MEMORANDUM

TO:	**Readers of May 2005 Edition of San Diego Drainage Design Manual**
FROM:	**County of San Diego Department of Public Works**
Date:	**July 2005**
Subject:	**Changes to San Diego Drainage Design Manual for July 2005 Edition**

The May 2005 edition of the San Diego Drainage Design Manual distributed at the APWA seminars on May 9, 22, and 23 has been revised and updated in response to comments received at those meetings and subsequent correspondence from the public. This memorandum summarizes the revisions made to the May 2005 edition, providing the context of the revision and adding emphasis (underline and/or strike-out) to demarcate the revised material.

Section 3.2.3.1, Page 3-2:

The material type, length of pipe segments, and bevel of joints limit the curvature of the storm drain. Appendix B presents additional information on pipe alignment based on some typical pipe characteristics.

Section 3.3.2, Page 3-8, Paragraph 2:

The pipe diameter is specified as the next standard pipe size larger than the minimum required (D_r). An analogous procedure can be followed for alternative conduit shapes. Figure 3-6 (page 3-24) illustrates the hydraulic properties for circular pipes, assuming that the friction coefficient (Manning roughness coefficient) does not vary with depth.

Section 3.2.9, Page 3-6, Paragraph 1:

There is a wide variety of materials that may be used for construction of a drainage systems, including: reinforced concrete pipe, cast-in-place concrete conduit, corrugated steel pipe, corrugated aluminum pipe, high-density polyethylene, and other materials. The specified material shall be approved by the governing Agency, have a minimum design life of 60 years, and shall meet the design criteria outlined in Appendix B.

Section 5.7.17, Page 5-23, Paragraph 1:

The Federal Highway Administration (FHWA HEC-15, 1988) provides a graphically-based method to design rock riprap-lined channels on steep slopes (i.e., those designed for supercritical flow). This procedure shall also be used for rock riprap lined channels whose depth of flow is equal to or less than d_{50}.

5.7.17.1 Rock Size

Figure 5-12 (page 5-45) provides design curves that simplify riprap design for steep channels by median riprap size (d_{50}) for a given flow, channel slope, and channel width. The design curves were developed for channels with 3H:1V side slopes and bottom widths of 0 feet, 2 feet, 4 feet, and 6 feet. When the channel slope is not provided by one of the design curves, linear interpolation is used to determine the riprap size. This is done by extending a horizontal line at the given flow through the curves with slopes bracketing the design slope. A curve at the design slope is then estimated by visual interpolation. The design median stone size (d_{50}) is chosen at the point that the flow intercepts the estimated design curve. Linear interpolation can also be used to estimate the d_{50} size for bottom widths other than those supplied in the figures. For practical engineering purposes, the d_{50} size specified for the design shall be translated into standard riprap gradation.

[Note: Office of Surface Mining reference in May 2005 Edition does contain steep-slope riprap nomographs, but the charts developed for the OSM designate 2H:1V sideslopes and different base widths.]

Section 5.11.5, Page 5-36, Paragraph 2:

Sediment routing analysis using a sediment routing model is the best method for estimating the general degradation and aggradation of a stream on a reach-by-reach basis. Examples of sediment routing computer models include the U.S. Army Corps of Engineers' *HEC-6 Scour and Deposition in Rivers and Reservoirs*, and proprietary models such as *QUASED* by Simons, Li & Associates; *FLUVIAL-12* by Howard Chang; *MIKE-21C* by the Danish Hydraulic Institute; and *ONETWOD* by Y. H. Chen (FERC, 1992). However, less elaborate methods using rigid bed hydraulic and sediment transport calculations may be used to estimate the relative balance between sediment transport capacity and sediment supply between adjacent reaches. The design engineer shall determine the level of sediment transport analysis required for a particular alluvial channel design project in consultation with the governing Agency.

Section 5.12, Page 5-37, Paragraph 3:

Channel grade control and drop structures may be constructed of many types of materials, including concrete, riprap, grouted riprap, gabions, sheet piles, or other materials. The selection of material and type of grade control depends in part on their hydraulic limitations (see Table 5-10 for typical hydraulic limitations), aesthetic considerations, and other site conditions such as presence of abrasive sediment bed load. This Section presents minimum design criteria and charts to aid in the design of sloping grouted boulder grade control structure. Section 5.13 provides several references for channel drop and energy dissipation design with the detailed information available on other types of structures.

