a minimum branching height of four feet above the ground for trees 1 ½" caliper to a minimum of six feet above the ground for trees with 2" caliper.

b. Plant material shall be grown to the current standards and specifications of the American Association of Nurserymen and American Standard for Nursery Stock. Plant material shall be of standard quality or better, true to name and type of their species or cultivar.

c. Trees shall be provided reasonably free, as defined by nursery industry standards for street trees, from insects, decay, major structural defects and damage to the trunk, branches, and root system.

d. Engineering shall be notified and will have the right to inspect all trees and shrubs before they are planted. Engineering reserves the right to reject any plant material at any time.

255.2.3 Street Tree Condition at Time of Planting

a. Balled and Bur lapped and in wire baskets

1. Trees shall have a sound root ball with a firm attachment of the trunk with the root ball. The trunk shall not be loose, but firmly held within the root ball.

2. The size and condition of root balls shall conform to the current standards and specifications of American Association of Nurserymen and the American Standard for Nursery Stock.

3. Root balls of trees shall not be allowed to dry out at any time from the nursery to the final planting.

4. Trees shall have a well developed root system and not be root bound or have circling/girdling roots.

b. In a Container

1. Trees shall be free of circling and girdling roots.

2. The trees shall have been grown in the container for a maximum period of one year.

c. Bare Root

1. Trees in bare root condition shall not exceed 1 ½ inch caliper, measured six feet above mean ground level.

2. The roots shall not be allowed to dry out and shall be kept moist at all times from the nursery to final planting.

3. The roots shall be well established and full of live and vigorous fibrous roots along with the larger structural roots.

255.2.4 Preparation of Tree Planting Holes

a. Balled and Bur lapped and in wire baskets

1. A shallow, broad tree planting hole at least 1 ½ times the diameter of the root ball shall be excavated to a depth that will position the trunk flare level with finish grade.

2. The inner surfaces of the excavation shall be scored or roughened to the extent necessary to encourage rooting in the native soil.

b. Bare Root

1. Tree planting holes shall be one inch wider than the spread of the roots.

2. Holes shall have sufficient depth to position the trunk flare level with finish grade.

3. A mound of native soil shall be left in the center of the hole to support the roots. The roots shall be draped and spread in their natural position over the mound.

255.2.5 Seating of Trees

a. Trees shall be set plumb, upright, and faced for best appearance. Broken branches shall be pruned after planting.

b. The hole shall be backfilled one-half with original soil and the hole flooded with water to remove any air pockets. After backfilling is complete, the entire planting area shall be thoroughly saturated with water to remove any remaining air pockets.

c. Mulch shall be applied to a depth of two to four inches around the tree. Mulch shall be kept free of an area within two inches of the trunk.

d. A continuous three inches high raised berm shall be constructed around the planting hole to direct water to the roots. The berm shall be removed after one year.

255.2.6 Staking

a. Hardwood stakes shall be driven firmly into the ground outside of the hole. Care shall be taken to avoid driving the stakes through the root structure.

b. Trees shall be attached to the stakes at a height of two feet using non binding tree ties or tree ties that are at least one inch wide to prevent damage to the tree trunk. Ties shall be attached in a manner that will allow the tree to move but still be held firmly in place.

255.2.7 Establishment Period

The establishment period for an original tree or replacement tree shall be a minimum of three summers.

255.2.8 Street Trees Installation

a. Street tree design and installation shall comply with Standard Drawings L100 and L200.

b. Trees shall not block street signs.

c. Trees shall be centered in the landscape strip.

d. The minimum distance between street trees shall be as follows:

   1. Spread crown trees (with a 30’ or more foot mature crown) - 30’ apart.

   2. Global, Pyramidal trees (with a 20’-30’ or more foot mature crown) - 30’ apart.

   3. Fastigate, Columnar trees (with a 10’-20’ or more foot mature crown) - 20’ apart.

e. The minimum distance between the trunk of a tree from objects shall be as follows (for linear landscapes):

Table 2-18. Tree Trunk to Object

Object	Distance (feet)
Sidewalks	2
Sidewalks not parallel to road	5
Face of curb	2
Manholes and catch basins	10
Fire hydrants	10
Water meters and other utility boxes	5
Stop signs	3.5
Utility poles	10
8" to 10" water lines	10
12" to 16" sewer lines	15
18"+ water and sewer lines	20
Driveways	10

f. The minimum distances between trunks and street lights shall be as follows:

Table 2-19. Tree Trunk to Streetlights

Type of Tree	Distance (feet)
Spread Crown	30
Global, Pyramidal	20
Fastigate, Columnar	10
Ornamental	10

g. No tree with potential of reaching a mature height of more than 35 feet shall be planted in the right-of-way under primary overhead wires.

255.3 Root Barrier

Root barriers, as shown in Standard Drawing L100 may be required for use in the installation of street trees. Any tree planted ten feet or closer to a structure, such as curb or sidewalk, shall have an engineered impenetrable root barrier installed near the structure. The root barrier shall run the length of the planting area or the structure and reach a depth of at least 18 inches.

255.4 Sight Distance

Proposed landscaping shall strictly comply with the sight distance standards of Section 240. If in question due to marginally adequate vertical or horizontal curvature, landscaping designers shall be required to provide evidence that proposed landscaping will not grow to become sight hazards.

SECTION 260 - TRAFFIC SIGNALS

260.1 Traffic Signal Approval

A traffic signal may be approved by Engineering if the criteria of this section are met.

260.1.1 Traffic Analysis

A traffic analysis is required prior to the approval of a traffic signal. Analysis requirements shall be based upon Section 295 and should include the following:

a. An analysis of other alternatives is required prior to the approval of a traffic signal. Possible alternatives to traffic signal installation include right and left turn lane additions, other lane additions, roundabout installation as well as modifications to traffic control.

b. An analysis of capacity, queuing and safety both with and without the proposed traffic signal. Additional roadway improvements may be required based upon this analysis to ensure safety is maintained with the installation of a traffic signal.

c. An analysis of alternatives shall establish that a roundabout is impractical or unreasonable before a traffic signal will be approved.

    1. The analysis shall include preliminary geometrics, a comparative estimate of right-of-way impacts of a traffic signal versus a roundabout, comparative benefit/cost ratio, and a comparative capacity analysis.

    2. In some instances, on a case by case basis, the County may assist in the acquisition of right-of-way in order to facilitate the installation of a roundabout.

d. Evidence that the criteria of Section 260.1.2 can be met.

e. In locations with other traffic signals nearby, the proposed traffic signal will not unacceptably decrease the corridor bandwidth.

f. Microsimulation modeling may be required per Section 295.12.

g. An analysis of traffic signal phasing including:

    1. Phasing analysis for different peak periods.

    2. Evaluation of warrants for left turn protected, protected/permissive, and permissive/protected signal phasing, and protected right turn signal phasing based upon ODOT's *Traffic Signal Policy and Guidelines*.

260.1.2 Traffic Signal Warrants

a. New traffic signals at intersections on County roadways shall meet at least one, preferably several, of the traffic signal warrants of the current version of the *MUTCD* prior to the approval of a traffic signal. A proposed traffic signal may not be approved unless the intersection meets several warrants and the proposed signal offers a clear benefit to the traveling public.

b. Traffic signals meeting only peak hour volume warrants shall only be approved if the intersection serves a special trip generator with unique peak traffic characteristics and evidence is provided that results in a finding by Engineering that the traffic signal offers a special benefit to the transportation system.

260.1.3 Traffic Signal Spacing

Traffic signals should generally be spaced a minimum of 1000 feet apart. No traffic signals should be approved within 1000 feet of an existing or planned future traffic signal unless evidence supports the adequate long term operations of such a proposal.

260.2 Traffic Signal Design

a. Traffic signal design shall be generally based upon the ODOT *Traffic Signal Design Manual*, *Oregon Standard Drawings* TM 400 and TM 600 Series, Clackamas County Traffic Signal Drawings and Details and the *MUTCD*.

b. Prior to the design of traffic signals, designers shall consult with Engineering to determine design requirements.

c. Plans shall be consistent with the results of the traffic analysis performed under Section 260.1.1.

d. Signalized intersections shall generally be accompanied by channelized left turn lanes on the major street and minor street and designed per Section 250.8.8.

e. Signalized intersections may be accompanied by channelized right turn lanes on the major street and minor street as warranted by Section 295.19.1 and designed per Section 250.8.8.

f. All plans shall be prepared under the direction of and stamped by an Engineer with expertise in traffic engineering or by a Traffic Engineer.

260.3 Traffic Signal Materials

Materials used in the construction of traffic signals shall be approved by Engineering and comply with the *Oregon Standard Specifications for Construction* and the Clackamas County Traffic Signal Drawings and Details.

260.4 Material Submittals

Prior to signal construction, the materials to be used on the project shall be submitted to Engineering for review and approval in the form of standard ODOT traffic signal blue sheets, green sheets, red sheets and applicable cut sheets.

260.5 Traffic Signal Funding and Agreements

If approved in conjunction with a development, the following shall apply:

a. The applicant shall be required to enter into necessary agreements to fulfill the obligations of this section.

b. The applicant shall provide funds for the staff review of all proposed traffic signal designs and construction inspection and coordination, in addition to the customary Development Permit review fees.

c. The applicant shall provide funds for necessary signal timing synchronization with existing traffic signals systems.

d. If approved at the intersection of a private driveway with a public roadway, the applicant shall be required to provide a cash advance equal to 15 years of the maintenance and power of the traffic signal.

e. The applicant shall provide or obtain the necessary right-of-way and/or easements to maintain the traffic signal appurtenances constructed at a development's private driveway or along a development's frontage.

260.6 Flashers in School Zones

New schools or existing schools with an expansion of 20% floor area or greater shall be required to install school zone flashers on roadways that are classified as arterial or collector roadways if the proposed or existing school speed zone signing would result in a school speed 20 MPH zone.

Schools proposing a school speed zone shall be required to install school zone flashers on roadways that are classified as arterial or collector roadways if the proposed school speed zone signing would result in a school speed 20 MPH zone.

SECTION 265 - TRAFFIC CALMING

a. The County has adopted a *Clackamas County Local Streets Traffic Calming and Skinny Streets Program.*

b. The use of traffic calming measures shall be considered in cases where a proposed development will have a detrimental effect upon existing neighborhoods. See Section 295 for additional information.

c. Traffic calming devices will only be considered if meeting the criteria of the *Clackamas County Local Streets Traffic Calming and Skinny Streets Program* or as recommended by Engineering to mitigate the impacts of a proposed development or project.

SECTION 270 - TRAFFIC SIGNING

270.1 Design and Construction Requirements

All proposed signing shall comply with the requirements of the *MUTCD*, Oregon MUTCD supplement, the ODOT *Sign Policy and Guidelines*, the Federal Highway Administration's *Standard Highway Signs*, and *Oregon Standard Specifications for Construction*.

All plans shall be prepared under the direction of and stamped by an Engineer with expertise in traffic engineering or by a Traffic Engineer.

270.2 Street Name Signs

The design and construction of permanent street name signs shall conform to Standard Drawing T100 except as required by Section 270.3.

270.3 County Logo Street Name Signs

The design and construction of permanent street name signs on arterials and collectors shall generally conform to Standard Drawing T110 and as follows:

a. Logo street name signs shall be used when street name signs are being replaced.

b. Logos shall be displayed only on the arterial or collector street name sign per Drawing T110.

c. County logo street name signs shall not be used on roadways within any City or short roadway sections where city boundaries vary.

d. Engineering shall approve all locations prior to design and installation.

270.4 Sign Mounting

The design and construction of permanent sign mounting shall conform to Standard Drawings T150 to T250.

270.5 Sign Materials

Sign materials shall conform to the *Oregon Standard Specifications for Construction*.

SECTION 280 - PAVEMENT MARKINGS

280.1 Design and Construction Requirements

All proposed pavement markings shall comply with the requirements of the *MUTCD*, Oregon MUTCD supplement, ODOT *Traffic Line Manual*, generally with *Oregon Standard Drawings* TM500 series, generally with the ODOT *Pavement Marking Design Guidelines* and the *Oregon Standard Specifications for Construction* except as modified below.

All plans shall be prepared under the direction of and stamped by an Engineer with expertise in traffic engineering or by a Traffic Engineer. Plans submitted that exhibit a lack of expertise may be returned without comment.

Materials shall conform to the ODOT Qualified Products List, or as otherwise approved by Engineering.

280.2 Crosswalk Markings

a. Crosswalk markings shall be "continental" style generally with two foot wide bars and three foot wide gaps and be oriented in travel lanes to avoid vehicle wheel tracks.

b. Crosswalks markings shall extend ten feet longitudinally.

c. Marked crosswalks shall be used at all signalized intersections. Marked crosswalks should normally be provided across all legs of a signalized intersection unless otherwise approved.

d. Marked crosswalks may be used in other locations only as approved by Engineering.

