Stormwater Management & Infrastructure Design

Presented by:

Erin Storey, P.E. & Stephen Nichols, P.E.

Transportation & Public Works Department

Stormwater Management & Development Services Division

November 14, 2018

Agenda

- Intro
- Announcements, Reminders, & Process
- Design Standards, Common Errors, & Examples

Announcements & Reminders

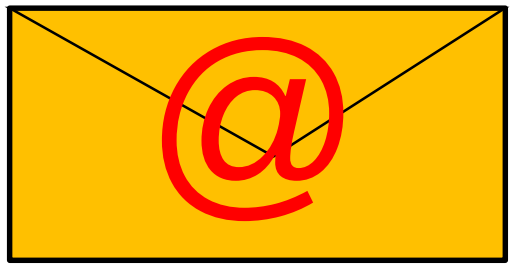
- SWFMA Fee
- Submission of Floodplain Development Permits
- Final SWMP submitted 7 days before IPRC Pre-sub
- TRWD and Water Quality
- Moving FDP & SWMP to Accela in 2019
- Stormwater Criteria Manual – Update in 2019
- NOAA Atlas

SWFMA Fee

- $635 paid at time of hard copy submission
- SDS continues to provide review of electronic exhibits during SWMP review
- A procedure and guide is available at: https://projectpoint.buzzsaw.com/fortworthgov/SDS/3%20-%20Resources_Public/Stormwater%20Facilities%20Maintenance%20Agreement%20%28SWFMA%29/Stormwater%20Facility%20Maintenance%20Agreement%20Procedure.pdf?public
- Questions? Email us at SWFMA@fortworthtexas.gov

Original Submission Process

SWMP submissions



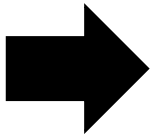
Digital documents to SDS via email or upload.

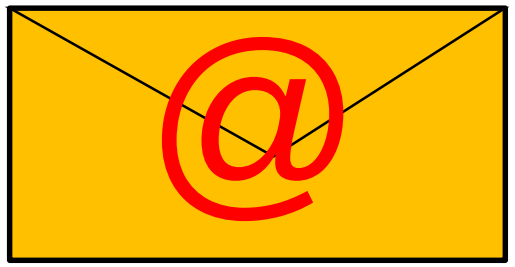
FDP submissions

Hard copy documents hand delivered to staff

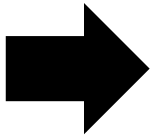
New Submission Process (effective 8/20)

