

DRAINAGE GUIDELINES FOR LYON COUNTY

June 20, 1996

Revised September 12, 2006

Revised September 20, 2018

These standards have been drafted as minimum design criteria to enable qualified engineers to design improvements, which will be acceptable to Lyon County. Standardized drainage studies are intended to simplify comparison and review and to ensure all projects meet a minimum standard. It is not the County's intent to restrict or in any way limit the use of engineering judgment, as the engineer is ultimately responsible for the design.

The Federal government, through the Federal Emergency Management Agency ("FEMA"), has identified the 100-year storm as the "base flood," which is the basis for their regulation. To remain in the flood insurance program, the County is required to comply with FEMA's criteria. Additional criteria are necessary to ensure that proposed projects adequately mitigate development impacts, provide appropriate levels of improvement, and to establish a baseline for project review.

1. Commercial, industrial and residential development is to be protected from the 100-year event for the fully developed condition and for all contributing drainage areas, based upon current zoning.
 - A. Lowest living level one foot above FEMA's base flood elevation, or as is otherwise acceptable in accordance with FEMA standards.
 - B. One emergency vehicle access (less than 1.0 foot of water at the deepest point in the traveled way) must be available to all new residential developments during the 100-year event.
2. The cumulative effect of all improvements (levees, berms, fill, culverts, etc.) cannot raise the base flood elevation more than one foot. Where improvements increase the base flood elevation more than one foot in localized areas, provisions for containment or easements shall be provided in accordance with FEMA guidelines.
3. For the purpose of these requirements, all areas shall be measured at the downstream end of the project.
4. Riverine conditions and areas with substantial existing channelization.
 - A. Improvements required to convey flows from drainage areas larger than two (2) square miles shall be designed for the 100-year, 24-hour event. At road crossings, culvert capacity shall be adequate to convey the 25-year, 24-hour event. The balance of the flow may be conveyed in an armored dip section.

- B. Improvements required to convey flows from drainage areas larger than 100 acres and less than 2 square miles shall be designed for the 25-year, 24-hour event. At road crossings, culvert capacity shall be adequate to convey the 50-year, 24-hour event without over-topping the road or flooding adjacent structures.
- 5. Alluvial fan areas shall be carefully studied to determine the type and extent of the potential flood hazard. Improvements may be required which will be similar to those outlined above for riverine conditions. Alternative protection schemes may be approved if the design engineer can provide adequate justification for the assumption of shallow flooding over a wide area and assurance that an appropriate conveyance area will be maintained in the future. (See FEMA Regulations, Section 65.13.)
 - 6. On-site storm drain systems serving tributary areas of less than 100 acres shall be designed for 1.5 times the five-year, 24-hour event unless other considerations require the use of a greater event (e.g. Item 9 below).
 - 7. Runoff from the 100-year event must be conveyed within the standard street right-of-way and/or drainage easements acceptable to Lyon County to the point of conveyance. Additional drainage improvements, such as channels, storm drains, etc., must be provided, if necessary, to meet this criteria.
 - A. Street flow velocities shall not exceed eight ft./sec. For the 100-year event.
 - B. Flows from undeveloped off-site areas shall not be conveyed as street flows unless appropriate measures are provided upstream to remove sediment and debris.
 - C. Downslope lots (including corner lots) shall not be permitted unless it can be demonstrated that adequate 100-year flow capacity can be provided to avoid flooding private property.
 - D. Minimum finished floor levels shall be at least 1.5 feet above the highest street centerline elevation adjoining the driveway, or as approved by the County Engineer.

Where street traffic speeds would exceed 35 mph, the following additional criteria shall apply.

The five-year, 24-hour storm must be conveyed within the street while leaving a dry eight-foot drive lane on each side of the crown. Additional drainage improvements, channels, storm drains, etc., must be provided as necessary to meet this criteria.