280.3 Left Turn and Right Turn Lanes Markings

a. Turn arrows shall be elongated per *Oregon Standard Drawings* TM 500 series.

b. A minimum of two turn arrows shall be provided within each turn lane at both signalized and unsignalized turn lanes.

c. At signalized intersections, the first set of arrows shall be placed a minimum of 40 feet from the crosswalk.

d. Dual left or right turn lanes shall include dotted lane extension lines through the intersection. Survey marks shall be provided by the applicant or contractor during field layout to ensure accuracy.

280.4 Stop Bars

a. Stop bars shall typically be placed behind the location of pedestrian crossings.

b. Stop bars shall not typically be used with crosswalk markings.

c. Stop bars should typically be used at intersections with arterial, collector and connector roadways.

280.5 Transverse Marking Materials

Durable markings shall be used for all crosswalks, bike lane symbols, turn lane arrows, stop bars and other pavement legends.

280.6 Longitudinal Markings

a. Durable markings shall be used for all major and minor arterials within the urban area.

b. Durable markings shall be used for all lane extension lines and transition areas.

c. Durable markings shall be used on all approaches within the queuing and transition areas approaching a signalized intersection or other areas where traffic would be expected to transition or frequently traverse over striping.

d. High performance markings shall be used for all other longitudinal markings.

e. Arterials outside the UGB shall be marked with centerlines. These arterials shall be marked with bike lanes or edge lines except where the overall road width is less than 20 feet.

f. Collectors outside the UGB shall be marked with centerlines. These collectors may be marked with a narrow double or edge lines except where the overall road width is less than 20 feet.

g. Paint, as defined by the *Oregon Standard Specifications for Construction*, may not be used on County roads.

280.7 Reflective Pavement Markers

Reflective pavement centerline markers shall be generally used on the following roadways:

a. Arterials within the UGB.

b. Arterials and collectors outside the UGB.

c. Roadways where raised pavement centerline markers already exist.

280.8 Temporary Markings

a. Foil back tape of similar width to the permanent line may be used for temporary marking for a period not to exceed one month. For periods exceeding one month, paint shall be utilized.

b. Temporary reflective pavement markers (also known as "stick and stomps") may be used for a period not to exceed two weeks and should be checked frequently to ensure adequate delineation is present. Use shall be based upon *Oregon Standard Drawing* TM810.

280.9 Marking Materials

Prior to marking layout, the materials to be used on the project shall be submitted to Engineering for review and approval.

280.10 Marking Layout

The applicant shall contact the County at least two working days in advance of striping for inspection of an applicant or contractor supplied striping field layout.

SECTION 290 - TEMPORARY TRAFFIC CONTROL

290.1 General

a. Traffic control shall be considered for all work located in the public right-of-way. All traffic control shall comply with the requirements of the *MUTCD*, Oregon MUTCD supplement, the ODOT *Sign Policy and Guidelines*, *Oregon Standard Drawings* TM 700 and 800 series, FHWA's *Standard Highway Signs*, *Oregon Standard Specifications for Construction*, *Oregon Temporary Traffic Control Handbook for Operations of Three Days or Less*, and *Oregon Traffic Control Plans Design Manual*.

b. Traffic control plans need not generally bear the stamp of an Engineer, except as required by the County. If required due to complexity, plans shall be prepared under the direction of and stamped by an Engineer with expertise in traffic engineering or by a Traffic Engineer. Plans submitted that exhibit a lack of expertise may be returned without comment.

c. At no time shall flagging operations delay traffic for a period greater than twenty (20) minutes.

d. Work and activity zones (construction, restoration, erosion control) shall extend no more than 2500 lineal feet at any one time unless otherwise approved.

e. Open trenches shall extend no more than 250 lineal feet at any one time, unless otherwise approved.

f. No trenches are to be left unprotected between dusk and dawn.

290.2 Plans Required

If required, a traffic control plan shall be submitted to Engineering for approval for all work in the right-of-way prior to the commencement of work.

290.3 Impacts to Traffic Signals

a. In no case may flagging operations take place in conflict with the indications of an operating traffic signal.

b. No flagging operations may take place within 200 feet of an operating traffic signal without the approval of a traffic control plan.

c. Should traffic control requirements dictate the "turn-off" and/or "turn-on" of a traffic signal, the following shall take place:

    1. The requestor shall coordinate with the County Traffic Signal Shop at least 48 hours prior to turn-off and/or turn-on.

    2. The requestor shall provide funds to the County Traffic Signal Shop equal to time and expenses required to complete the turn-off and turn-on, including overtime expenses.

290.4 Temporary Road Closures

290.4.1 General

a. Temporary road closures will be approved on a case-by-case basis and are generally discouraged.

b. Road closures are not for the purpose of convenience or cost reduction for an applicant. Proposed closures shall establish that a clear public safety and convenience benefit would result from a closure.

c. With increasing ADT, functional classification and closure duration, the applicant's burden becomes greater in establishing the benefit of a proposed closure.

d. Proposed closures shall be accompanied by a traffic control plan. More complex closures may be required to be designed by an Engineer.

e. If a road closure is approved, the following may be required:

    1. Time of day restrictions or extension of normal working hours and days.

    2. Contract requirements of incentives/disincentives for completing/not completing closure on time.

    3. Written notification of nearby property owners and service providers as defined by the County.

    4. Public meeting to address neighborhood concerns.

    5. Off-site improvements to meet minimum safety of the detour route and/or return the detour route to its original condition.

    6. Portable variable message signs.

290.4.2 Arterial Road Closures

a. Temporary road closures proposed on arterial roadways will generally not be approved.

b. Prior to the approval of a temporary road closure on an arterial roadway, the applicant shall establish that the following conditions exist:

   1. There is no other feasible alternative to closure.

   2. The proposed closure offers a clear benefit to the safety of the roadway system.

   3. Temporary improvements to the roadway are infeasible.

   4. The proposed detour route can safely and legally accommodate the detoured traffic.

290.4.3 Submission and Approval

a. General road closure requests and the associated traffic control plans shall be submitted at least four (4) weeks in advance of the proposed closure.

b. Road closures exceeding six (6) months in duration or closures proposed on collectors or arterials shall be submitted at least six (6) weeks in advance of the proposed closure.

c. Plans submitted with inadequate traffic control plans may extend this timeline, possibly significantly.

d. Road closures of duration greater than six months may require BCC approval, while closures of shorter duration require Road Official approval.

SECTION 295 - TRANSPORTATION IMPACT STUDY (TIS) REQUIREMENTS

295.1 General

The objective of a transportation impact study (TIS) is to assess the impacts of a proposed project or land use action on the transportation system and identify mitigation for any capacity or safety deficiencies. A development should only be approved if criteria are met from both a capacity and safety perspective. These requirements are intended to provide standards for generation of a TIS for land development applications that are consistent with existing land use regulations.

295.2 Traffic Impact Study Required

a. A TIS shall be required based upon an assessment of Engineering regarding the anticipated relative impact of a proposed development on the existing or planned transportation system.

b. A TIS to address traffic capacity should not typically be required where the proposed development will generate less than twenty vehicles trips in any peak hour. However, a TIS may be required to address safety issues.

295.3 Traffic Study Scope and Coordination

a. Applicants should contact Engineering to discuss the application of these *Standards*, the *ZDO* and the *Comprehensive Plan* prior to beginning work on a TIS.

b. Engineering and the applicant should coordinate to develop a written TIS scope that will guide the work of the TIS and define the study requirements based upon the anticipated influence area of the proposed development.

c. Engineering will determine the scope to be included in the TIS. For smaller projects that generate very little traffic, a very limited scope may be appropriate, while a project generating a large volume of traffic may require a very detailed analysis.

d. The influence area of a proposed development establishes the requirements of analysis for the TIS and is defined on a case by case basis, but is generally based upon the trip generation of the proposed development in relation to the proximity of congested roadways and intersections or the proposed development's potential impact on safety issues.

e. It is strongly **recommended that the Engineer contact staff when critical study decisions are made to ensure that the consultant and staff are both comfortable with assumptions.**

f. It is also encouraged that a large TIS be submitted for review prior to land use application submittal, as an incomplete TIS can significantly delay a project. Engineering will provide reviews of incomplete studies in order to avoid the need for future revisions.

g. Engineering will use these *Standards*, other applicable criteria, as well as any specific TIS requirements in their review of a TIS and will request revisions if the study is inadequate to address the applicable criteria.

295.4 Traffic Engineering Expertise

All traffic impact studies shall be conducted under the direction of and stamped by an Engineer with expertise in traffic engineering or by a Traffic Engineer.

295.5 Coordination with Other Agencies

The applicant shall coordinate with ODOT and affected local jurisdictions in the scoping, development, and review of a TIS regarding intersections or roadways that are not under the County's jurisdiction. In some cases, the County has adopted adjacent agency standards, so coordination is advised.

295.6 Long Term Analysis

Zone changes and *Comprehensive Plan* amendments require long-range year analysis. The applicant shall obtain horizon year link volume estimates from Engineering or Metro for use in their analysis.

295.7 Clackamas Regional Center (CRC) Area Analysis Period

a. *ZDO* Section 1007 and *Comprehensive Plan* Chapter 10 require special analysis periods within the Clackamas Regional Center Area.

b. Within the CRC area, a weekday PM peak two hour analysis is required. The first hour of analysis shall be based upon the peak hour of the subject intersections. If the mobility standard is met for the first hour, no further analysis is required. If the mobility standard is not met in the first hour, a second hour of analysis is required. The second hour of analysis shall be based upon the "shoulder" ½ hours before and after the peak hour.

c. Within the CRC area, a weekday midday hour analysis is required.

295.8 Analysis Methodology

All analyses shall be conducted in compliance with the most recent versions of the following:

a. *Highway Capacity Manual* (*HCM*)

b. ITE *Trip Generation Manual*

c. ITE *Trip Generation Handbook*

d. *MUTCD*

e. AASHTO's "*A Policy on the Geometric Design of Highways and Streets*"

f. AASHTO's "*Guidelines for Geometric Design of Very Low-Volume Local Roads*"

g. AASHTO - *Highway Safety Manual*

It is recognized that in many instances, the *HCM*'s methodology is limited. In instances where the *HCM* is incapable of providing accurate analysis, the County and applicant shall coordinate on an appropriate analysis method.

The HCM provides methodology for reporting intersection level of service (LOS) in a variety of ways, including by movement, by approach, or by the intersection as a whole. The following establish the County's LOS determination method and other analysis parameters required to evaluate the requirements of the *Comprehensive Plan* and *ZDO*.

295.8.1 Two-Way Stop Controlled (TWSC) Intersections

At two-way stop controlled intersections, including driveways, the weighted average methodology of the critical approach of the *HCM* shall determine the LOS and v/c of the intersection.

295.8.2 All-Way Stop Controlled (AWSC) Intersections

At all-way stop controlled intersections, the intersection average methodology of the *HCM* shall determine the LOS and v/c of the intersection.

295.8.3 Signalized Intersections

At signalized intersections, the intersection average methodology of the *HCM* shall determine the LOS and v/c of the intersection.

295.8.4 Roundabout Intersections

At roundabouts, a volume to capacity ratio of 0.95 or less shall be provided on each approach based upon HCM methodology or as approved by Engineering.

295.9 Signalized Intersection Analysis Parameters

The TIS shall analyze traffic signals in the following manner with regard to traffic signal timing:

a. The existing, background and total traffic analysis shall generally be consistent with the existing signal timing.

   1. Signals operating as isolated intersections shall optimize the existing timing, with green times not to exceed the maximum existing green times.

   2. Signals that operate in a coordinated timing plan shall be analyzed as such, with consistent cycle lengths, forceoffs, green time, yellow time, red time and offsets.

   3. Pedestrian volume and timing shall be considered.

b. The total traffic analysis may vary from the existing signal timing under the following conditions:

   1. If modifications to the signal timing are proposed or shown in the analysis, the total traffic analysis shall contain two scenarios: total traffic with existing signal timing and total traffic with proposed signal timing. Generally, signal timing modifications are not acceptable as mitigation to a project's impacts.

2. Additional analysis requirements may apply in the case of coordinated signal systems as changes at one intersection may affect other intersections not included in the study area of the project.

c. The Engineer shall request County, ODOT and local jurisdiction signal timing for use in their analysis. The Engineer is responsible for ensuring that the existing timing is used in the analysis as appropriate.

d. If recommended by the applicant and approved by Engineering as acceptable mitigation to a project's impacts, funds will be required to design and implement new signal timing plans suggested as mitigation by the applicant.

295.10 Peak Hour Factor ("PHF")

a. The peak 15 minutes of the peak hour shall be the basis for determining level-of-service except as noted in the *ZDO* and *Comprehensive Plan*.

b. The PHF shall be derived from the existing raw manual turning movement counts and be applied uniformly over each scenario except in the case of long term analysis.

c. In the case of long term analysis, the default PHF of the *HCM* or the existing PHF, whichever is greater, shall be used in analysis.

d. The intersection peak hour factor may be utilized rather than individual movement peak hour.