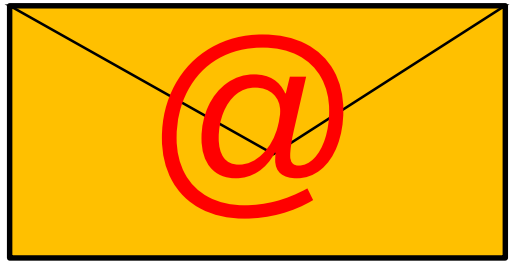
SWMP submissions





FDP initial submissions

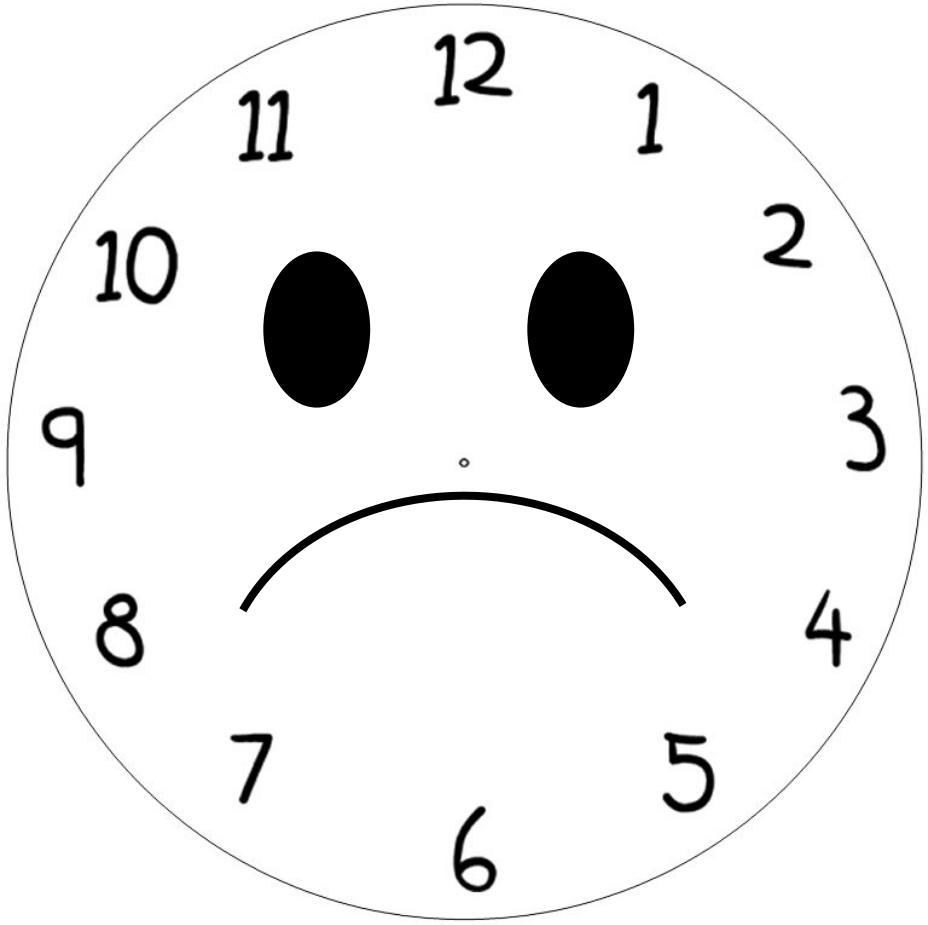




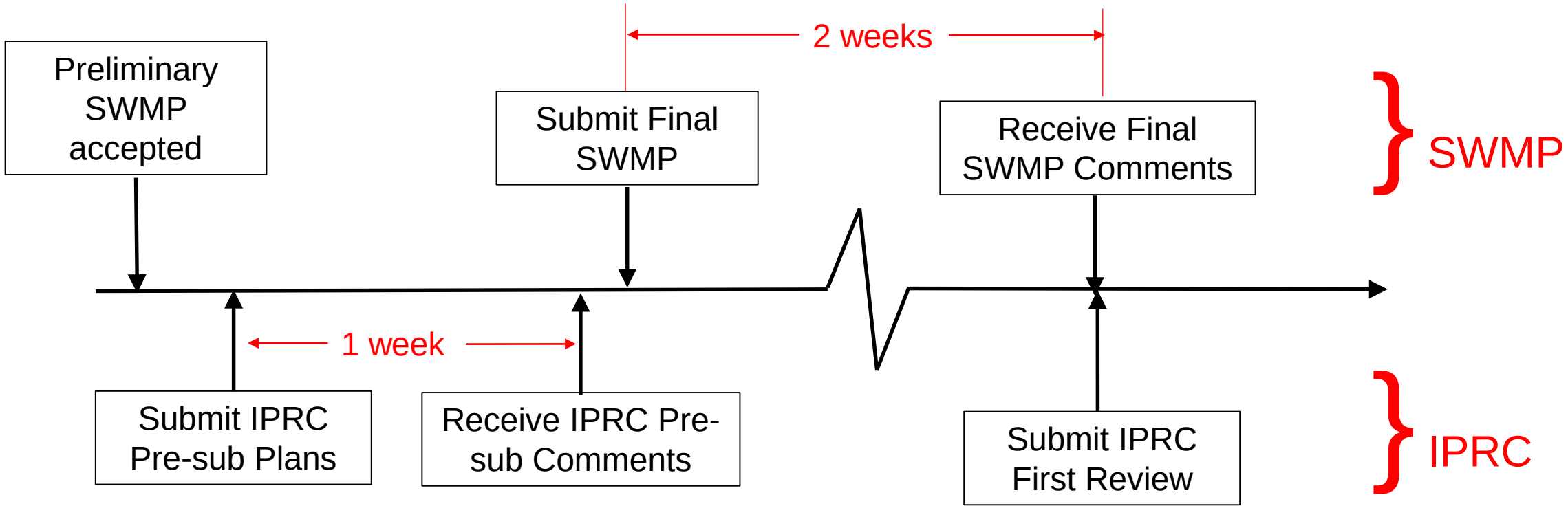
Digital documents to SDS via email or upload. *

* Final hard copy report for record filing or for outside agency review.