Table 5-10, Page 5-38:

Table 5-10 Channel Drop Structures

Description	Upstream Flow Regime	Max. Drop Height	Max. Unit Discharge	Max. Inflow Velocity	Upstream Cross-Section
		(ft)	(cfs/ft)	(ft/s)	
Sloping Riprap Drop Structure	Subcritical	10	35	7	Trapezoidal
Vertical Riprap Drop Structure	Subcritical	3	35	7	Trapezoidal
Straight Drop Structure	Subcritical	8	n/a	n/a	Rectangular
USBR Type IX Baffled Apron	Subcritical	N/a	60	n/a	Rectangular

Section 5.12.1.4, Paragraph 1, Page 5-39:

Drop structure shall include appropriate structural analysis and analysis of geotechnical factors such as seepage. Weep drains ~~are needed~~ should be considered for seepage and uplift control. Figure ~~(Section C-C) illustrates weep drains for grouted sloping boulder drop structures. This type of system is appropriate for smaller drops and other locations where space is limited.~~ A continuous manifold is preferred over a "point" system for weep drainage of a drop structure, as it provides more complete interception of subsurface drainage. Weep systems requires special attention during construction. The boulders can crush the pipes and alignment of the pipes between the boulders can be difficult. Flexible outlet pipes shall be used to allow alignment of the pipes around the boulders when necessary.

Section 5.13, Page 5-41:

Add or Revise:

Chang, Howard. (1992). Fluvial Processes in River Engineering. Reprint ed. Krieger Publishing: Malabar, Florida.

U.S. Army Corps of Engineers. (1991). *HEC-2 Water Surface Profiles. User Manual*, Version 4.6.2, May 1991

U.S. Army Corps of Engineers. (2005). *HEC-RAS River Analysis System. User Manual*, Version 3.1.3, May 2005.

Delete:

~~U.S. Army Corps of Engineers. (July 1991). *Hydraulic Design of Flood Control Channels.* EM 1110-2-1601.~~

Table 5-13, Page 5-43:

Material or Lining	**Maximum Permissible Average Velocity* (ft/sec)**
. . .	
Grouted Riprap	25.0
. . .	

** Maximum permissible velocity listed here is basic guideline; higher design velocities may be used, provided appropriate technical documentation from manufacturer.*

Figure 5-11:

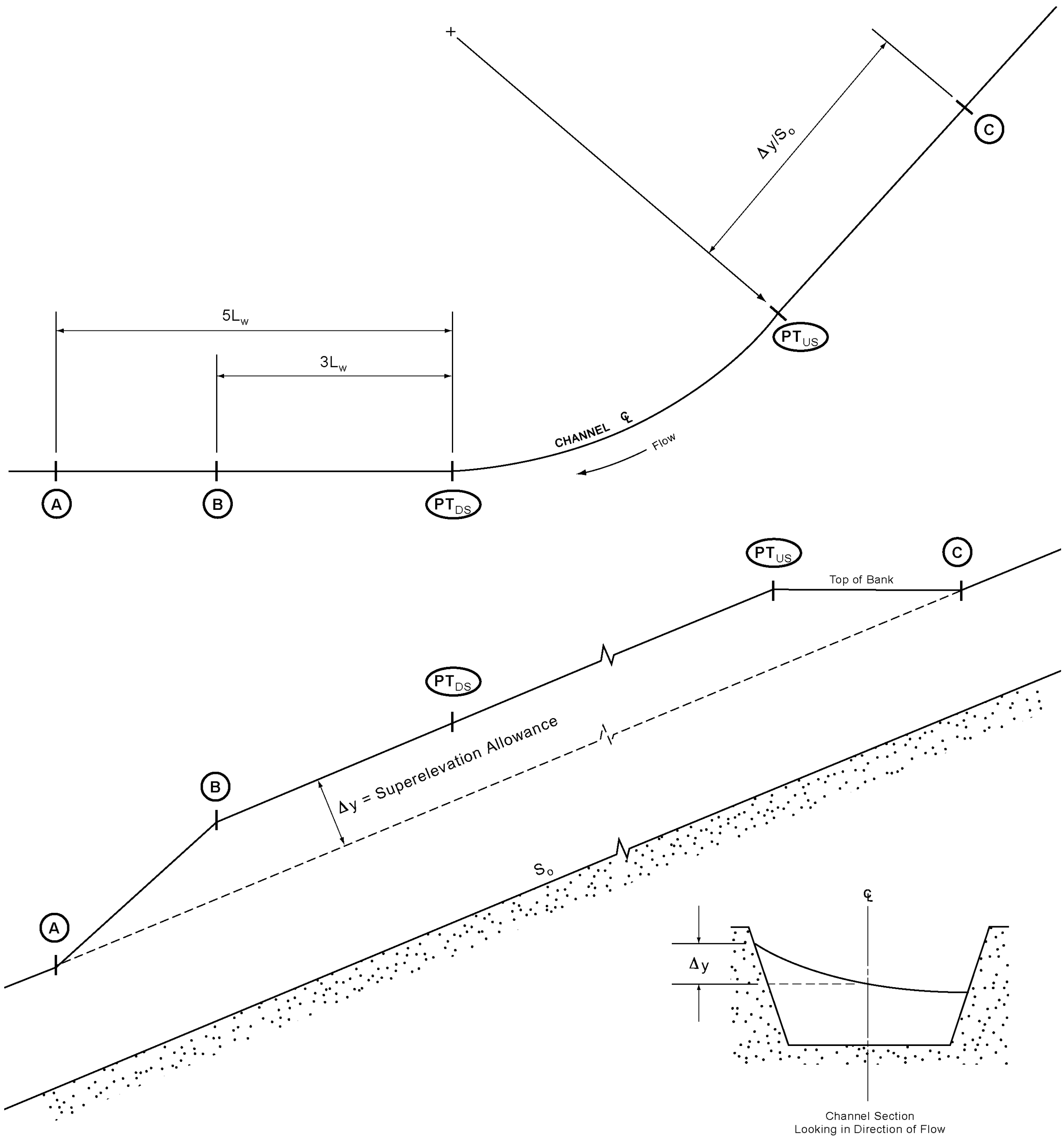
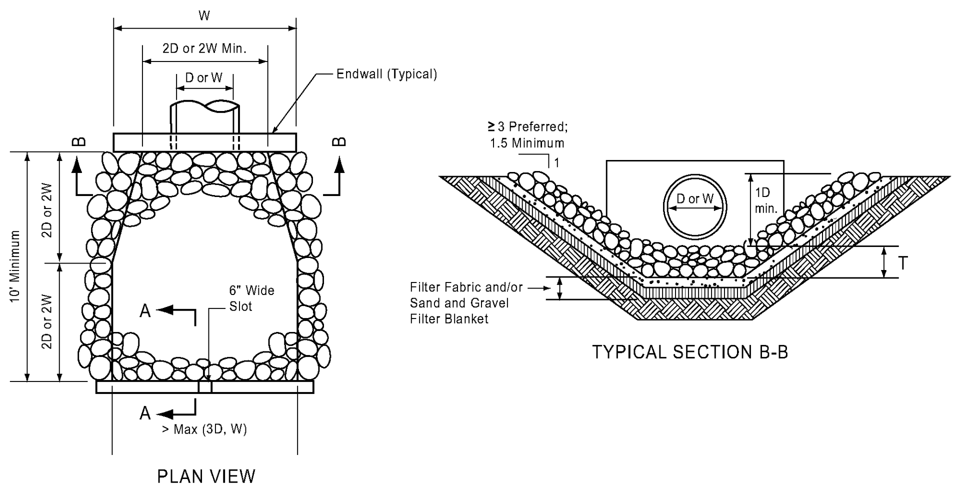

Δy/So
C
5Lw
3Lw
PTUS
CHANNEL ℄
Flow
A
B
PTDS
PTUS
C
Top of Bank
PTDS
B
Δy = Superelevation Allowance
So
A
℄
Δy
Channel Section
Looking in Direction of Flow

Figure 5-19, Page 5-53:

Note Added: "for Illustration Only"

Figure 7-1, Page 7-3:

Revised:



Section 7.3.4, Page 7-3:

Design standards for the impact basin depicted on San Diego Regional Standard Drawing No. D-41 are based on the USBR Type VI Basin. The original USBR basin has been modified to allow drainage of the basin during dry periods, which enhances the usefulness of the basin in urban environments. The width of D-41 is based on discharge from the storm drain or culvert; this width must be specified on drawings.