295.11 Microsimulation Models

a. Highly congested conditions will require the use of microsimulation models.

b. The use of microsimulation models shall require general adherence to the procedures of FHWA's *Traffic Analysis Toolbox Volume III: Guidelines for Applying Microsimulation Modeling Software*.

295.12 Growth Rates and In Process Traffic

a. For short term analysis of five years or less, growth rates shall not typically be less than 2% per year unless verifiable evidence is submitted or known which indicates that the local growth rate is less than 2% per year.

b. For long term analysis of six years or more, simple growth rates shall not be used. The applicant shall obtain data per Section 295.6 for use in their analysis.

c. In process traffic, or developments that have been approved yet are not yet occupied, shall be included in addition to growth projections only when modeling data per Section 295.6 is not utilized.

295.13 Turning Movement Counts

Turning movement counts shall be conducted as follows:

295.13.1 Count Hours

The count hours stated in Table 2-19 shall be collected in analysis unless the TIS scope specifies otherwise.

Table 2-19. Traffic Count Hours by Area

Outside Clackamas Regional Center Area	
Weekday AM Peak Hour	6:30 AM to 8:30 AM
Weekday PM Peak Hour	4 PM to 6 PM
Within Clackamas Regional Center Area	
Weekday Midday Peak Hour	11 AM to 2 PM
Weekday PM Peak Hour	3:30 PM to 6:30 PM

295.13.2 Day of Week

Turning movement counts shall be conducted on Tuesdays, Wednesdays and Thursdays unless otherwise directed.

295.13.3 Holidays

Turning movement counts shall not be conducted within one week of a federal holiday.

295.13.4 Current Counts

Traffic counts should be based upon counts collected within 12 months of the completed land use application. Counts older than 12 months may not be accepted or may require adjustment to current traffic conditions.

295.13.6 Turning Movement Count Required Data

Turning movement counts shall separately include vehicular (truck vs. non-truck), bicycle and pedestrian traffic volumes.

295.13.5 Traffic Count Submission

Raw traffic counts files shall be submitted electronically with each TIS submission.

295.14 Trip Generation

a. Trip generation shall be based upon the latest edition of ITE's *Trip Generation Manual* and *Trip Generation Handbook*.

b. The traffic impact study shall include an estimate of site generated trips, pass-by trips, diverted linked trips, and internal capture trips during each study period.

c. If a trip generation rate similar to the proposed use is not available within *Trip Generation Manual*, then the procedures of the *Trip Generation Handbook* regarding obtaining local rates shall generally be required unless local trip data is unavailable for the proposed use or as approved by Engineering.

d. Trip generation shall be based upon an average weekday unless otherwise specified by Engineering.

295.15 Trip Distribution

a. For smaller projects, trip distribution may be based upon existing traffic conditions, engineering judgment, and previous traffic studies.

b. For larger projects, the transportation modeling methodologies of NCHRP 255 should be used as a general guideline.

c. In both cases, prior to trip distribution, it is strongly recommended that the method of trip distribution be confirmed with Engineering.

295.16 Queuing Analysis

a. As required by Engineering, the TIS shall provide 95th percentile queue estimates for each movement at each study intersection.

b. In tabular format, the traffic study shall identify the existing available queue storage, anticipated 95th percentile queue and indicate if that storage is or will be exceeded.

c. In cases where the anticipated 95th percentile queue exceeds the available storage:

   1. A development may be required to mitigate a queue back to the background condition if a safety issue would result without mitigation.

   2. Additional or alternative methods of analysis may be required to provide an accurate analysis if *HCM* methodology is limited.

d. Microsimulation utilized to substantiate queuing shall comply with Section 295.11.

295.17 Traffic Safety

The TIS shall analyze the existing and future safety of the transportation network by addressing the following:

295.17.1 Sight Distance

Sight distance shall be determined at each proposed site driveway and at affected off-site intersections per the standards of Section 240.

295.17.2 Crash History

a. Crash history shall be provided for all study intersections and along all sections of roadway to which access is proposed.

b. Crash rates, frequency and severity shall be reported at all study intersections.

c. The consultant shall evaluate the crash history to determine crash patterns, severity and frequency and make recommendations for safety improvements.

d. Intersection crash rates in excess of 1.0 crashes/million entering vehicles require an in depth safety analysis based upon the *Highway Safety Manual* and may require proportional mitigation.

e. Segment crash rates in excess of 5.0 crashes/million vehicle miles require an in depth safety analysis based upon the *Highway Safety Manual* and may require proportional mitigation.

f. A discussion of Safety Priority Index System (SPIS) rankings, if required. SPIS data will be provided to the applicant, if required.

295.17.3 Analysis of Access Standards

The TIS shall provide an analysis of access standards per Section 220.

295.17.4 Truck Circulation

a. An analysis of the ability of the onsite design and control vehicle to circulate on-site and at access locations.

b. The minimum onsite design vehicle is a fire truck.

c. As required, for developments that will be frequently served by vehicles in size greater or equal to WB-50, an analysis of truck turning movements to the intersection:

   1. With the nearest collector or arterial roadway (whichever is closer) if within the urban area.

   2. With the nearest arterial roadway if within the rural area.

   3. Mitigation may be required if a safety issue would result.

295.17.5 Roadside Characteristics

As required by Engineering, address any existing roadside deficiencies such as lack of sidewalk, shoulders and bikeways and discuss proportional roadside improvements along the project frontage and impacted roadways and intersections.

295.18 Mitigation

The traffic study shall include suggested mitigation to comply with *ZDO* and *Comprehensive Plan* level of service requirements, to provide a minimum level of safety to support the proposed development per Sections 225, 240.3 and this section, to determine a development's proportional share of needed improvements, to address neighborhood livability issues, and other requirements of these *Standards* as required.

Proposed mitigation may require a safety analysis based upon the *Highway Safety Manual*.

Mitigation that shall be considered in the analysis is described below, as applicable:

295.18.1 Turn Lane Warrants

a. The consultant shall analyze the need for right and left turn lane warrants as required by Engineering.

b. The County utilizes the current ODOT left turn and right turn siting criteria of the *Highway Design Manual* when establishing the possible need for left and right turn lanes.

c. The affirmation of a warrant being met for a turn lane does not dictate its installation. County staff will make a determination regarding the need for turn lanes based upon the following factors:

   1. ODOT turn lane siting criteria.

   2. Relative turn volume to through volume.

   3. Bicycle and pedestrian activity.

   4. Proportional impact of the development upon the movement.

   5. Right-of-way availability.

   6. Crash history or anticipated crashes.

   7. The presence of other turn lanes along the roadway.

   8. Functional classification of the roadway.

   9. Planned cross section of the roadway within the *Comprehensive Plan* or *CIP*.

d. Signalized intersections shall generally be accompanied by channelized left turn lanes on the major street and minor street and designed per Section 250.8.8.

e. Signalized intersections may be accompanied by channelized right turn lanes on the major street and minor street as warranted above and designed per Section 250.8.8.

295.18.2 Traffic Signal Approval

a. A traffic signal proposed to address safety or capacity issues shall meet the requirements of Section 260 including evidence to indicate that other alternatives have been considered.

b. The approval of traffic signals shall be based upon Section 260.

295.18.3 Analysis of Neighborhood Impacts

a. Some developments may have a detrimental effect upon existing neighborhoods. As applicable, the TIS shall evaluate impacts such as traffic volume increases, potential speed increases, safety impacts and other livability issues.

b. Based upon the relative impact of the development upon the neighborhood, the County may recommend improvements to mitigate a development's impact upon an existing neighborhood.

c. Elements to be considered as potential mitigation include the traffic calming measures of Section 265.

295.18.4 Other Mitigation

Other mitigation, such as the installation of stop signs, warning signs, signal timing modifications, additional through travel lanes, roundabouts, traffic circles, pedestrian and bicycle improvements and other potential improvements, will be evaluated on a case by case basis on their own merits. Suggested mitigation shall be accompanied by appropriate engineering analysis to allow for the review of such proposals.

295.19 Traffic Study Components

The following are generally required for a TIS:

295.19.1 Executive Summary

An executive summary shall be prepared generally discussing the proposal and the results of the study and any necessary traffic related mitigation to meet the requirements of the land use application.

295.19.2 Project and Study Area Description

A description of the existing and proposed land uses, site characteristics, surrounding land uses, roadway system characteristics, transit service, pedestrian and bicycle facilities, and any pending transportation system improvements as identified in the *Clackamas County Capital Improvement Program*, *Comprehensive Plan*, and ODOT or local jurisdiction plans.

295.19.3 Analysis Periods and Scope

a. Analysis of intersection capacity and/or roadway segment capacity, as required by the Scope, meeting the requirements of these *Standards*, *ZDO* and *Comprehensive Plan*.

b. The analysis shall include the following study scenarios at a minimum or as directed by staff:

1. Existing Traffic (Analysis based upon "current" traffic counts)

2. Background Traffic at a reasonable full build-out year (Existing Traffic + Growth + In Process Traffic)

3. Total Traffic at a reasonable full build-out year (Background Traffic + Site Generated Traffic)

295.20 Submittal Requirements

a. Traffic studies, revisions, and all communications intended for the land use written record shall be submitted to the Planning staff responsible for the land use action. Unless prior to a land use application, a TIS should not be submitted directly to Engineering.

b. Completed traffic studies and revisions shall be submitted, in their entirety, as a pdf document.

c. All electronic files used in support of a traffic analysis shall be submitted upon request.

d. Traffic counts shall be submitted electronically.

e. Printed traffic impact studies shall be submitted to Planning in the number and form required by Planning.

CHAPTER 3 - ON SITE DESIGN OF COMMERCIAL, INDUSTRIAL AND MULTIFAMILY DEVELOPMENTS

SECTION 310 - GENERAL

Site improvements for commercial, industrial, and multifamily developments are generally conditioned through the development review and the land use approval process, described and administered pursuant to the *ZDO* or by Federal, State or other local agency regulation. The goal of site design in Clackamas County is to provide safe, efficient, convenient, and economical movement of all vehicles, pedestrians and service providers.

This chapter supplements the requirements of *ZDO* Section 1007, which contains greater detail in relation to onsite design of commercial, industrial and multifamily developments.

SECTION 320 - PARKING AREAS

320.1 General

All parking areas shall conform to the following minimum requirements:

320.1.1 Maximum Slopes

a. Disabled parking and disabled loading area slopes shall not exceed 2%.

b. General parking area slopes shall not exceed 5%.

c. Drive aisles not adjacent to parking spaces shall not exceed a longitudinal slope of 12%. Cross slopes shall not exceed 5%.

320.1.2 Pedestrian Walkways

For developments with more than 150 parking spaces, no parking space shall be more than 150 feet from an unobstructed pedestrian walkway which connects to a public building entrance.

320.1.3 Circulation and Maneuvering

a. For 90 degree parking spaces, a minimum of 24 feet of back up maneuvering room is required.

b. For dimensions of parking spaces, refer to Standard Drawing P100 for maneuvering requirements.

c. Loading spaces shall provide adequate maneuvering room for anticipated delivery or service vehicles.

d. All movements for non-passenger design vehicles shall be shown on plans or exhibits, showing paths traced by the extremities of the vehicles, including off-tracking. Adequate turning radii shall be provided for vehicles maneuvering on site and at driveway approaches.

320.1.4 Parking and Maneuvering Area Surface

a. Inside the UGB, all parking and maneuvering areas shall be hard surfaced.

b. Outside the UGB, all parking and maneuvering areas shall be hard surfaced or surfaced with screened gravel or better. All disabled parking areas and adjacent accessible areas shall meet current ADA requirements, requiring a hard surface access way to the building entrance.

c. The structural section of parking lots shall meet Standard Drawing R100.

320.1.5 Number & Dimensions

a. All automobile off-street parking numbers and dimensions shall meet minimum and maximum *ZDO* Section 1007.07 requirements (see Standard Drawing P100).

b. All off-street loading parking numbers and dimensions shall meet minimum and maximum *ZDO* Section 1007.08 requirements.

c. All off-street bicycle parking numbers and dimensions shall meet minimum and maximum *ZDO* Section 1007.07.E requirements.

d. All plans shall list the minimum number of parking and loading spaces required and the number of parking and loading spaces provided.

e. Plans shall show parking and loading space and drive aisle dimensions.

a. The applicant shall label all compact, carpool, disabled, and loading berth spaces on the plans.

320.1.6 Curbs

a. If curbs carry, direct or channel surface water, the curb shall typically be type "C". Curb and gutter shall be used if curb line slope is less than 1%.

b. Alternative curbs will be considered when it is determined by Engineering that type "C" curbs or curb and gutter are not appropriate.

c. Extruded curbs shall not be used for carrying, directing or channeling surface water, or as a vehicle wheel stop.