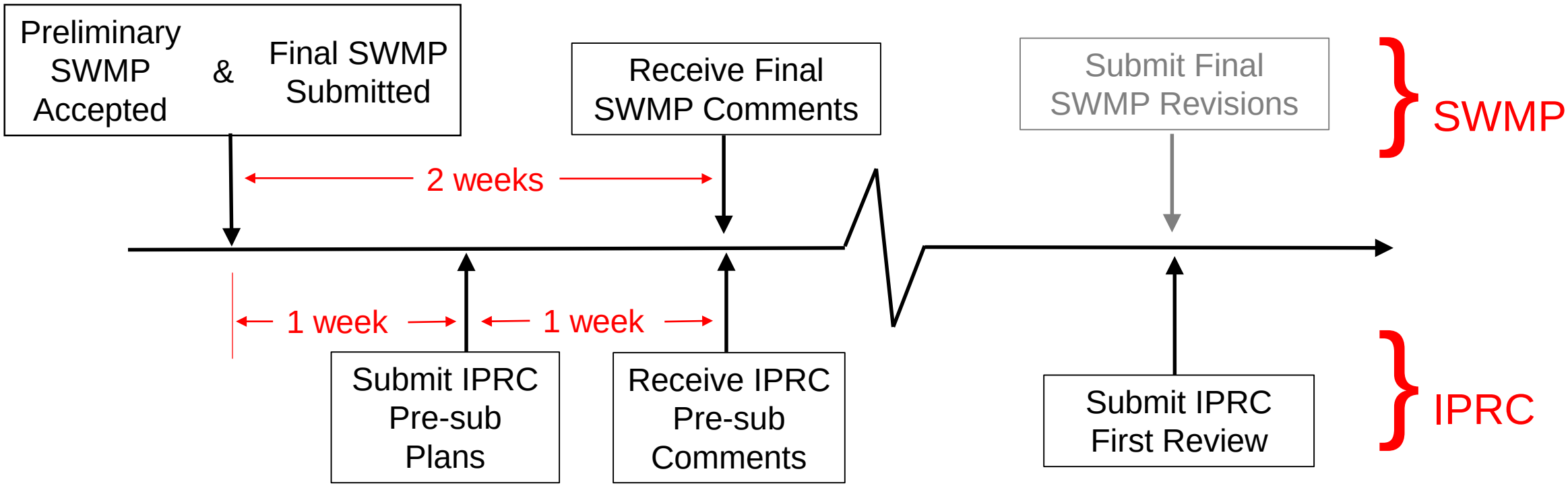
SDS@fortworthtexas.gov


12
1
2
3
4
5
6
7
8
9
10
11

Original Process / Timeline



New Process / Timeline



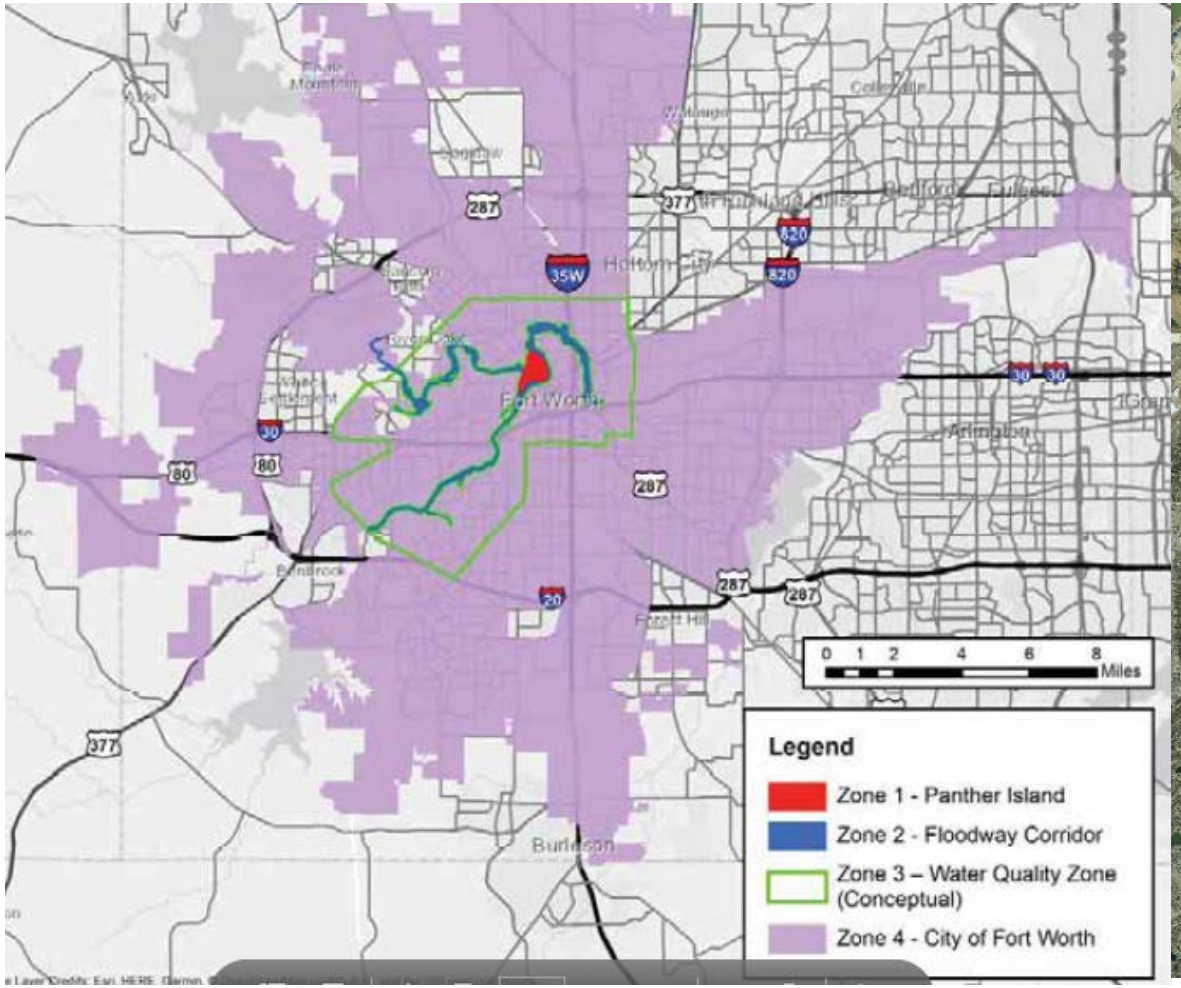
SWMP & IPRC Process Links

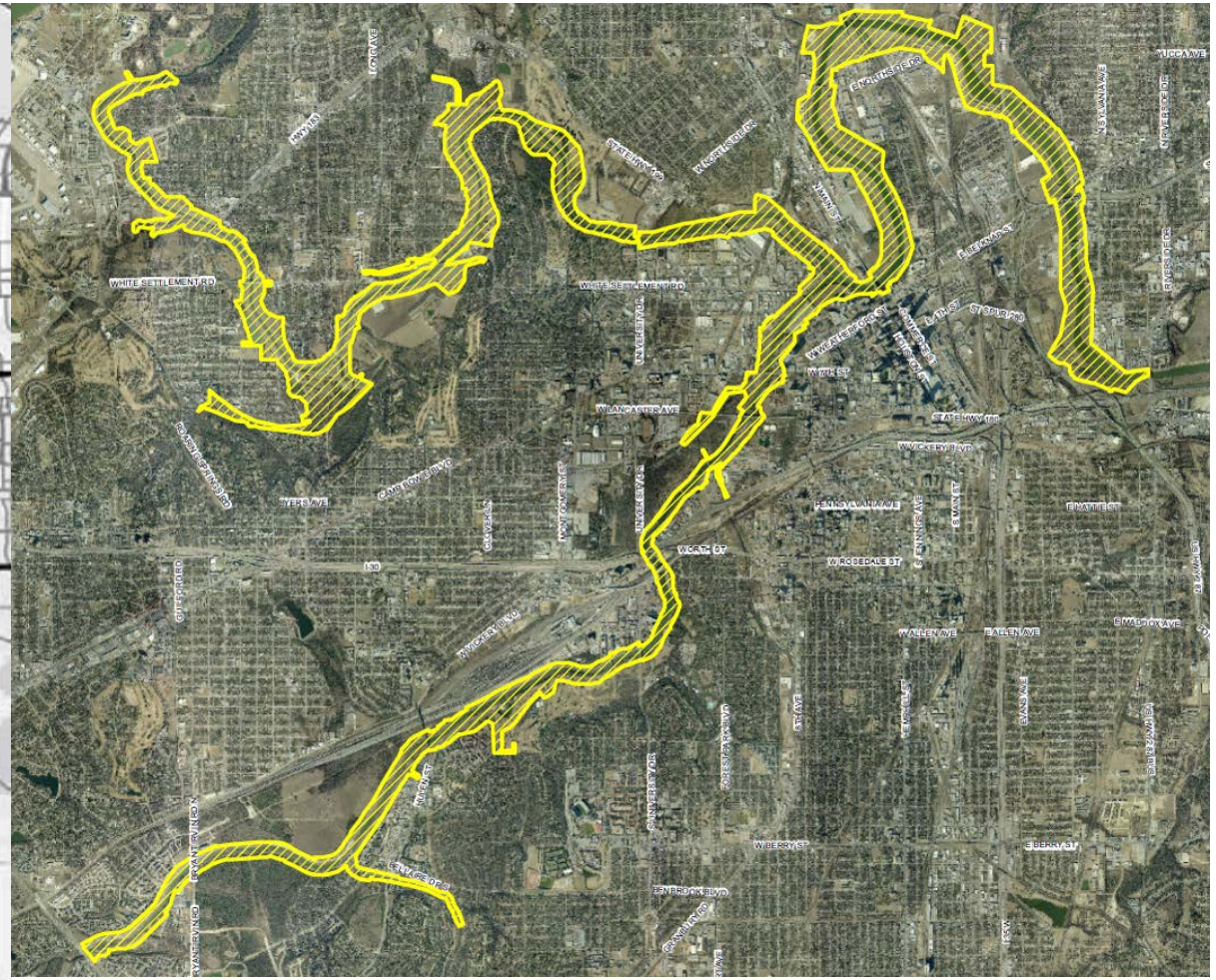
- Preliminary & Final SWMP – IPRC Pre-sub
- Final SWMP acceptance - Pre-con

- What is the difference between Final SWMP and IPRC review – keep infrastructure review in IPRC

Tarrant Regional Water District (TRWD)

- Newly published Water Quality guidelines: http://www.trwd.com/water-supply/environmental/environmental-stewardship/water-quality/stormwater/
- Green infrastructure, not grey infrastructure
- Success requires early site planning for green infrastructure
- Contacts:
  - Brenton Dunn Brenton.Dunn@trwd.com (primary contact)
  - Woody Frossard Woody.Frossard@trinityrivervision.org


0 1 2 4 6 8
Miles
Legend
Zone 1 - Panther Island
Zone 2 - Floodway Corridor
Zone 3 – Water Quality Zone (Conceptual)
Zone 4 - City of Fort Worth