⁴ Revised 9/12/06

8. The 100-year storm can be conveyed across the street right-of-way with less than six inches of flow over the crown. Additional improvements must be provided if required to meet this criteria. (For flows perpendicular to the street dip-sections, etc.)
9. For storm drain systems that will serve as outlets for sump areas, a design storm frequency of 50 years shall apply. An overland emergency outlet shall be provided with adequate protection to resist 100-year flow velocities. A sump is defined as a low area, which prevents the free passage of water with consequent flooding of private property.
10. Development improvements shall include the detention facilities necessary to ensure that the peak rate of discharge from the 100-year, 24-hour storm is not increased above the peak rate for the undeveloped condition.
11. The detention requirement may be waived if it can be demonstrated to the satisfaction of the County Engineer that the increase in peak runoff will not materially affect downstream property owners.
12. The drainage study submitted with the tentative map shall be sufficient to show conceptually that the proposed improvements are adequate both on-site and off-site and shall include a discussion of any special circumstances or unusual considerations which would necessitate a variance from these standards.
13. A final drainage report shall be submitted with the improvement plans which shall provide all hydrologic and hydraulic calculations necessary to verify that the proposed facilities will be functional for both existing and future developed conditions and shall show that the proposed improvements at least meet the requirements outlined in the drainage guidelines.
14. Development of property shall not adversely affect any natural major drainage facility or natural water course. Natural facilities shall remain in as near a natural state as is practicable, with any modifications proposed, including any erosion mitigating measures, shall be addressed in the drainage report and on the drainage plan. When flows, velocities, headwalls or side slopes, as identified in the drainage report, indicate a hazard to life or limb, fencing shall be provided. Easements shall be provided over all natural drainage courses, which are to remain in the developed area.
15. Drainage studies shall be based upon rainfall data from NOAA ATLAS 14, Latest Edition soils data from the SCS Soils Report for Lyon County shall be used to establish hydrologic soils groupings; runoff curve numbers shall be based upon SCS TR-55 Table 2-2 (AMC 2); lag times shall be based upon TR-55, Figure

3-3. Hydrologic modeling shall utilize HEC-1 or HEC-HMS (balanced storm), TR-55 (type 2 storm) or the Rational Method (areas less than 200 acres only). Design storms shall be 24-hour duration, except for the Rational Method where design storm shall equal time of concentration. HEC-2 or HEC-RAS modeling may also be required for larger drainage areas.

16. Appropriate measures shall be included in all designs to minimize potential maintenance requirements, particularly street cleaning and basin cleaning, after smaller events (5- year).
17. Areas of shallow flooding identified within a proposed development for the purpose of conveying the 100-year event, which are substantially outside of drainage easements, streets, or flood zones identified by FEMA shall be appropriately identified on the final map.
18. Existing surface drainage from adjoining property shall be perpetuated through the development or other means of disposal provided acceptable to the District Engineer.
19. Surface drainage from any developed area shall not cross any property line, except by way of a natural watercourse, major drainage facility, an approved drainage system within a public storm drain easement, or a permanent surface drainage easement.
20. Easements for access to and maintenance of the 100-year storm flood path associated with a major drainage facility or natural water course are to be provided.
21. Major drainage facilities shall include appropriate provisions for access for repair and/or maintenance. Access roads will be required on both sides of all channels. This requirement may be relaxed, at the discretion of the County Engineer, if it can be demonstrated that the facility can be adequately maintained from one side.
22. Subdivision Tentative Map and Improvement Plans shall include construction of these area drainage channels/improvements shown in the County Storm Drain Master Plan within the subdivision boundaries and include pro-rata improvements downstream proportional to the number of proposed homes/businesses versus the number of total homes/businesses in the County full buildout condition. Drainage channels/improvements shall be sized for passage of the 100-year event without flooding or damage to area properties. Total flow of drainage way shall be calculated or the entire contributing drainage basin watershed.
23. In instances where unique situations necessitate the application of storm drainage and flood control designs and systems not provided in this article, the following provisions shall apply:
 - A. Accepted Engineering Practices. Any storm drainage or flood control systems not addressed by these standards shall be designed in accordance with accepted

engineering practices, the Standard Specifications for Public Works Construction, and the Standard Details for Public Works Construction, and shall be subject to the approval of the County Engineer.

B. Alternative Standards. The County Engineer may, at his or her discretion, authorize alternative standards not covered in this article, subject to the following:

- The alternative standards shall be the equivalent of the design requirements as set forth in this code; and
- The alternative standards shall not be used for purposes of mere convenience or economy and the alternative must have equal or better function, quality, and safety.