320.1.7 Signage

a. All traffic control devices on private property, and those located where private driveways intersect County facilities, shall be installed and maintained by the property owner, and shall meet standards set forth in the *MUTCD* and Oregon MUTCD supplement.

b. The applicant shall provide a signing and pavement marking plan to Engineering for on site parking and circulation.

c. This plan shall be reviewed and approved by Engineering and the local fire service provider prior to the applicant being issued a Development Permit.

d. Stop signs shall meet the following minimum requirements:

1. Applicant shall install a 30-inch "STOP" sign, behind the sidewalk, at the driveway exit.

2. Within the urban area, the bottom of the "STOP" sign shall be positioned a minimum of 7 feet above the surface of the new sidewalk or pavement.

3. Outside the urban area, the bottom of the "STOP" sign shall be positioned a minimum of 5 feet above the surface of the new sidewalk or pavement.

320.1.8 Crossover Access Easements

See Section 220.2 for requirements.

SECTION 330 - COMMERCIAL, INDUSTRIAL AND MULTIFAMILY DRIVEWAYS

330.1 Minimum Driveway Design Requirements

a. Driveways shall be designed with a minimum 28-foot wide approach.

b. Driveways on streets with curbs and driveways within the UGB shall typically be constructed per Standard Drawing D600. In cases where a development's trip generation is such that higher speed egress maneuvers from the adjacent roadway are desired, the County may require driveways to be constructed per Standard Drawing D675.

c. Driveways constructed without curbs shall be constructed per Standard Drawing D500 with appropriate radii for turning movements.

d. Driveway throats (measured from the back of the public sidewalk to the nearest perpendicular drive aisle) shall have a minimum length of 20 feet. Driveway throat depths may be required to be based upon a traffic study per Section 295.

e. Parking and intersections are prohibited in the minimum throat depth.

f. Driveways accessed by trucks with trailers, shall require a minimum throat length of 50 feet.

SECTION 340 - REFUSE AND RECYCLING ENCLOSURE STANDARDS FOR COMMERCIAL, INDUSTRIAL AND MULTIFAMILY DEVELOPMENTS

340.1 Location

All garbage and recycling enclosures located within 15 feet of any structure shall be designed to protect other structures from fire hazard.

340.2 Slope and Structural Section of Pad

a. The enclosure pad shall be constructed of Portland Cement Concrete, a minimum of four inches in thickness.

b. The grade of the pad for the enclosure shall be between 1.5% and 2%, to allow the pad to discharge surface water runoff. The grade for access to the pad shall not exceed 3% (*ZDO* subsections 1021.04.A and 1021.07.E)

340.3 Other Design Requirements

All other design elements shall conform to *ZDO* Section 1021 and Strategic Planning and Sustainability Division design guidelines. Prior to the issuance of a Development Permit, the applicant shall obtain written approval from the Strategic Planning and Sustainability Division of the proposed design and location of the enclosure.

CHAPTER 4 - STORM WATER MANAGEMENT

SECTION 410 - GENERAL

410.1 Regulatory Authority

Engineering is responsible for ensuring the adequate drainage of public roads in the County. Engineering regulates the construction of public and private roads to ensure adequate drainage of storm/surface water to an appropriate discharge point.

Clackamas County has four surface water districts: Clackamas County Service District #1 (CCSD#1), the Surface Water Management Agency of Clackamas County (SWMACC), Clean Water Services (CWS) and the Oak Lodge Sanitary District (OLSD). CCSD#1 and SWMACC are regulated by Clackamas County Water Enviroment Services (WES)

Engineering manages storm water drainage and surface water regulations for all development outside of the County's four storm water districts or outside a City located within the County's boundary. For the regulations in these areas, please refer to the respective jurisdiction.

410.2 Engineering Regulations Outside the Tualatin River Basin

Engineering has adopted WES standards, for CCSD#1, Chapters 1-5 & 8-10 outside the Tualatin River basin. Chapters 6 and 7 do not apply.

410.3 Engineering Regulations Within the Tualatin River Basin

Engineering has adopted WES standards for SWMACC, Chapters 1-6 & 9-11 within the Tualatin River basin. Chapters 7 and 8 do not apply.

410.4 Erosion Control Contractor Certification Not Required

CCSD#1 & SWMACC Section 4.2.8 Erosion Control Certification shall not apply to Engineering regulations.

410.5 Fees

Engineering does not have a surface water management district. Any reference to fees in WES standards apply to WES districts only. There are no surface water management fees outside of CCSD#1 and SWMACC required by the County.

SECTION 420 - DTD DESIGN EXCEPTIONS TO WES STANDARDS

The following standards are exceptions to WES surface water regulations. These standards are directed towards the design and construction of public storm drainage facilities and for the coordination of storm water runoff from private drainage systems into public systems. The intent is to ensure a comprehensive engineering review and sufficient design to identify and mitigate existing deficiencies, protect the environmental health of our watersheds, as well as to identify the capacity requirement of new system improvements resulting in an overall benefit of reduced flooding.

If any conflicts arise between these standards and WES regulations, the following standards shall govern.

420.1 Best Management Practices (BMP) & Low Impact Development Approaches (LIDA)

Engineering acknowledges the need for BMPs/LIDAs in new development. Currently, Engineering does not have a list of accepted LIDAs. However, Engineering encourages designers to submit LIDA designs for

review to meet the water quality and infiltration requirements outlined in WES rules and regulations. Calculations will be required to illustrate to Engineering how a given LIDA provides water quality benefit.

420.2 Acreage as a BMP

Development outside WES service districts is predominated by larger lot sizes. A reasonable BMP may be the utilization of undeveloped acreage. The applicant shall demonstrate to Engineering that water quality, detention, and/or infiltration requirements are met using this BMP.

420.3 Underground Injection Control (UIC) Devices not Permitted in Right-of-Way

UICs are not permitted in Clackamas County right-of-way.

SECTION 430 - HYDROLOGY

430.1 Acceptable Hydrology Methods (Detention Hydraulics)

Engineering accepts the Rational Method, TR-55, and continuous runoff models. Other methods will require prior approval from Engineering.

Detention pond routing shall be by the Storage Indication (Modified Pulse) method:

$\{2S_2/\Delta t + O_2 = I_2 + I_1 + 2S_1/\Delta t + O_1\}$ or approved equal.

430.2 Rational Method

The Rational Method (Q=ciA) may be used to estimate peak discharge from drainage basins of less than 300 acres.

The Soil Conservation Service ("SCS") TR55 method may be used for drainage areas less than 25 square miles.

Refer to the ODOT *Hydraulics Manual* for additional information. Some of the figures contained herein have been reproduced from the above manual.

430.2.1 Rational Method Basic Methodology

The Rational Method is a simplified model for estimating the discharge of a drainage basin based on the area of the basin, type of ground cover, and intensity of rainfall.

Q	=	ciA
Q	=	peak discharge (cfs)
c	=	runoff coefficient
i	=	rainfall intensity (in/hr)
A	=	drainage area (acres)

The Rational Method can result in a wide range of discharge values based on assumptions made by the Engineer. The following sections establish parameters for the variables in the Rational Method and should be used in the design of drainage systems within Clackamas County.

430.2.2 Runoff Coefficient - C

The runoff coefficient is a dimensionless parameter based on the type of ground cover and slope of the terrain. Table 4-1 lists runoff coefficients for various conditions of ground cover and slope.
Where ground conditions vary throughout a drainage basin, a composite runoff coefficient can be calculated as follows:

$$C_{avg} = \frac{(C_1A_1 + C_2A_2 + C_3A_3 + \ldots C_nA_n)}{(A_1 + A_2 + A_3 + \ldots A_n)}$$

Table 4-1 Runoff Coefficients (C) for Storm Drainage

Ground Cover	Terrain		
	Flat	Rolling 2-10%	Hilly Over 10%
Pavement and Roofs	0.9	0.9	0.9
Earth Shoulders	0.5	0.5	0.5
Drives and Walks	0.75	0.8	0.85
Gravel Pavement	0.5	0.55	0.6
City Business Areas	0.8	0.85	0.85
Apartment Dwelling Areas	0.5	0.6	0.7
Suburban, Normal Residential	0.45	0.5	0.55
Dense Residential Sections	0.6	0.65	0.7
Lawns, Sandy Soil	0.1	0.15	0.2
Lawns, Heavy Soil	0.17	0.22	0.35
Grass Shoulders	0.25	0.25	0.25
Side Slopes, Earth	0.6	0.6	0.6
Side Slopes, Turf	0.3	0.3	0.3
Median Areas, Turf	0.25	0.3	0.3
Cultivated Land, Clay and Loam	0.5	0.55	0.6
Cultivated Land, Sand and Gravel	0.25	0.3	0.35
Industrial Areas, Light	0.5	0.7	0.8
Industrial Areas, Heavy	0.6	0.8	0.9
Parks and Cemeteries	0.1	0.15	0.25
Playgrounds	0.2	0.25	0.3
Woodland and Forests	0.1	0.15	0.2
Meadows and Pasture Land	0.25	0.3	0.35
Unimproved Areas	0.1	0.2	0.3

430.2.3 Rainfall Intensity

The rainfall intensity indicates the "quantity" of rainfall and is related to the rainfall duration and the design storm. Rainfall intensity is usually represented by an Intensity-Duration-Frequency (I-D-F) curve. The I-D-F curves for drainage design in Clackamas County are taken from the *Hydraulics Manual* (see Figures 4-1 to 4-5).

430.2.4 Time of Concentration

a. The duration of rainfall is equal to the time of concentration (T_c), in minutes, where the time of concentration is defined as "that amount of time from beginning of a storm event, that it takes water from the most remote time location in the basin to reach the point being considered."

b. Determination of the time of concentration, T_c, shall be in accordance with the *Hydraulics Manual* as follows: Most drainage basins will consist of overland flow segments as well as channel flow segments. Overland flow can be further divided into a sheet flow component and a shallow concentrated flow component. Urban drainage basins may be further complicated by having

significant pipe flow segments. The travel time is computed for each flow segment and the time of concentration is equal to the sum of the segment travel times.

c. The best method of determining overland sheet flow time is the kinematic wave equation. The equation is only applicable for travel distances less than 300 feet.

$$T_c = KL^{0.6}n^{0.6} / I^{0.4}S^{0.3}$$

Where:
T_c = overland flow time in minutes
L = overland flow length in feet
n = Manning's roughness coefficient (see Table 4-2)
I = rainfall intensity, in/hr
S = the average slope of the overland area
K = 0.93

d. Figure 4-6 is a nomograph for the solution of the kinematic wave equation for overland sheet flow. In using the nomograph, the time of concentration and rainfall intensity are unknown. The solution is one of iteration or trial and error.

Table 4-2 Mannings Surface Roughness Coefficients (n) for Overland Sheet Flow

Surface Type	n Value
Pavement and Roofs	0.014
City Business Areas	0.014
Graveled Surfaces	0.02
Apartment Dwelling Areas	0.05
Industrial Areas	0.05
Urban Residential Areas (> than 6 units/acre)	0.08
Meadows, Pastures and Range Land	0.15
Rural Residential Areas (< than 6 units/acre)	0.24
Playgrounds, Light Turf	0.24
Parks and Cemeteries, Heavy Turf	0.4
Woodland and Forests	0.4

e. After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from Figure 4-7 in which average velocity is a function of watercourse slope and type of channel. This figure was reprinted from the 1972 SCS Handbook.

f. For open channels, Manning's equation can be used to estimate average flow velocity, which is usually determined for bank-full flow.

430.2.5 Design Storm

a. A design storm defines the statistical recurrence interval of a storm event. The probability of a 25-year storm occurring in a given year is 4%. Conversely, a 25 year storm will statistically occur once every 25 years. The selection of a design storm is dependent on the balance between the cost of the drainage facility and the flood risks associated with the storm event. The design storm required for public drainage facilities within the County shall be based on a 25 year storm event.

b. The effects of the 100 year storm event on storm drainage structures and bridges shall be evaluated as required.

c. The effects of the 100 year storm event on developments within a flood plain shall be evaluated as required.

d. The effect of the 100 year storm shall be evaluated when the path of the drainage could place persons or property in jeopardy.

430.2.6 Drainage Area

The discharge of a storm system is dependent on the size of the basin contributing to the flow. The design of a drainage facility should account for the entire drainage basin surrounding the affected area. The Engineer shall submit a topographic map of the entire drainage basin with the drainage calculations. This map should identify the existing and proposed drainage facilities and sub-basins considered in the design. This overall design shall anticipate and accommodate the acceptance and conveyance of surface water on or crossing the roadway or roadway system considered in the design area.