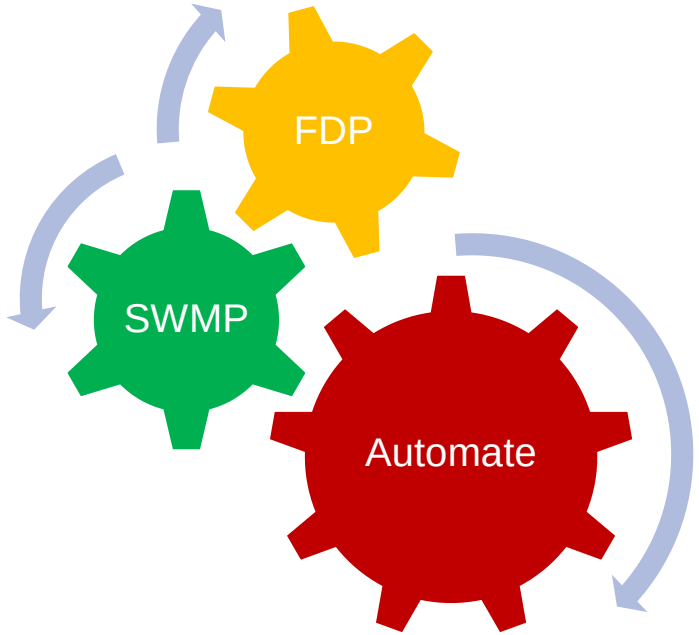


General Process: Water Quality Review

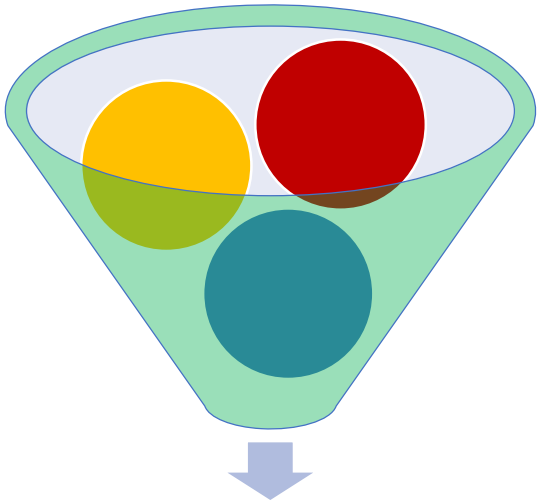
- Submit conceptual green infrastructure plan for review
- Work with TRWD to reach consensus on concept plan
- Submit detailed design calculations signed and sealed by PE
- Work with TRWD to reach approval of design
- After permit is issued and construction is completed, submit a report signed and sealed by PE confirming that construction complied with design.

SDS & Accela

- Building on success of IPRC transition to Accela
- Transition FDP, SWMP, & Flood Study to Accela



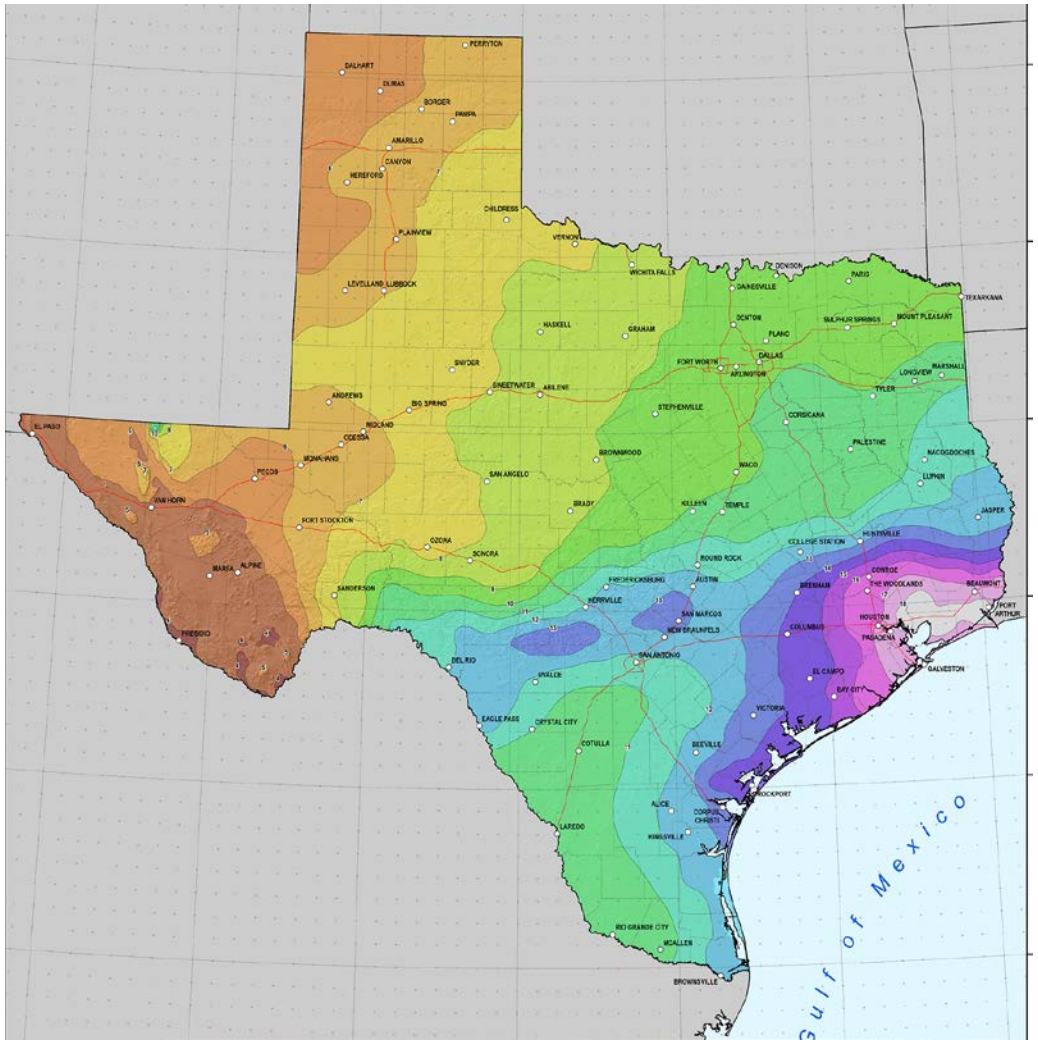
Stormwater Criteria Manual



- Update planned for 2019
- Refinements & clarifications

- Contact:
  - Clair Davis Clair.Davis@fortworthtexas.gov
  - Stephen Nichols Stephen.Nichols@fortworthtexas.gov