Figure 7-2 (FHWA HEC-14, 1983) provides a nomograph that may be used to estimate the energy loss through an impact basin. This energy loss can then be used to estimate the flow velocity exiting the impact basin. The energy loss through the impact basin is a function of the Froude Number of the flow entering the impact basin, calculated in this case as:

$$FR = v_O \Big/ \sqrt{g y_e} \qquad (7\text{-}2)$$

$$y_e = \sqrt{A/2} \qquad (7\text{-}3)$$

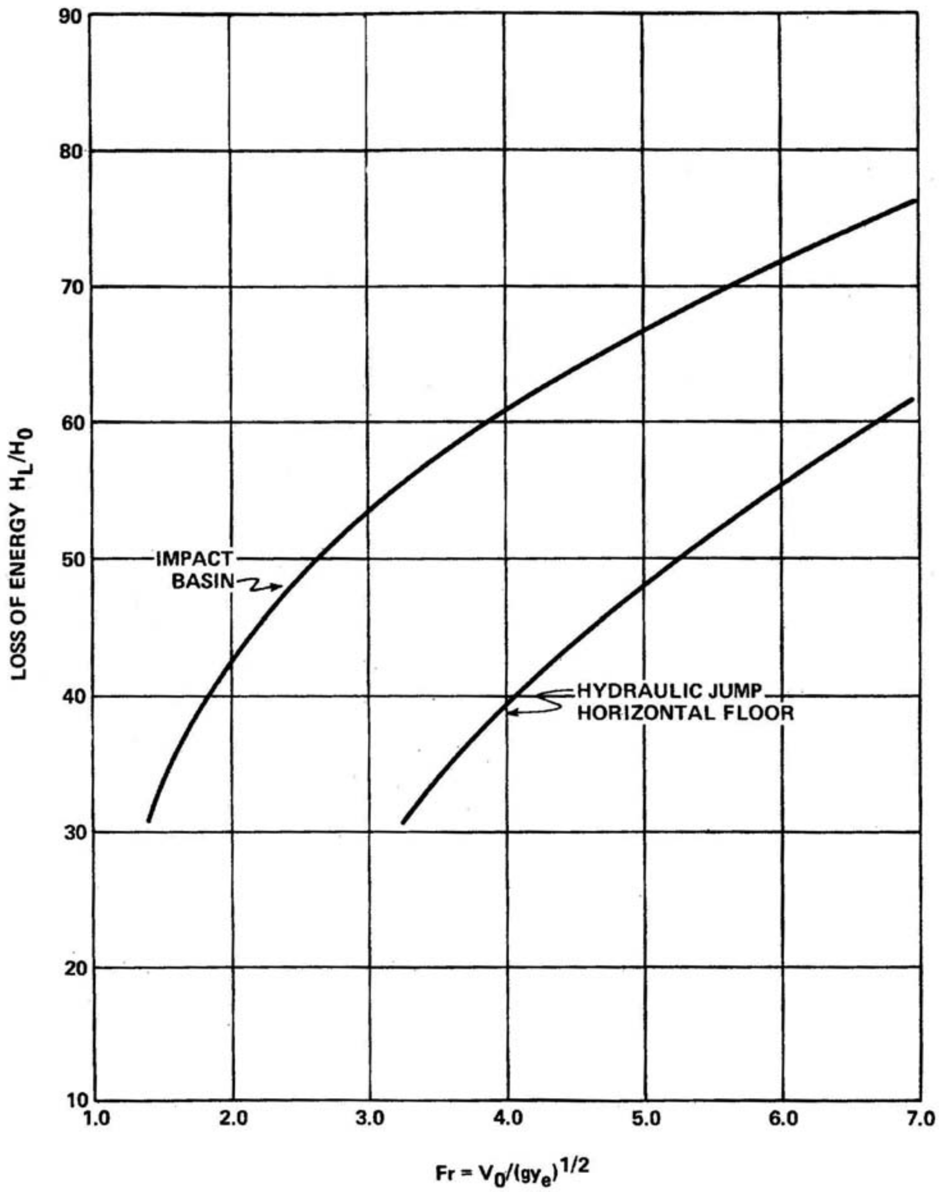
$$H_O = y_e + \frac{v_O^2}{2g} \qquad (7\text{-}4)$$