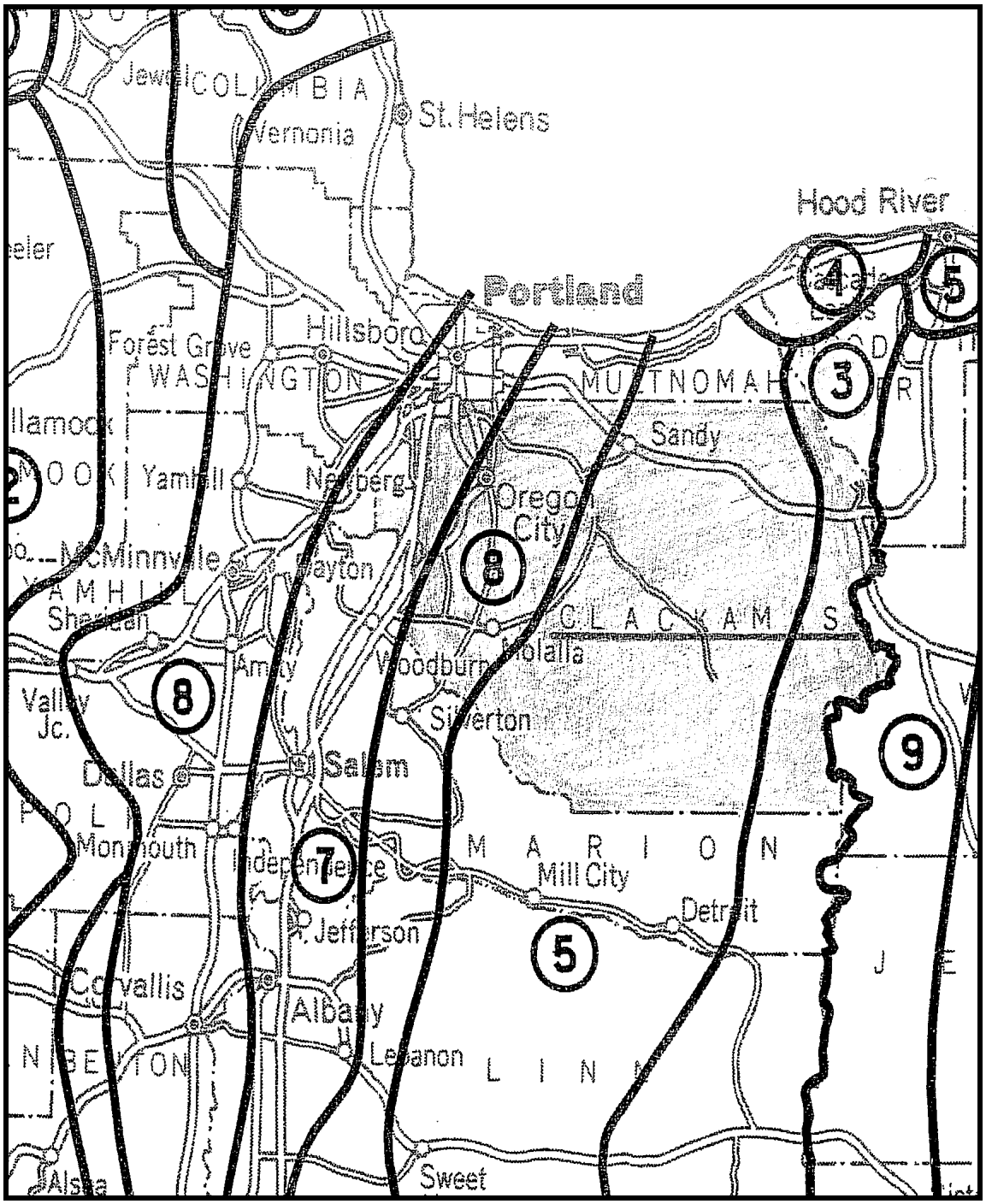

Figure 4-1. Clackamas County Rainfall Zones
Reference: ODOT *Hydraulics Manual*

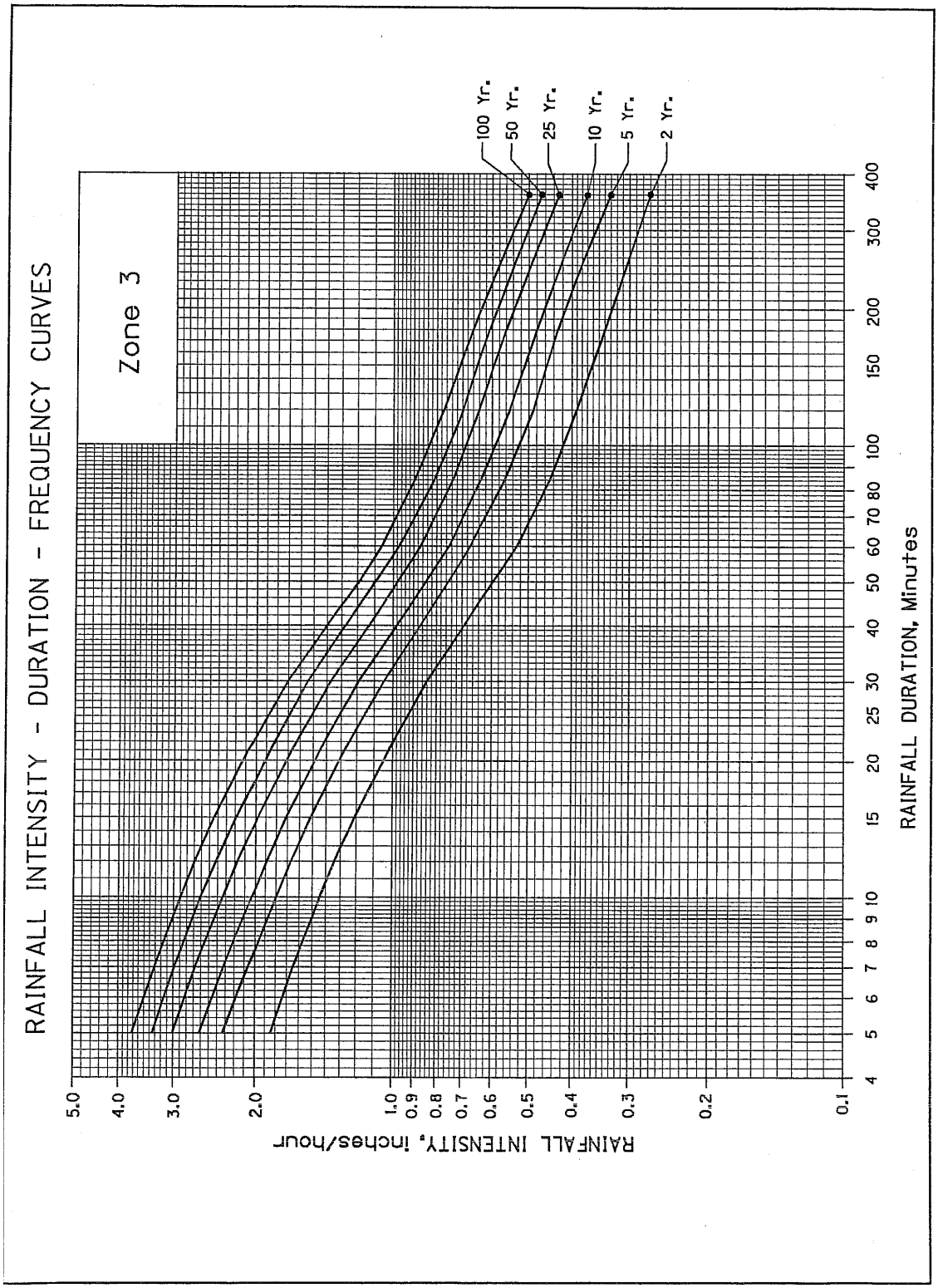

Figure 4-2. ZONE 3 Rainfall Intensity, Duration, Frequency Curves
Reference: ODOT *Hydraulics Manual*

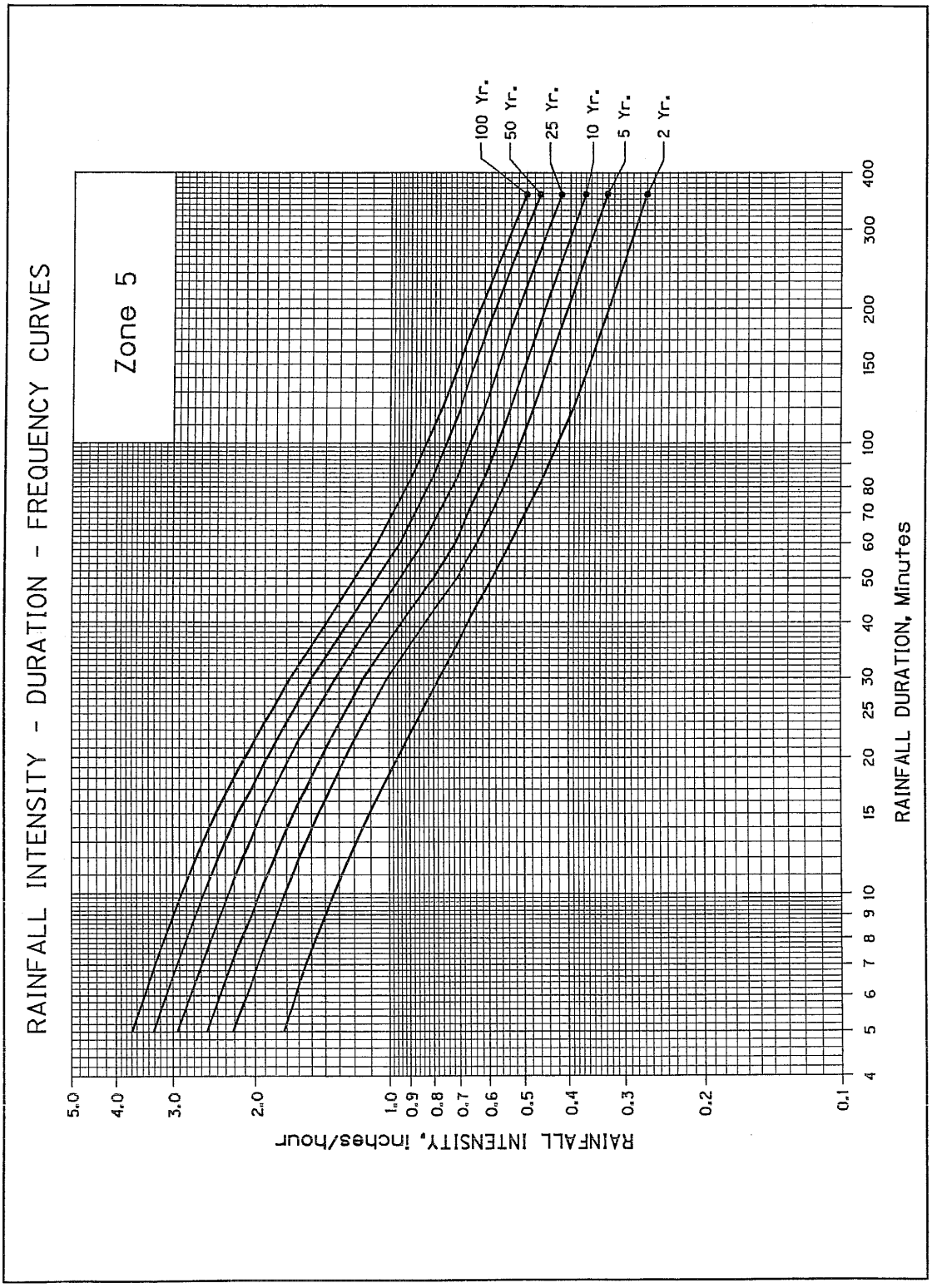

Figure 4-3. ZONE 5 Rainfall Intensity, Duration, Frequency Curves
Reference: ODOT *Hydraulics Manual*