NOAA Atlas 14



Available at:
https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=tx

iSWM Review Comment Assessment

- Purpose
  - Evaluated reviews to identify source or reason for review iterations and identify opportunity for program refinement
  - Reduce time and effort for development community (and city)
- Assessment performed by two firms – JGR & PK
- Sample of 20 project reviews with 3 or more iterations
- Mix of preliminary and final iSWM plans, construction plans
- 14 categories of comments

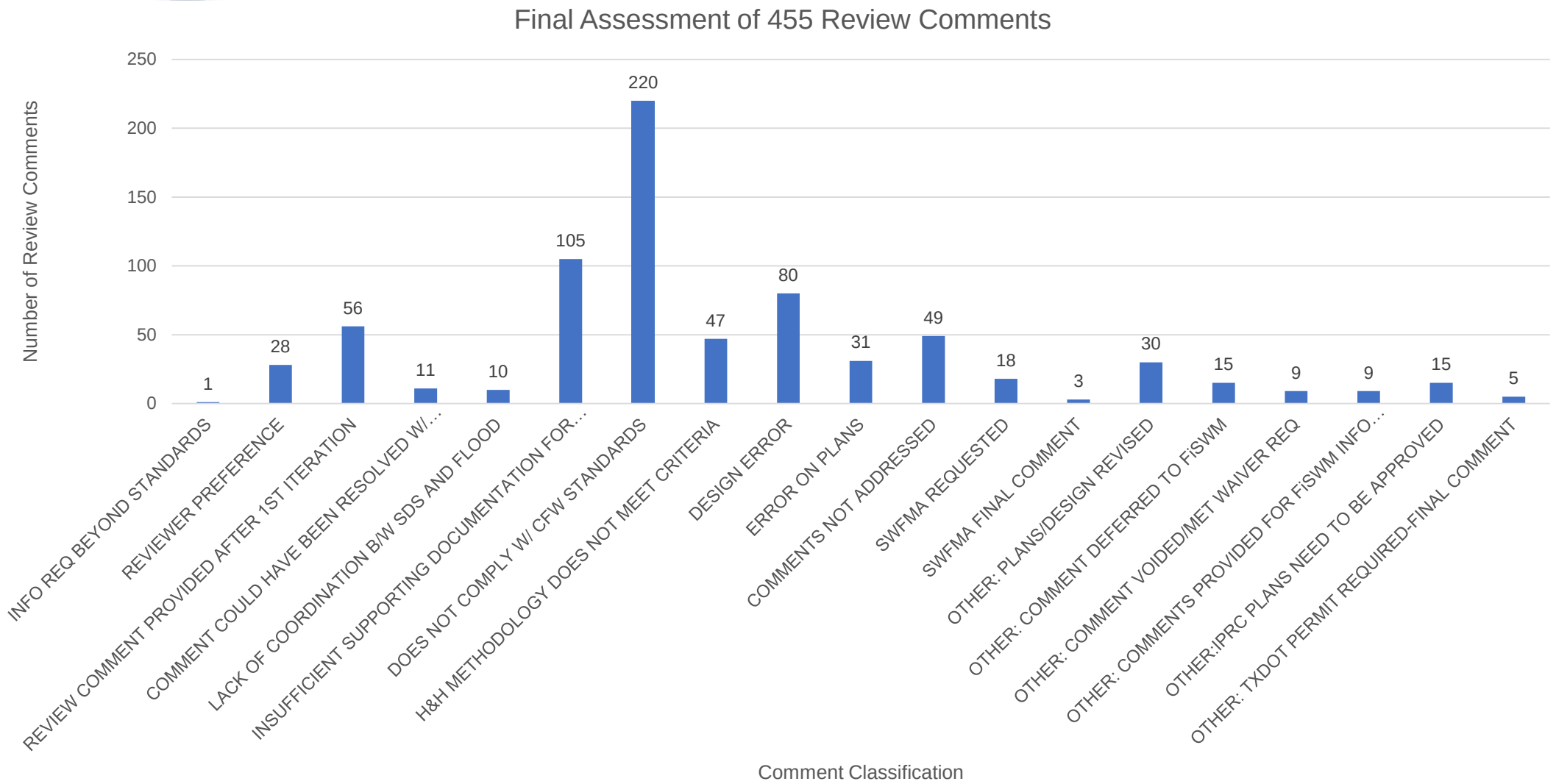
14 Firms Represented in Sample of 20 Projects