24. The requirements set forth in this section shall apply to all development subject to this article.

A. The Truckee Meadows Construction Site Best Management Practices (BMP) Handbook, updated February 2015, Sections five (5) through eleven (11) shall be the basis for Storm Water Pollution Prevention Plans (SWPPP), unless it is in conflict with this article, in which case the criteria in this article shall apply. The Nevada Department of Environmental Protection (NDEP) SWPPP requirements shall have priority over other requirements, where applicable.

B. Off-site Stormwater Discharge. Discharge of the 100-year storm waters into a major drainage facility or natural water course shall not contribute to increasing the existing peak flow of storm drainage runoff in the drainage facility or natural water course. A major drainage facility is a channel or drainage way that has a drainage basin of one hundred (100) acres or more.

C. On-Site Facilities. All drainage relating to the proposed development shall be collected on-site by facilities to accommodate, at a minimum, the storm drain waters for 1.5 times the 5-year storm flow, both entering the site and generated on-site or the 100 year storm pre-development vs. post development, whichever is the greater of the two. The drainage shall be piped in accordance with County standards to an existing adequate public storm drain system, major drainage facility, natural water course, or a permanent surface drainage easement capable of conveying the drainage flows.

- Where by reason of terrain or other circumstances the County Engineer determines that piping storm drain waters is inappropriate or unnecessary, alternative methods may be approved in lieu of piping; and
- Easements to access and accommodate storm waters flowing across private property shall be provided for.

D. Natural Water Facilities. Development of property shall not adversely affect any natural drainage facility or natural water course, and shall be subject to the

following provisions:

- Natural facilities shall remain in as near a natural state as is practicable, with any modification proposed, including any erosion mitigating measures, addressed in the Drainage Report and drainage plans.
 - Sediment separation/entrapment proposed shall be addressed in the Drainage Report and drainage plans.
- E. Detention. On-site detention requirements for the 5-year and 100-year storms are as follows:
- For a 5-year storm, detention of the difference in peak runoff between the developed and undeveloped conditions shall be required at 1.5 times the required volume; and
 - For a 100-year storm, detention of the difference in peak runoff between the developed and undeveloped conditions shall be required.
- F. Erosive Soils/Sediment Control. Design of drainage systems in erosive soils may require the following in order to protect against plugging of the drainage system and to minimize maintenance as determined by the County Engineer:
- Construction of sedimentation basins: The design shall calculate the annual sediment yield (in tons and cubic yards) from all on-site and off-site contributing areas. The calculation for sediment yield can be done using the Revised Universal Soil Loss Equation (RUSLE) or other methods acceptable to the County Engineer;
 - Basins shall include additional volume for anticipated sediment accumulation;
 - Access to basins for cleaning shall be provided;
 - Oversizing of storm drain pipes and ditches;
 - Steepening of pipe and channel grades;
 - Use of self-cleaning channel lining; and
 - Rear-yard landscaping.
- G. Wetlands. When the U.S. Army Corps of Engineers (C.O.E.) has determined there are wetlands on a proposed site, a wetlands delineation map approved by the C.O.E. must be submitted to the Department of Community Development and the County Engineer. Any construction proposed in the wetland will require a permit from the C.O.E. with a copy provided to the County Engineer prior to construction.
- H. Waters of the State of Nevada. Any work which requires fill intended to be placed

within the "Waters of the State of Nevada" shall receive permission from the State Division of Environmental Protection prior to beginning construction. The County Engineer shall receive a copy of this permission prior to the issuance of any permit.