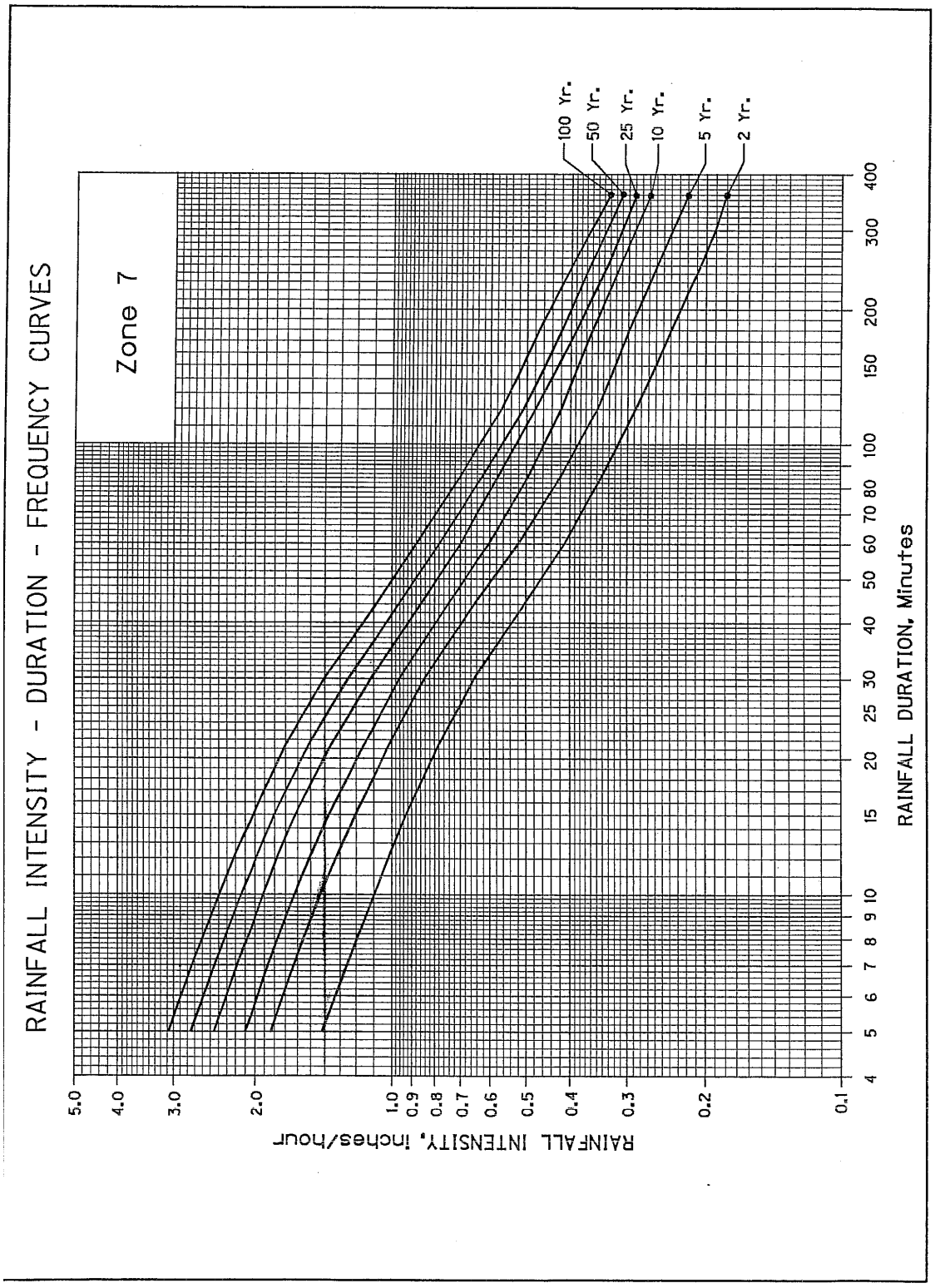

Figure 4-4. ZONE 7 Rainfall Intensity, Duration, Frequency Curves
Reference: ODOT *Hydraulics Manual*

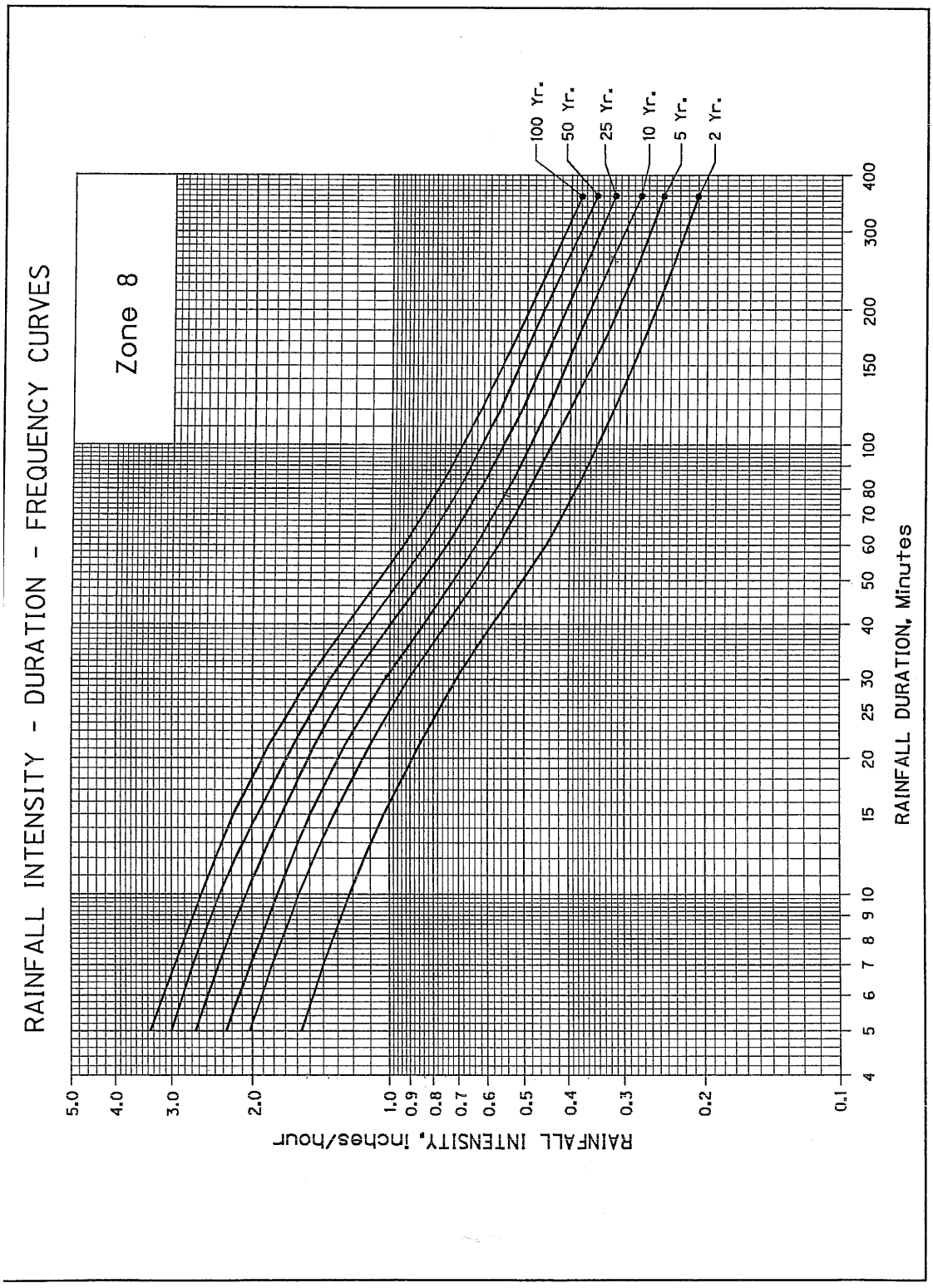

Figure 4-5. ZONE 8 Rainfall Intensity, Duration, Frequency Curves
Reference: ODOT *Hydraulics Manual*

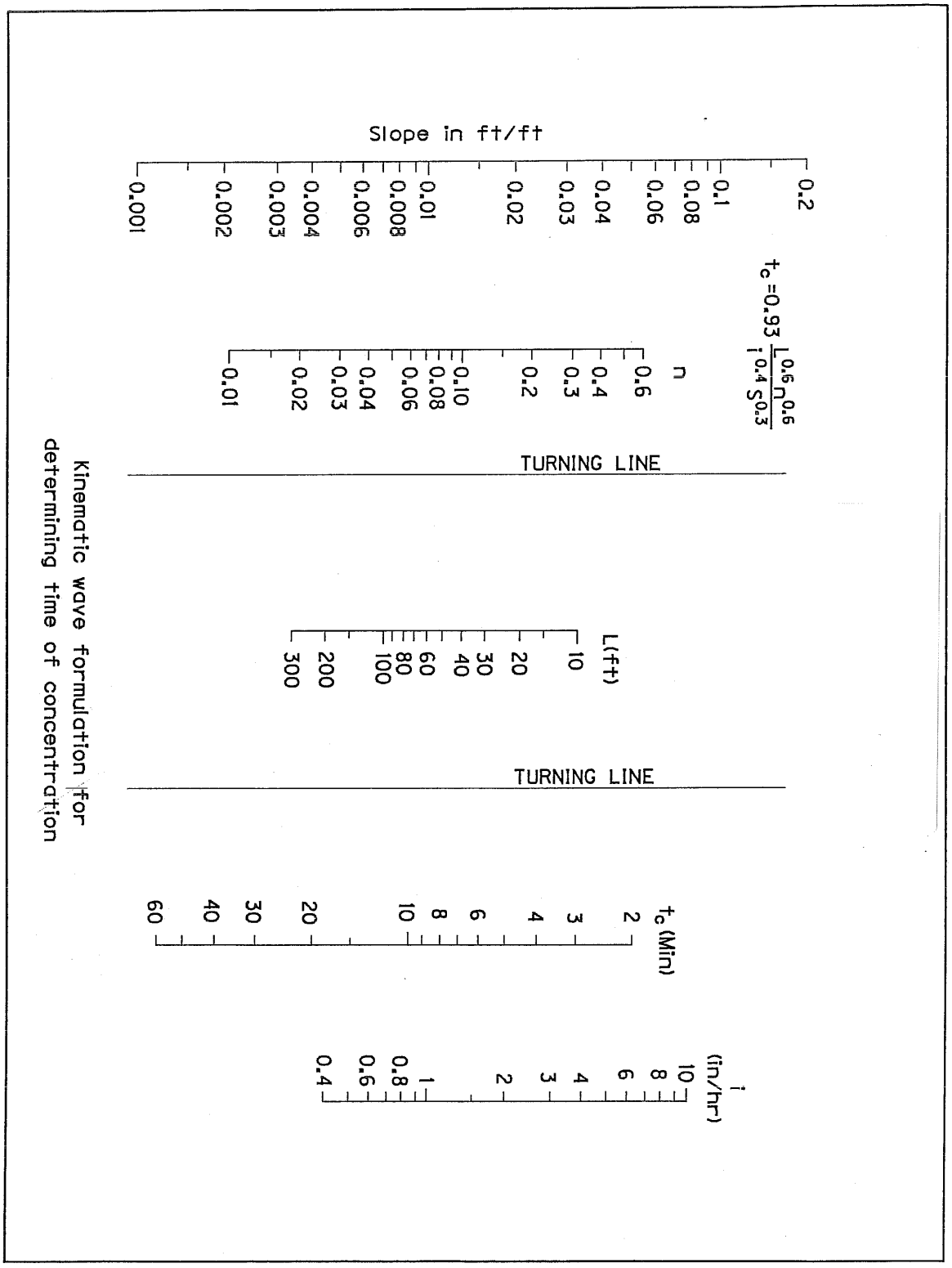

Figure 4-6. Time of Concentration
Reference: ODOT *Hydraulics Manual*

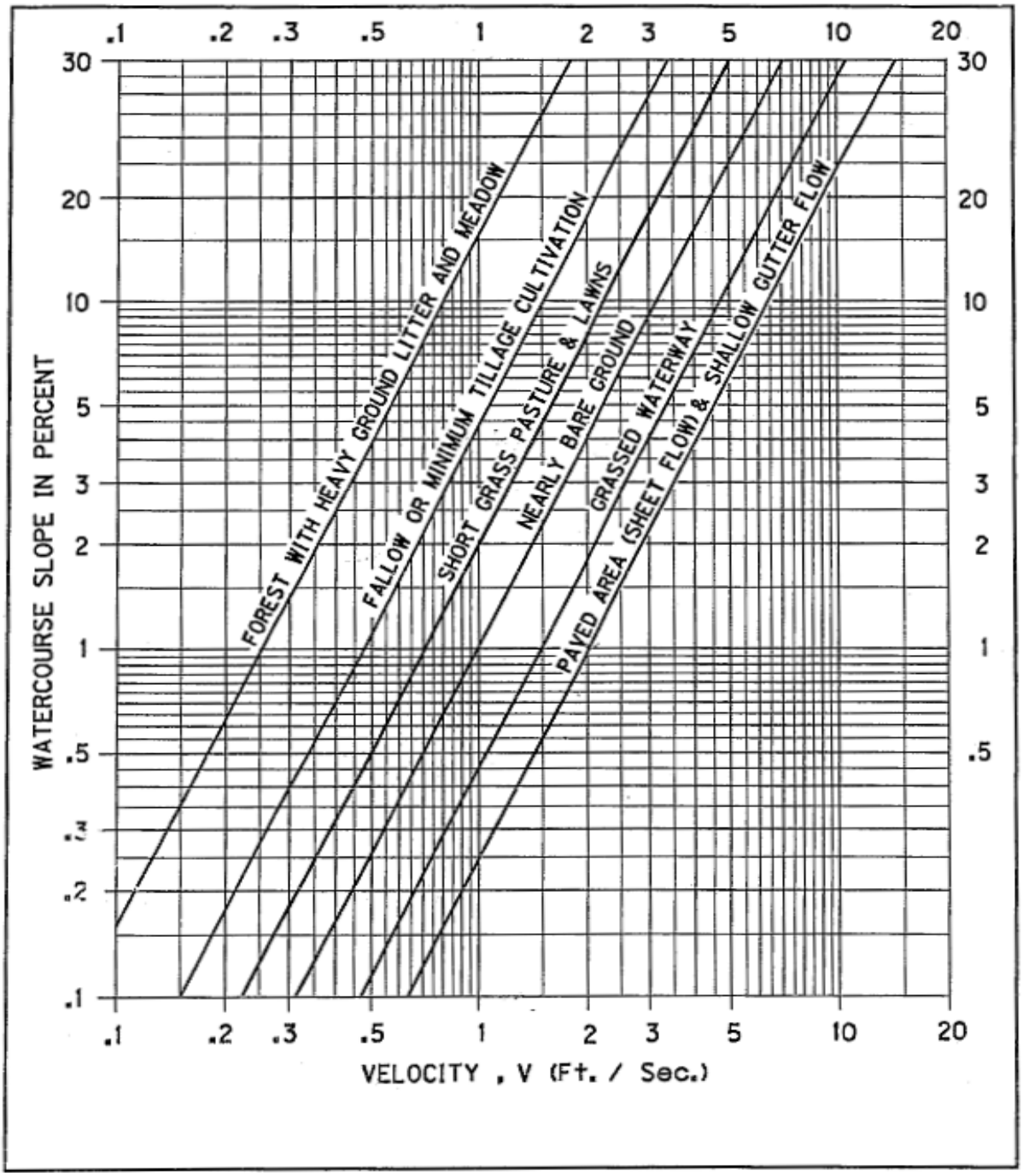

Figure 4-7 – Shallow Concentrated Flow Velocity
Reference: ODOT *Hydraulics Manual*