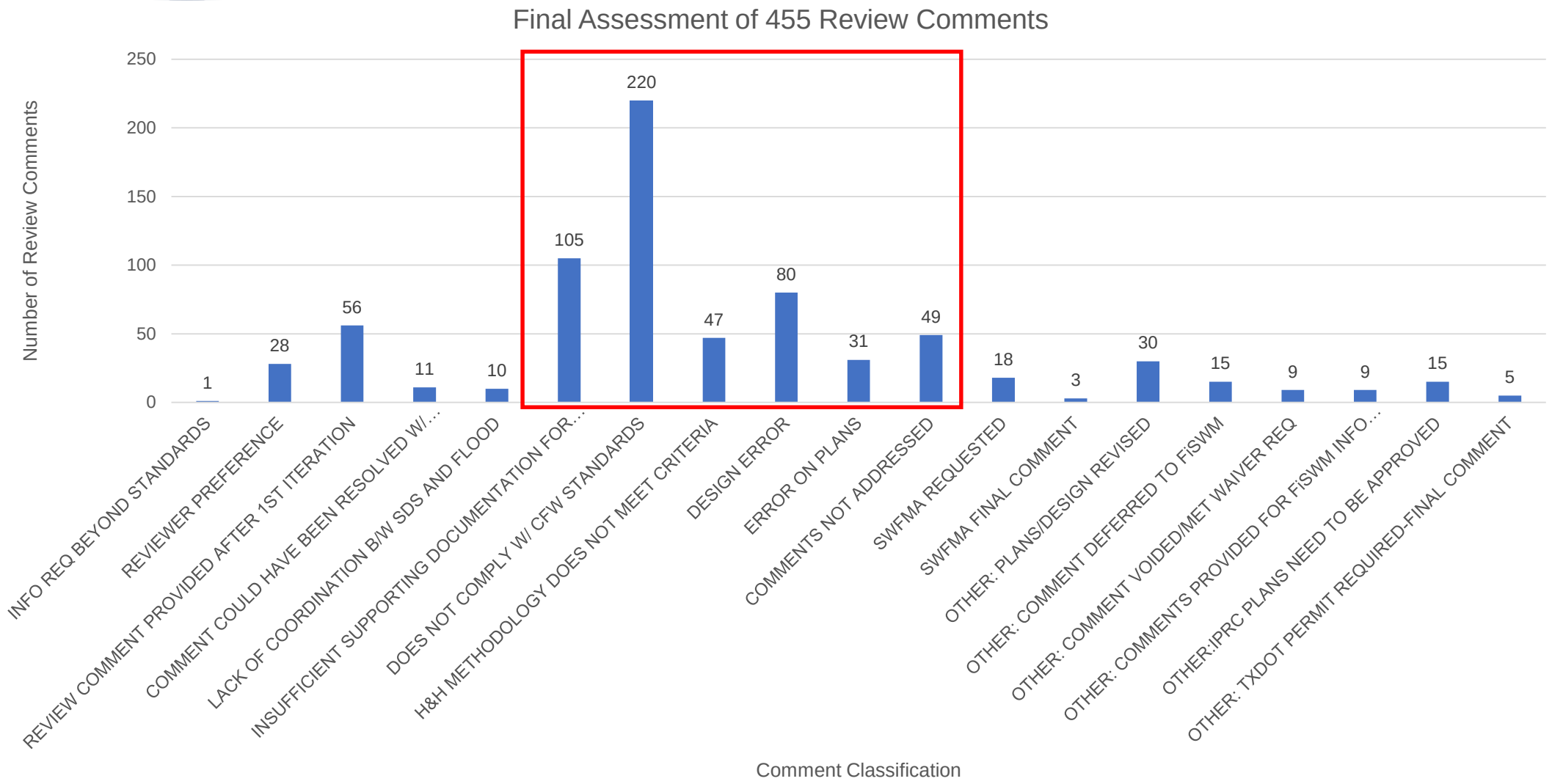
- Frequent customers – 9
- Occasional customers – 3
- One time customers – 2

Summary of Findings

Total of project samples affected by:

- Previous comments were not being addressed (100%)
- Submittals were missing data that was required in order to perform a review (94%)
- Submittals did not follow CFW criteria or show sufficient information to demonstrate compliance (59%)
- Design error/error on plans (59%)


Final Assessment of 455 Review Comments
Number of Review Comments
250
200
150
100
50
0
1
28
56
11
10
105
220
47
80
31
49
18
3
30
15
9
9
15
5
INFO REQ BEYOND STANDARDS
REVIEWER PREFERENCE
REVIEW COMMENT PROVIDED AFTER 1ST ITERATION
COMMENT COULD HAVE BEEN RESOLVED W/…
LACK OF COORDINATION B/W SDS AND FLOOD
INSUFFICIENT SUPPORTING DOCUMENTATION FOR…
DOES NOT COMPLY W/ CFW STANDARDS
H&H METHODOLOGY DOES NOT MEET CRITERIA
DESIGN ERROR
ERROR ON PLANS
COMMENTS NOT ADDRESSED
SWFMA REQUESTED
SWFMA FINAL COMMENT
OTHER: PLANS/DESIGN REVISED
OTHER: COMMENT DEFERRED TO FiSWM
OTHER: COMMENT VOIDED/MET WAIVER REQ
OTHER: COMMENTS PROVIDED FOR FiSWM INFO…
OTHER:IPRC PLANS NEED TO BE APPROVED
OTHER: TXDOT PERMIT REQUIRED-FINAL COMMENT
Comment Classification