- I. Construction within a 100-Year Floodplain and Floodway. Embankments and other structures shall not be placed within a 100-year floodplain, as determined by the most recent hydrologic study acceptable to the County Engineer, or of a major drainage facility without prior approval by the County Engineer. Construction in the Floodway shall not be allowed.
 - J. Discharge Across Property Lines. Surface drainage from any developed area shall not cross any property line except by way of a natural watercourse, major drainage facility, approved drainage system within a public storm drain easement, or permanent surface drainage easement. The manner of discharge shall be approved by the County Engineer and the discharge must produce no significant adverse impacts to the downhill property. Surface flows should cross a property line within historic drainage ways and in a similar manner and quantity (or less) as the predeveloped conditions.
 - K. Extension of Storm Drain Facilities. Storm drain facilities shall be extended from within a development to adjacent undeveloped properties for future extensions in accordance with approved drainage plans.
 - L. Adjoining Property Surface Drainage. Existing surface drainage from adjoining property shall be perpetuated through a development unless other means of disposal acceptable to the County Engineer are used.
 - M. Irrigation Waters. Irrigation waters not controlled by a ditch or utility company and storm drain waters shall be conveyed by separate systems.
25. Other Improvements/Requirements (Public and Private).
- A. Minimum Pipe Diameter. Minimum pipe diameter for any public storm drain shall be fifteen (15) inches.
 - B. Maintenance Access Roads. Access roads in a minimum easement width of twenty (20) feet shall be constructed and recorded, when required by the County Engineer.
 - C. Corrugated Metal Pipe. Corrugated metal pipe is not acceptable for use in County-owned storm drain systems.
 - D. Storm Water Piping. Storm drains to a major drainage facility shall extend, in the direction of flow, at a minimum, to the 100-year flood line and be rip rapped from the outlet to the bottom of the channel. Channel modifications for erosion control shall be designed so that the receiving channel or entering channel will contain the flows without erosion. Channel alignment geometry shall minimize the depositing of storm water sediment.

- E. Overland Flow. Overland flow shall be provided for and channeled to County standards within dedicated easements or public rights-of-way to protect structures from flooding during storms that exceed the 25-year storm, up to and including the 100-year storm.
- F. Piping in County Right-of-Way. The storm drain piping contained within County right-of-way shall be a minimum of Reinforced Concrete Pipe (RCP) Class III or the appropriate class when design requires a higher pipe support strength. Thermoplastic pipe with a minimum pipe stiffness of 46 psi or the appropriate class or stiffness when design requires a higher pipe support strength is allowed when installed and tested in accordance with procedures in the Standards Specifications for Public Works Construction (Orange Book), or as approved by the County Engineer.
- G. Headwalls. Standard headwalls or flared end sections shall be placed on the inlet and outlet of all public pipe and culverts per Standards Specifications for Public Works Construction (Orange Book) and details, or as approved by the County Engineer.
- H. Trash Racks. Trash racks shall be provided at the upper end of all closed public conduits as approved by the County Engineer.
- I. Manholes. Manholes for public improvements shall be located at junction points, at changes in horizontal or vertical alignment exceeding the maximum allowable pipe deflection, at changes in conduit size, and at the end of public lines, unless otherwise approved by the County Engineer.
- When permitted by the County Engineer, pipe placed on curves (horizontal and vertical) shall meet manufacturer's recommendations for curved alignment.
 - All curves, radii, length of pipe joints, and types of pipe shall be shown on the plans.
 - Manholes shall be spaced at intervals not greater than three hundred (300) feet unless otherwise approved by the County Engineer.
- J. Catch Basins. Catch basins are to be designed and located in accordance with the following criteria:
- Catch basins shall be installed at low points, at all major street intersections where appropriate, and at sufficient intervals to intake the peak flow storm runoff, such that flows will not interfere with traffic or flood adjoining property;
 - Laterals from catch basins are to tie into manholes in the direction of the flow (catch basins shall not tie into each other unless otherwise approved by the County Engineer);
- K. Drainage Facilities Crossing Under County Roadways. Drainage structures

crossing under County roadways shall be designed to pass the 100-year storm flow resulting from a fully developed condition within the watershed. A depressed roadway section, or alternative route as approved by the County Engineer, shall be provided in the event stormwater flows overtop the roadway.