SECTION 440 - STORM DRAINAGE COMPONENTS

440.1 Pipes and Culverts

440.1.1 Pipe Material

a. The pipe material permitted for use within the public right-of-way is as follows:

1. Concrete, non-reinforced, ASTM C-14, Class 3 (maximum size: 18" inside diameter).

2. Concrete, reinforced, ASTM C-76, Class III (minimum).

3. Ductile Iron, cement lined, class 52.

4. High Density Polyethylene Pipe (HDPE) smooth interior, corrugated exterior HDPE sewer pipe and associated HDPE fittings shall conform to AASHTO M294, AASHTO 252, ASTM 405 or ASTM 667.

5. The following may be used as an alternate as approved by Engineering: High Performance Polypropylene (HP3) smooth interior, corrugated exterior HP3 sewer pipe (12" to 30") as per ASTM F2736 and smooth interior and smooth exterior HP3 sewer pipe encasing a corrugated layer (30" to 60") as per ASTM 2764. Associated HP3 fittings shall conform to ASTM D3212.

b. Pipe used as culverts shall have the ends protected with concrete headwalls unless concrete or ductile iron pipe is used. The minimum life span of pipe used within the right-of-way shall be 70 years.

c. The Engineer shall provide to the County certification with respect to alternative pipe materials, if allowed by the County. Certification shall state that upon inspection the installation, cover, and backfill compaction are in conformance with the manufacturer's recommendations for installation and the product and installation procedures are sufficient for HS 20 loading.

d. The specific strength and depth of cover for pipe shall be based on the manufacturer's recommendations for the loading requirements. Private storm drainage materials shall conform to the Oregon State Plumbing Specialty Code and requirements of the local plumbing official. If private storm drainage materials and applications are not listed in the plumbing code, Engineering will determine the requirements.

440.1.2 Pipe Size

a. Publicly maintained storm drains shall be a minimum of 12-inch inside diameter.

b. Pipes shall be sized to convey the 25 year design storm flow to accommodate the existing and subject development at a minimum velocity of 3 ft/sec when flowing full.

c. The method of analysis shall be based on Manning's equation as follows:

$$Q = \frac{1.49}{n} \times A \times R^{0.67} \times S^{0.5}$$

Where:
- Q = discharge (cfs)
- n = Manning's roughness coefficient (see Table 4-2)
- A = pipe area (ft^2)
- R = hydraulic radius (ft)
- S = slope of the energy grade line (ft/ft)

Table 4-2 Mannings Surface Roughness Coefficients (n) for Pipes

Pipe Material	n Value
Concrete	0.013
Concrete Lined Ductile Iron	0.013
High-Density Polyethylene	0.012
Polyvinyl Chloride	0.011

440.1.3 Pipe Slope

All pipes and culverts shall be designed to operate under gravity flow and be sloped to provide a minimum velocity of 3 ft/sec when flowing full. This may be reduced to 2.5 ft/sec with approval of Engineering.

440.1.4 Pipe Cover

a. Pipe trenching, bedding, and backfill shall conform to Standard Drawing U200.

b. The required minimum cover for pipe for all public storm drains shall be 36 inches or shall be as specified by manufacturer, whichever is greater, as measured from the top of pipe to the finished roadway or ground grade.

c. Reduced depth of cover may be considered by the County due to topographical constraints. Appropriate pipe material shall be used to ensure the pipe's capacity to withstand HS 20 loading.

d. Fill heights over pipes shall meet manufacturer's recommendations and are subject to the approval of Engineering.

440.1.5 Pipe Alignment and Connections

a. Pipes shall be laid to a straight line and grade with no curves, bends, or deflections in any direction.

b. All changes in pipe slope, material or alignment shall require a manhole or catch basin.

c. Catch basin locations shall have a maximum spacing of 500 feet from the high point in the road provided that the catch basins drain in opposite directions and there is not a pipe connected for that distance. Typical in line spacing shall be 250 feet.

d. Extensions of pipes and culverts shall be in the same line, grade, and inside diameter as the existing pipe. Extensions shall be of like material and with a connection approved by Engineering.

440.1.6 Pipe Inspection Including Televiewing

a. All pipes shall be lamped, mandreled and video recorded.

b. Upon completion of all storm drain construction, the storm line shall be inspected by televiewing. The applicant shall coordinate the video recording inspection with Engineering.

c. If deficiencies are revealed by the inspection, the corrections shall be made and the televiewing shall be repeated until all work is accepted. The cost of the televiewing shall be borne by the Applicant.

440.2 Catch Basins and Inlets

440.2.1 Catch Basin Type

Standard GB-2 catch basins shall be used in locations where vertical curb is used. Standard catch basins shall conform to Standard Drawing S200.

440.2.2 Catch Basin and Inlet Spacing and Location

a. The spacing of catch basins or curb inlets shall be as required to limit gutter flow to less than 4 inches depth and limit water depth in a travel lane to less than 1 inch during the 10 year storm event. The maximum length of pipe between catch basins and inlets shall be 250 feet.

b. Catch basins or inlets shall be provided just prior to curb returns where the centerline gradient is greater than 5% or where the next upstream inlet is 100 feet away or farther. Catch basins also are required within 500 feet of the high point of the roadway profile.

440.2.3 Catch Basin and Inlet Connections

All catch basin laterals shall be a minimum 12 inches inside diameter. Catch basin laterals shall connect to the receiving main with a manhole or another catch basin or curb inlet. Blind tee connections are not allowed.

440.2.4 Lateral Connections

Lateral connections from roof and foundation drains from individual properties are allowed when the lateral diameter is less than half of the mainline diameter. The lateral shall be above the spring line of the mainline. The lateral shall have a clean out at the property line. Connections will not be allowed if the lateral is connected to an inlet or area drain.

440.3 Manholes

440.3.1 Manhole Size and Alignment

a. The diameter of manhole required shall ensure a minimum dimension, of solid concrete manhole wall, between pipe openings of 12 inches. The standard and minimum manhole size shall be 48 inches in diameter. Maximum spacing of manholes shall be 250 feet.

b. Access locations shall be required at a change in vertical or horizontal alignment or a change in pipe size or material.

c. Manhole rims shall be flush with top of asphalt. If only one lift is placed, or a portion of the overall depth of asphalt, the rim shall still be flush with the top of the asphalt constructed. As additional asphalt thickness is added later, the rim shall be adjusted to be level with the new top of asphalt.

440.4 Open Channels and Ditches

440.4.1 Natural Channels

a. Natural channels are those which occur naturally due to the flow of water or, following construction, those manmade channels that have become vegetated and stable.

b. Natural channels shall remain in their existing, or natural, condition wherever feasible. The preservation of natural drainage-ways shall conform to the requirements of the *ZDO*. Alteration of natural drainage-ways shall not occur without approval of all agencies having jurisdiction.

440.4.2 Constructed Channels & Ditches

a. Constructed channels include those constructed and maintained by human activity and include bank stabilization at existing channels.

b. Roadside ditches shall conform to the requirements and sections for County rural roadways. Roadside ditches shall not be constructed within the urban growth boundary.

c. The County may consider a constructed channel along the roadside when pedestrian and vehicle safety are not compromised and sufficient road right-of-way is available.

440.4.3 Design Criteria

a. Roadway grading shall conform to clear zone requirements of Section 245 and cross section requirements of Standard Drawings C110 to C140.

b. Constructed channels and ditches shall be trapezoidal or parabolic in cross section with side slopes no steeper than 3H:1V for vegetation-lined channels and 2H:1V for rock-lined channels. Constructed channels and ditches shall be designed for a 25 year storm event. Constructed channels and ditches within the required recoverable slopes shall meet recoverable slope requirements: 4H:1V on the fore slope (down slope) and 3H:1V on the back slope (up slope).

c. Vegetation-lined channels shall maintain a maximum velocity of 5.0 ft/sec at the 25 year event. Rock-lined channels or bank stabilization shall be required when design velocities exceed 5.0 ft/sec.

d. Access and utility easements shall be provided for all publicly maintained open channels and ditches as required by the County.

SECTION 450 - DETENTION AND DOWN STREAM IMPACTS

a. Detention requirements shall conform to WES standards.

b. The requirements for downstream analysis shall conform to WES standards.

c. Bridges and other major conveyances identified as deficient in a downstream analysis shall be designed to accommodate the 100 year storm.

d. The outfall of detention facilities may be required to accommodate the 100 year storm depending on the downstream impacts.

e. Detention structures shall not be constructed in the public right-of-way without prior approval from Engineering.

f. Infiltration testing is required for all detention ponds and other surface water management facilities proposed that utilize infiltration.

SECTION 460 - WATER QUALITY

a. The installation of water quality facilities shall conform to WES standards.

b. Water quality structures shall not be constructed in the public right-of-way without prior approval from Engineering.

SECTION 470 - EROSION AND SEDIMENTATION CONTROL

a. Erosion and sedimentation control measures are required for construction areas where the ground surface will be disturbed with clearing, grading, fills, excavations, and other construction activities. Erosion and sediment controls shall conform to WES standards. Design guidelines with respect to plans and implementation of soil loss protection measures can be found in the *Erosion/Sedimentation Control Plans, Technical Guidance Handbook*.

b. NPDES 1200C permits are issued by WES for all of Clackamas County.

CHAPTER 5 - STRUCTURES

All structures not detailed in the Standard Drawings of this document or the *Oregon Standard Drawings* shall be designed by the applicant's Engineer and approved by Engineering.

The project special provisions shall specify the APWA/ODOT requirements for bridges and other structures that apply to the specific project.

All structures, excluding bridges, on private property shall meet the requirements of the International Building Code ("IBC"). All bridges (public and private) and all structures in the public right-of-way will be reviewed per AASHTO requirements as determined by Engineering.

CHAPTER 6 - STREET ILLUMINATION

SECTION 610 - GENERAL

610.1 Streetlights Required Within UGB

Streetlights are required of all development (subdivisions, commercial, industrial, and multifamily residential) within the UGB in Clackamas County by ZDO 1006.02.C if adequate street lighting does not already exist.

610.2 Streetlight Design by PGE

Streetlight design and installation are subject to the approval of Clackamas County Service District No. 5 ("Service District"), working through Engineering, and the utility serving the development, Portland General Electric ("PGE").

610.3 Streetlights are Option A

Streetlights are owned, operated, and maintained by PGE, as Option A and PGE is responsible for the streetlight design.

610.4 Illuminating Engineering Society (IES)

Lighting is generally designed to IES guidelines for the road classification utilizing existing infrastructure (poles, transformers, and circuitry) where available.

610.5 Fixture Approval

The Service District has final approval for all streetlight fixtures for each development.

SECTION 615 - PROCESS FOR OBTAINING APPROVAL FOR STREETLIGHTING

The following process is required in order to obtain Service District approval for street lighting for all new development as required above:

615.1 Approval Process

a. The applicant shall contact the Service District and have the property owner sign a "Request for Street Lighting."

b. The applicant shall also contact PGE and request a streetlight design.

c. The Service District, in turn, places an annual assessment determined by the district rate schedule on the property tax statement of the affected properties for the operation of the street lights.

d. The tax lots in the development will be required to form an assessment area within Clackamas County Service District No. 5 for the purpose of paying for the operation and maintenance of street lights.

e. After a formal hearing process, a special assessment is placed on the tax roll at the District rate determined by the classification of the property and the type of lighting installed.

f. Contact Engineering at 503-742-4400 with any questions or to initiate the street lighting process for a development.