where …

F_R	=	Froude Number of flow entering the impact basin;
v_O	=	velocity of flow entering the dissipater (ft/s);
g	=	gravitational acceleration (32.2 ft/s^2); and
y_e	=	equivalent depth of flow entering the dissipator, (ft)
A	=	area of flow entering the dissipater (ft^2); and
H_O	=	kinetic energy of flow entering the dissipater (ft).

Information on the original hydraulic design reference can be found in the *Hydraulic Design of Stilling Basins for Pipe or Channel Outlets* (Peterka, 1984). The designer is encouraged to use the design guidelines contained within the Regional Standard Drawings.

NEW Figure 7.2: Impact Basin Energy Loss Nomograph



NEW Section B.2, APPENDIX B:

B.2 CAST IN PLACE CONCRETE PIPE (CIPP)

Cast in place concrete pipe construction shall conform to San Diego Standard Specifications ACI Standard 346-70, Standard Specifications for non-reinforced concrete pipe and Section 63 Caltrans Standard Specifications modified as follows:

1. The County of San Diego shall provide continuous field inspection on this project, or as otherwise required.
2. A soils engineer certificate shall be submitted certifying that the trench walls are able to stand vertically for the required heights and that the water tables in the trenches are below the bottom of the trench or the trench can be dewatered to allow construction, and the water table maximum elevation is enough to preclude future damage to the C.I.P.P.
3. For pipes with slopes less the 1%, the following provisions shall apply:
    a. Grade and Alignment Tolerance

       Departure from and return to established grade shall not exceed 3/8” plus or minus, per ten (10) lineal feet, and the maximum departure limited to ¾” from the theoretical flow line. In no event shall this variation result in ponding in excess of 3/8” deep.

    b. Conformity to Tolerances

       In order to conform to the preceding established flow line tolerances, the Contractor shall be permitted, but not limited to, exercising the following methods of construction; however, the County of San Diego shall have the option of requiring that any or all of these methods of construction be followed:

       (i.) Use of laser-directed digging bucket during trench excavation.

       (ii.) Use of Patented Canadas-Coulson “Trench Plane” to adjust final trench grade.

       (iii.) Use of non-reinforced concrete grade rail to guide the pipe machine during placement of concrete in the pipe.

       (iv.) Use of water within the pipe to check the flow line for variations in grade.

    c. General Provisions

       The Contractor, at his sole option, may elect to use, but is not to be limited to any or all of the following methods to restore, or correct flow line to specified tolerances:

       (i.) Troweling, floating, screeding, and adding or removing concrete while in a plastic state.

       (ii.) Removal of concrete to bring high points to flow line grade shall be permitted.

[Note: Subsequent sections are re-numbered to accommodate new section.]

APPENDIX C

Appendix C has been revised and expanded with new pagination, to clarify the different types of culvert nomographs included.

Workbook Example WB-6:

Determine Riprap Size

Based on Table 7-1, for a flow velocity of 10.5 fps:

Median Stone Diameter: d_{50} = 1.8 ft (¼-ton Riprap)

Determine Length of Riprap Apron

Once the riprap size is determined, the apron length can be determined using Equation 7-1:

$$L_a = 4 * D_O = 4 * 1.5 = 6.0 ft$$

An apron length of 6.0 feet is shorter than the minimum length defined by regional standard drawings. Therefore, specify the minimum apron length of 10 feet.

Determine Thickness of Riprap Apron

Per the standard drawing and Section 7.3.1 of the Manual, the minimum riprap apron thickness is 1.5 times the median stone diameter d_{50}.

$$T_{\min} = 1.5 d_{50} = 1.5 * 1.8 = 2.7 ft$$

Flow velocities exiting the riprap apron must be checked to ensure that they are not erosive downstream.