- L. Valley Gutters. Reinforced concrete valley gutters for public improvements may be placed at street intersections only when approved by the County Engineer and shall not be placed transverse to collector and arterial streets.
 - M. Floodplains. Embankment shall not be placed within the 100-year flood plain of a major drainage facility without prior approval by the County Engineer. Where such approval is given, the embankment shall be faced with rip rap or an approved lining designed for velocity to a minimum of one (1) foot above the 100- year flood line.
 - N. Sump Conditions. Sump conditions within streets shall require paved overland concrete swales in drainage easements and a storm drain system for conveyance of storm water.
 - O. Lot Drainage Swales. Lot drainage swales on private property shall be provided in accordance with the provisions of this subsection.
 - Surface drainage swales collecting runoff from the area of two (2) or more lots are to be maintained and perpetuated by the property owners and shall include erosion control.
 - Standard lot line drainage swales are to be designed to carry the waters generated by a 100-year storm with a maximum six (6) lots contributing run-off to the swale. Discharge from swales shall be conveyed to a public drainage facility. Should it be necessary to provide for drainage from more than six (6) lots and/or to exceed the maximum horizontal or vertical alignment, a modified design capable of conveying the run-off from the 100-year storm may be submitted for review by the County Engineer.
 - Easement requirements for lot drainage swales shall be established as a note on the official plat which reads: "A five (5) foot private drainage easement shall be located along all side and rear lot lines."
26. Drainage Easements. Easements shall be provided in accordance with the provisions set forth in this section.
- A. Maintenance Access. Drainage easements with improved vehicular access in accordance with County standards shall be provided to publicly and privately owned storm drain manholes, storm drain inlets and outlets, ditches and associated structures not located within an improved street section. The portion of the easement used for vehicular access shall be a minimum of twenty (20) feet or as determined by the County Engineer.
 - B. Easement Widths. Storm drain easements for public and private improvements shall be a minimum width of twenty (20) feet. The easement width shall be

determined by pipe or ditch width, required trench clearance, and excavated trench side slopes not less than one horizontal to one vertical (1:1), and as approved by the County Engineer.

- C. Private Property. Storm drainage easement(s) will be required for storm waters generated within the boundaries of a development that discharge onto or across private property. If the storm drain waters generated within the boundaries of a development discharge from a public drain system onto or across private property, a permanent easement for access and maintenance shall be created from the property boundary to the point of discharge into an existing public storm drain system, major drainage facility, or natural water course. Improvements to County standards shall be required and the County Engineer shall determine if the easement(s) are to be accepted for maintenance.
 - D. 100-Year Floodplain. Easements for access to, and maintenance of, the 100- year storm floodplain associated with a major drainage facility or natural water course shall be provided. Improved vehicular access in accordance with County standards shall be provided when determined necessary by the County Engineer.
27. Water Supply Ditches. Water supply ditches shall be designed in accordance with the conditions set forth in this section.
- A. Public and Private Storm Drainage Runoff. No discharge of runoff from a public or private storm drain into a water supply ditch shall be allowed unless otherwise approved by the ditch or utility company and the County Engineer. Post development sheet flow into a water supply ditch shall not exceed pre-development sheet flow.
 - B. Access. Where water supply ditches are located within or adjacent to a proposed development, access and maintenance of the ditch shall not be hindered.
 - C. Improvements within Easements. Any improvements within the ditch company's easements are subject to the ditch company's approval.
28. Setbacks from Drainage Ways.
- A. The following minimum setbacks for structures shall be maintained from the centerline of drainage ways which are not classified as perennial streams:
 - Fifteen (15) feet from the centerline of incidental drainage ways [drainage area less than one thousand (1,000) acres].
 - Twenty-five (25) feet from the centerline of secondary drainage ways [drainage area one thousand (1,000) to five thousand (5,000) acres].
 - Fifty (50) feet from the centerline of major drainage ways [drainage area greater than five thousand (5,000) acres].
 - B. The setbacks may be modified upon submission and approval of plans for construction of improvements to drainage ways in question. Improvements shall provide capacity within drainage ways for the free unobstructed passage of the

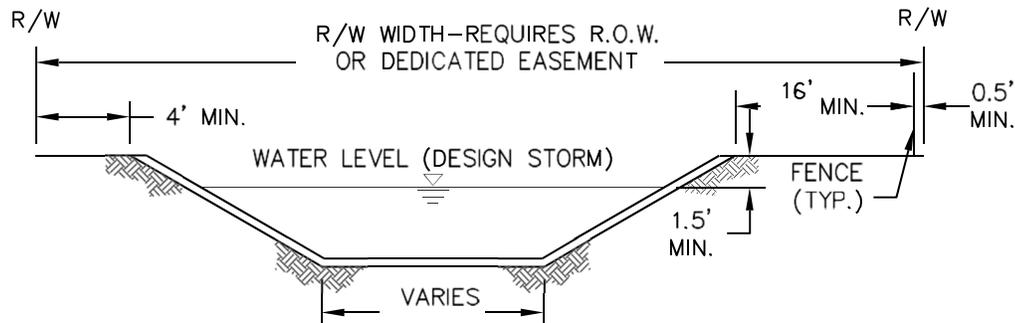
required flood flow quantity as determined by an approved hydrologic/hydraulic analysis.