615.2 Construction & Installation

a. In areas where new underground or overhead electricity supply circuitry is required, PGE will coordinate the street light circuitry design with the primary power supply. However, the applicant cannot assume that this will happen automatically, a separate request for street lighting shall still be made.

b. Depending on the circumstances of the installation, the applicant may be required to provide and install at their expense and according to the design approved by the District and PGE:

    1. Pad-vaults for transformers or overhead transformers for street lights,

    2. Splice boxes, and/or

    3. Circuitry conduit with pull line.

c. PGE will provide the transformers and circuitry for street lights but will bill the applicant directly for any costs that may be incurred to install these; these charges may be offset to some extent by PGE line extension allowances.

d. PGE will provide and install the street light poles and luminaries at no charge to the applicant.

615.3 Rates

Rates are subject to change annually. The first assessment is usually in November following the date of installation and the assessment is pro-rated to the date of installation.

CHAPTER 7 - UTILITIES

SECTION 710 - GENERAL

710.1 General Construction and Location Details for Utilities

a. Locating Existing Utilities – All existing utilities shall be located sufficiently ahead of trench excavation to allow for their protection or relocation. Potholing may be necessary to confirm their actual location.

b. Practices and procedures for locating existing utilities shall adhere to all requirements of ORS 757.

710.2 Permitting

a. When attachment to a road structure is involved, (i.e. a bridge or a box culvert), details of the attachment method and specifics of the dead load, support, spacing, size of pipe and attachment method shall be quantified and designed by an Engineer. The attachment shall be designed to be structurally sufficient and compatible with the affected road structure. The design of the attachment shall be approved by Engineering.

b. When the proposed utility involves pressure pipe line, the following additional details are required:

1. Design pressure of pipe;

2. Normal operating pressure;

3. Maximum operating pressure.

c. Construction related noise should be kept to the lowest possible level. Such noise shall be within the hours and decibel level limits established in the County Noise Control Ordinance or other applicable local noise control ordinances.

710.3 Specific Construction Details for Utility Facilities

a. Engineering may require provisions to prevent damage to public property, or to prevent construction from being conducted in a manner hazardous to life or property, or likely to create a nuisance. Such conditions may include, but shall not be limited to:

1. Limitations on the season or time of the year in which the work may be performed;

2. Restrictions as to the size and type of equipment;

3. Designation of routes upon which materials may be transported;

4. The place and manner of disposal of excavated materials;

5. Requirements as to the abatement of dust, the cleaning of streets, the prevention of noise, and other results which are offensive or injurious to the neighborhood, the general public, or any portion thereof;

6. Regulations as to the use of roadways as alternate routes to bypass construction delays in the course of the work;

7. Limitations on the operation to protect the roadway from temperature related damage, i.e., delamination of oil Macadam surfaces or through freeze/thaw cycles;

8. Mitigation of potential subsurface hydrologic flow along the utility or appurtenant trench;

9. Additional asphalt area removal and replacement to ensure the smoothness or ride characteristic present in the former undisturbed asphalt surface. This provision would apply on arterial and collector classified roadways or where the affected roadway surface is newer than five years from the time of the last overlay, without regard to roadway classification.

b. All underground installations shall be buried a minimum of thirty (30) inches below the nearest vertical roadway surface, (i.e., from the bottom of ditch line). Plans must show the distance from the nearest vertical roadway surface to the top of the proposed buried cable, pipe line, or facility.

c. Aerial utilities crossing the roadway shall have a minimum vertical clearance of eighteen (18) feet from the lowest elevation above the nearest roadway surface.

d. All debris which accumulates upon the right-of-way in association with a permitted activity shall be removed immediately upon completion of the activity, and the right-of-way must be restored to its previous condition or better.

e. Direct burial of cable placed by the plowing method shall be limited to areas behind the ditch line. Approval of alternate means is subject to time and schedule restraints to allow for preferable soil moisture conditions, oil Macadam road surface temperatures, and other roadway characteristics. In all cases mechanical comparative efforts shall be applied to the entire disturbed portion of the right-of-way. Restoration of gravel shoulders and drainage ditches and the verification of the function of all drainage structures must be achieved prior to completion.

f. Warning signs for buried power or communications cable, and for pipe lines carrying gas or flammable liquids, shall be placed at each crossing under the roadway, and at intervals along longitudinal installations as required by the current Public Utility Commissioner's Order and as specified by the Road Official as follows:

1. Signs shall be placed as near the right-of-way line as is practical.

2. Notwithstanding subsection (1) above, signs for an installation within the roadway shall be placed behind the existing guardrail.

g. Pedestals installed as part of a buried cable installation are to be located as far from the traveled portion of the roadway as is practical, and preferably one foot from the right-of-way line. All pedestals located within the right-of-way where maintenance operations occur, including routine mowing operations, shall be routinely maintained by the applicant for vegetation control.

h. All material installed within the right-of-way shall be durable, designed for long service life expectancy, and relatively free of routine servicing and maintenance requirements.

i. Soil loss and erosion control measures shall conform to the Clackamas County Department of Water Environment Services "Erosion Prevention and Sediment Control Plans," Technical Guidance Handbook.

j. Placement of any utility within a nonconductive chase or casing shall be accompanied with excavation warning tapes and a location tracer wire placed immediately above the utility.

710.3 Requirements and Specifications for Controlled Density Fill

a. All utility trenches shall be backfilled with CDF when:

1. Utility trenches are within the roadway of Arterial and Collector classified roadways; or

2. The affected roadway surface is newer than 5 years from the time of the last overlay, without regard to roadway classification; or

3. Engineering deems it necessary.

b. Backfill materials meeting the *Oregon Standard Specifications for Construction* may be proposed, reviewed and approved for use when trenches exceed one of the following dimensions:

1. Wider than four feet (trench edge to trench edge); or

2. 100 feet in length or longer; or

3. Greater than 10 feet in depth.

c. Exemption from CDF may be considered if all of the following construction requirements are otherwise met:

1. Backfill materials meeting Class "B" backfill specifications from the *Oregon Standard Specifications for Construction* or its approved equal are used;

2. Not less than 97% relative maximum density (using AASHTO T-99) is achieved;

3. Compaction results are provided by a certified testing lab;

4. Perimeter excavation for manholes is 10'X10' or greater to allow for sufficient mechanical compaction of the backfill;

5. The surety repair time duration is extended an additional two years beyond the three years as specified in the subsequent section "Open Cut of Paved Roadway Surfaces".

d. CDF shall conform to the following specifications:

1. Be excavatable and produce unconfined, compressive, 28-day strengths from 50 psi to a maximum of 150 psi.

2. Contain aggregate no larger than 3/4 inch, and for trenches less than 12 inches in width, the aggregate shall be no larger than 3/8 inch.

3. Slump shall be 6 to 8 inches to insure flowbility and will fill all voids without requiring compaction efforts.

4. The surface of fill shall reach a strength to withstand the process of paving without displacement or disruption within 48 hours, regardless of weather conditions, temperature or moisture content of the soil where placed. Additives such as calcium (1% or 2%), hot water and/or a pozzilith (water reducer) are acceptable means to achieve this set.

5. Copies of the CDF batch weights must be submitted to Engineering.

e. Trenches backfilled with CDF shall be protected in the following manner:

1. Sufficient weight and size steel plating or approved equal materials, capable of carrying a minimum of H-20 loading, shall be present at the work site prior to excavation and placed over the trench to protect the public. Plating shall be positively secured (steel pins or welded lugs) from movement and shall be ramped with cold mix asphalt to provide for all traffic.

2. Plates must extend beyond the trench wall a minimum of one foot on all sides.

3. Lighted barricades with appropriate signage shall be placed sufficiently ahead of, and adjacent to, plating to warn all traffic.

4. All plating and signs are to remain in place until permanent surface repair paving operations are underway.

5. A 24-hour phone number will be provided while plates are in the roadway.

710.4 Open Cuts of Paved Roadway Surfaces

a. A cable, pipeline, or conduit which crosses under the roadway, other roadway connections, or road approaches or driveways, shall either be tunneled, jacked, driven, or placed in a casing bored under the surface for that purpose in accordance with the following provisions:

1. All utility companies serving the work site vicinity shall be contacted to request line locate services.

2. Any utility conflicts shall be resolved before initiation of construction.

3. The applicant will again be required to comply with ORS 757.

4. Should the Applicant/Owner and the owners of the existing utilities determine that exploration and pot holing is necessary, the disturbed roadway must be restored to County specifications.

b. When requested, special permission may be granted and acknowledged on the permit to open cut the roadway. The following provisions shall be adhered to:

1. Immediately after the utility has been placed upon its prepared bedding in the trench and covered to meet the pipe zone specifications, the remaining trench section shall be backfilled with materials approved or specified by Engineering. The backfill material shall be placed and compacted to an elevation compatible with subsequent surface repair. When approved and exempt from use of CDF, the roadway trench shall be backfilled using granular materials conforming to the following:

i. Granular backfill materials in CDF exempt trenches shall meet *Oregon Standard Specifications for Construction*, or its approved equal, from the pipe zone to the bottom of the asphalt concrete surface repair;the Clackamas County Roadway Standards.

ii. Separate, sequential, mechanical compaction efforts on all bedding, pipe zone, and backfill materials shall produce a density in place of not less than 95% relative maximum density (using AASHTO T-99);

iii. Trench backfill materials outside of the ditch line or the curb and sidewalk zone, but in the right-of-way, shall may meet the *Oregon Standard Specifications for Construction* unless otherwise noted in this section or in the permit's special provisions.

2. When trenching across more than one-travel lane of the roadway, no more than one-half (1/2) of the traveled portion is to be opened at any one time. The relevant installation shall be made, then the opened half shall be covered and secured with steel running plates or be completely back filled and compacted before opening the remaining half.

3. No closure of intersecting streets, roadways, driveway approaches or other access points will be permitted without review and approval by the Road Official. Upon trenching, steel running plates or other satisfactory methods shall be used to maintain traffic.

4. No more than two hundred and fifty (250) feet of longitudinal trench along the roadway shall be open at one time and no trench shall be left open overnight.

5. All undermined pavements caused by trench excavation and cave-in, shall be removed immediately during construction.

6. Asphalt roadway surface repairs shall conform to the following specifications:

i. Trenches in paved areas shall provide the typical "T" cut trench repair, not necessarily being centered over the utility;

ii. Asphalt shall be saw cut with neat lines. The cut lines are to be a minimum 1 foot (12") beyond the trench edges to the depth of the first pavement lamination or at a depth sufficient to permit removal of pavement without damage to pavement that is to be left in place;

iii. Removal of the pavement to the neat lines shall be by methods satisfactory to the Road Official; use of a pavement mill (cold plane) and depth of asphalt removal may be prescribed in permit special provisions;

iv. Pavement within the cutting limits, together with all other excavated material, shall be removed and disposed of outside the road right-of-way in proper dump sites;

v. If work results in an irregular trench width, or if incidental damage to the adjacent roadway surface occurs, another sawing and removal of the pavement shall be performed along a line approved by Engineering prior to the placement of the permanent surface repair;

vi. Surface repairs to asphalt pavements shall conform to the *Oregon Standard Specifications for Construction*;

vii. Asphalt joints (seams) shall be sealed with hot liquid asphalt, (i.e. CRS-2 AR 4000 or its approved equal), and choked with sand.

viii. Compacted asphalt concrete shall be a minimum of 4", or be equal to the thickness that was removed or four (4) inches, whichever is greater;

ix. For a period of three (3) years following the initial completion of the installation and the surface repair, the applicant's bond shall remain in full force and effect, ensuring the condition of the roadway surface repairs. If earlier repairs become settled, cracked, broken or otherwise faulty, during this surety repair time duration, Engineering may request that the applicant make subsequent repairs in order to comply with specifications. The applicant shall comply with any such request.

x. The applicant of the permitted utility shall be responsible indefinitely for settlement over the utility and structural failures in the right-of-way that Engineering deems attributable to the installation or occupancy of the utility.

7. Concrete roadway surface repairs shall conform to the following specifications:

i. The entire Portland Cement concrete panel must be removed between the nearest construction joint. If the trench excavation is within two feet of the nearest joint the abutting panel must be removed.

ii. Placement of the bedding material and approved granular backfill must be placed and compacted to 95% compaction.

iii. Replacement of the Portland Cement concrete panel must equal the thickness and design strength of the concrete material removed, or be of a minimum 4,000 pound, 28 day strength design mix, whichever is stronger. The concrete must be placed in conformance with industry standards and protected against freezing. The texture of the concrete surface must be like the adjoining surfaces.

iv. The work area must be signed and protected to detour traffic away from the repair for seven (7) days following the placement of the concrete repair.