- C. The County Engineer shall require that any such improvement conform to any master plan of drainage as may be presently or hereafter adopted by Lyon County.
- 29. The County reserves the right to increase these requirements if necessary to protect the public's health, safety and/or welfare.

²Revised 9/12/06

LYON COUNTY DRAINAGE CHANNEL STANDARD

(FOR CHANNELS AND DITCHES WITH TOP WIDTH GREATER THAN 6 FEET)



TYPICAL SECTION

NOTES:

1. DESIGN VELOCITIES LESS THAN 5 FPS: EARTHEN CHANNELS ARE PERMITTED. DESIGN MUST ADDRESS SITE SOILS AND EROSION POTENTIAL FOR THE DESIGN CONDITION. SIDE SLOPES 2:1 OR FLATTER.
2. EARTHEN CHANNELS WITH BOTTOM WIDTHS OF LESS THAN 10 FEET SHALL HAVE SIDE SLOPES OF 3:1 OR FLATTER UNLESS OTHERWISE APPROVED. MINIMUM BOTTOM WIDTH 6 FEET.
3. FOR UNLINED CHANNELS, A "V" CHANNEL IS PREFERRED TO A TRAPEZOIDAL CHANNEL WITH A NARROW BOTTOM WIDTH TO FACILITATE MAINTAINANCE.
4. DESIGN VELOCITIES 5 TO 10 FPS: CHANNEL LINING OF LOOSE ROCK RIPRAP OR OTHER APPROVED MATERIAL SIZED FOR VELOCITY. SIDE SLOPES 2:1 OR FLATTER.
5. DESIGN VELOCITIES GREATER THAN 10 FPS: CHANNEL LINING OF CONCRETE OR AN ENGINEERED EQUIVALENT.
6. ACCESS ROAD SHALL BE CONSTRUCTED AS REQUIRED PER ORDINANCE (14 FOOT MINIMUM WIDTH REQUIRED ON BOTH SIDES UNLESS OTHERWISE APPROVED). TURN AROUNDS SHALL BE PROVIDED FOR NON-CONTINUOUS ACCESS ROADS (30 FT. MIN RADIUS)
7. A MINIMUM 4 FOOT SETBACK SHALL BE PROVIDED AT GRADE ALONG THE TOP OF THE CHANNEL WHERE ACCESS ROAD ARE NOT REQUIRED.
8. THE DEVELOPER SHALL PROVIDE EASEMENTS COVERING THE CHANNEL, ACCESS ROADS, AND SETBACK AREAS PRIOR TO COUNTY ACCEPTANCE OF THE FACILITY.
9. FENCING, GUARD RAILS, DELINEATORS, ETC., SHALL BE PROVIDED AS APPROPRIATE FOR PUBLIC SAFETY.
10. ACCESS ROADS SHALL SUPPORT ALL WEATHER ACCESS. ROAD BASE WILL BE REQUIRED WHERE COMPACTED NATIVE SOILS ARE NOT DEMONSTRATED TO BE ADEQUATE.
11. THE DESIGN ENGINEER SHALL SUBMIT CALCULATIONS SUPPORTING: STABILITY AT DESIGN VELOCITY, SLOPE STABILITY, PROPOSED LINING SECTION, SEDIMENT TRANSPORT, UPLIFT, SUB-DRAINS, APPROPRIATE FREEBOARD, AND ANY OTHER PERTINENT DESIGN CONSIDERATIONS.
12. UNCONTROLLED INFLOWS DOWN THE CHANNEL BANK SHALL NOT BE PERMITTED.
13. CHANNEL ACCESS SHALL BE PROVIDED AS NECESSARY FOR MAINENANCE.

LYON COUNTY POLICY ON SAND-OIL INTERCEPTORS / STORM WATER

Revised September 2018

**INTERCEPTORS OR SIMILAR FACILITIES TO BE LOCATED WITHIN
THE PUBLIC RIGHT-OF-WAY
AND/OR MAINTAINED BY LYON COUNTY**

1. These facilities are very expensive to maintain and should be used only where absolutely needed.
2. These facilities need constant maintenance and must be located for safe and easy access. Suggested locations are along an improved street adjacent to back of walk, in or along cul-de-sacs, etc. Problem areas include locations which will substantially block traffic or require traffic control for maintenance, areas of one-way or poor physical access and areas without all weather access.
3. The system shall be designed in accordance with the manufacturer's recommendations, i.e., five minute holding time, etc., for the design flow (per the drainage ordinance), or shall provide for a bypass to allow storm water discharge even if the interceptor facility is plugged. If the facility is designed with a bypass, the low flow design shall be based on a five-year event.
4. Designs which include interceptors in sumps without an appropriate bypass and overland escape route may not be approved.
5. It is anticipated that a single interceptor used in conjunction with a detention basin will be much more functional and more easily maintained than individual interceptors at each catch basin. Where substantial sediment volume can be expected, provide a larger sump in the catch basin below the discharge pipe, rather than an additional interceptor at each catch basin.

DRAINAGE REPORT REQUIREMENTS

The following information shall be provided for a required Drainage Report.

The Report is required to identify problems and present solutions for engineering documentation. Tabularized data on maps is preferred to lengthy written descriptions, except for unusual items such as detention, HEC items, etc.

- I. Title Page.
 - A. Project name.
 - B. Preparer's name, firm, date.
 - C. Professional Engineer's stamp of preparer and signature.

- II. Introduction.
 - A. Site location.
 - (1) Street location, Assessor's Parcel Number(s).
 - (2) Section reference, longitude and latitude.
 - (3) Adjacent developments.
 - B. Site description.
 - (1) Topography, ground cover, soils, etc.
 - (2) Existing drainage facilities, major drainage facilities, flood hazard areas, irrigation ditches, and other site conditions that must be considered.
 - (3) FEMA zone and description (locate site on FEMA map, if applicable).
 - C. Proposed project description (include proposed phasing).
 - D. Other previous studies relevant to site.

- III. Historic Drainage System (discuss the following).
 - A. Basins.
 - (1) Relationship to major drainage facilities.
 - (2) Major basin drainage characteristics (topography, runoff, cover, use, erosion, etc.).
 - (3) Existing drainage patterns, channelized or overland flow and point of discharge, etc.
 - (4) Historic information, including pertinent rainfall or discharge data.
 - (5) Effect of historic flows on adjacent properties.

- IV. Proposed (Developed) Drainage System (discuss each of the following).
 - A. Criteria used in design.
 - (1) Design storm (to be per Lyon County Drainage Guidelines).
 - (2) Hydrologic method to be used for analysis (Rational, HEC I, TR5520, etc.).
 - (3) Rainfall information used.
 - B. Runoff.
 - (1) Historic storm flow rates and paths.
 - (2) Developed storm flow rates and paths for minor and major storms.
 - C. Summary of proposed improvements.
 - (1) The storm drain system – inlets, piping, channels, outlets, including all downstream improvements (must be shown on drainage plan).

- (2) Verify storm flows from inlets to ultimate outlets of the drainage system (show flows including street-flows for design storm and 100-year on drainage plan).
- D. Detention (1.5 times the 5-year or the pre- vs. post- 100-year storm(s), whichever is greater).
 - (1) Volume required and provided for zero increase in peak flows.
 - (2) Provide for an emergency overflow that will not cause a direct impact to neighboring sites.
 - (3) Engineer to provide detailed description of downstream constraints, and shall include appropriate mitigation measures in the design.
 - (4) The detention basin shall be clearly identified on the plans, and all related improvements required for proper basin operation.
- V. Areas Within Flood Hazard Zone (When Applicable).
 - A. Impacts of the project on current mapping.
 - B. Protection required per FEMA.
 - C. Compliance with Federal Emergency Management Administration requirements and Lyon County flood plain ordinances.
- VI. Conclusions: Discuss Impact of Improvements.
 - A. Benefits.
 - B. Adverse effects with solution to mitigate impact to them.
 - C. Does project meet all appropriate Lyon County standards? If not, provide justification for approval.