Final Assessment of 455 Review Comments
Number of Review Comments
250
200
150
100
50
0
1
28
56
11
10
105
220
47
80
31
49
18
3
30
15
9
9
15
5
INFO REQ BEYOND STANDARDS
REVIEWER PREFERENCE
REVIEW COMMENT PROVIDED AFTER 1ST ITERATION
COMMENT COULD HAVE BEEN RESOLVED W/…
LACK OF COORDINATION B/W SDS AND FLOOD
INSUFFICIENT SUPPORTING DOCUMENTATION FOR…
DOES NOT COMPLY W/ CFW STANDARDS
H&H METHODOLOGY DOES NOT MEET CRITERIA
DESIGN ERROR
ERROR ON PLANS
COMMENTS NOT ADDRESSED
SWFMA REQUESTED
SWFMA FINAL COMMENT
OTHER: PLANS/DESIGN REVISED
OTHER: COMMENT DEFERRED TO FiSWM
OTHER: COMMENT VOIDED/MET WAIVER REQ
OTHER: COMMENTS PROVIDED FOR FiSWM INFO…
OTHER:IPRC PLANS NEED TO BE APPROVED
OTHER: TXDOT PERMIT REQUIRED-FINAL COMMENT
Comment Classification

Summary of Findings (cont.)

- Does not comply with CFW standards (220)
- Insufficient supporting documentation for review (105)
- Design error - conflicting information (80)
- Review comment provided after 1st iteration (56)
- Comments not addressed (49)
- H&H methodology does not meet criteria (47)
- Reviewer Preference (28)

Design Standards & Common Errors

- Manhole Locations
- Lateral Slopes
- Lateral Connections & Inlets
- SFR Lot Grading
- Erosion Protection at Outfalls & Sediment Control
- Convey Runoff to Receiving Flowline
- Parallel RCP and Box Culverts
- CFW Standard Data Tabulations

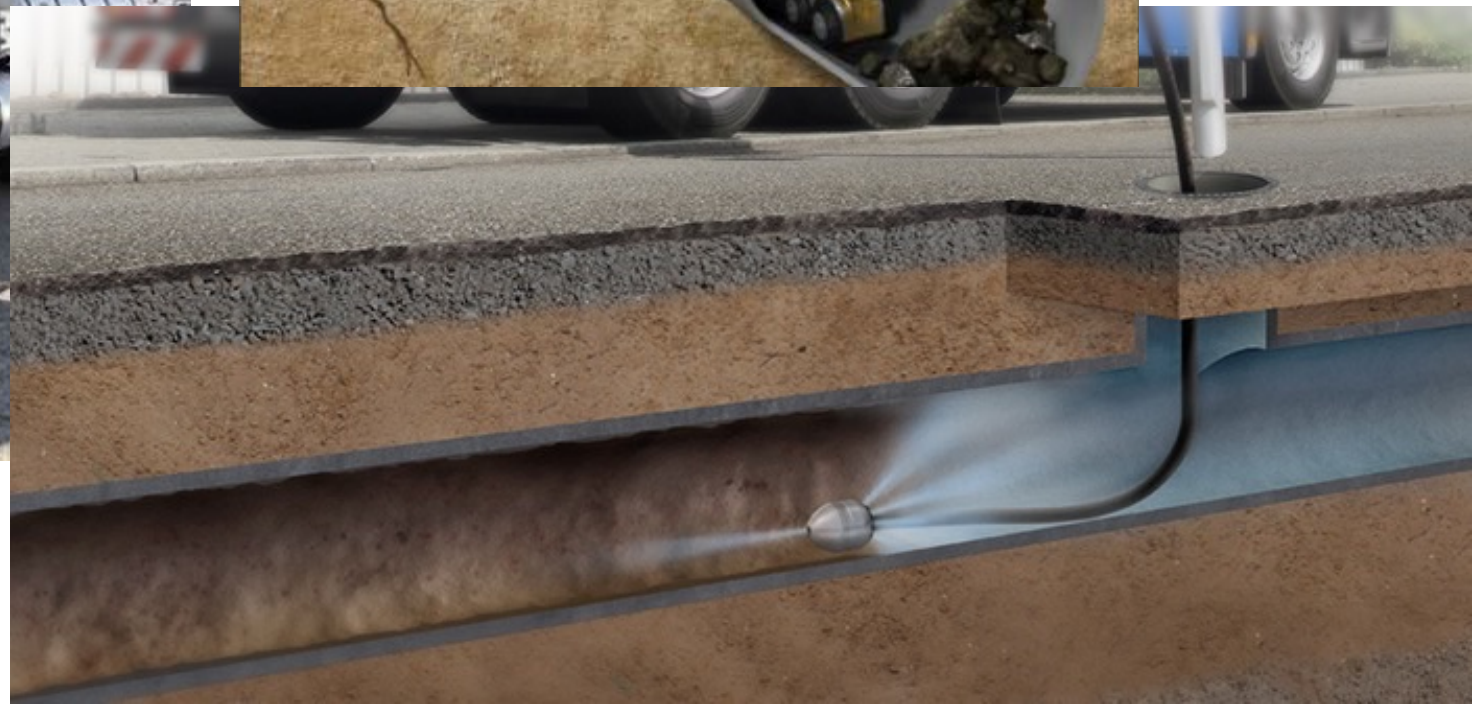
Manhole Locations

- Installed at upstream end and per stated Manual interval
- Locate correctly to avoid revising hydraulic tables
- Criteria Manual page 3-32:

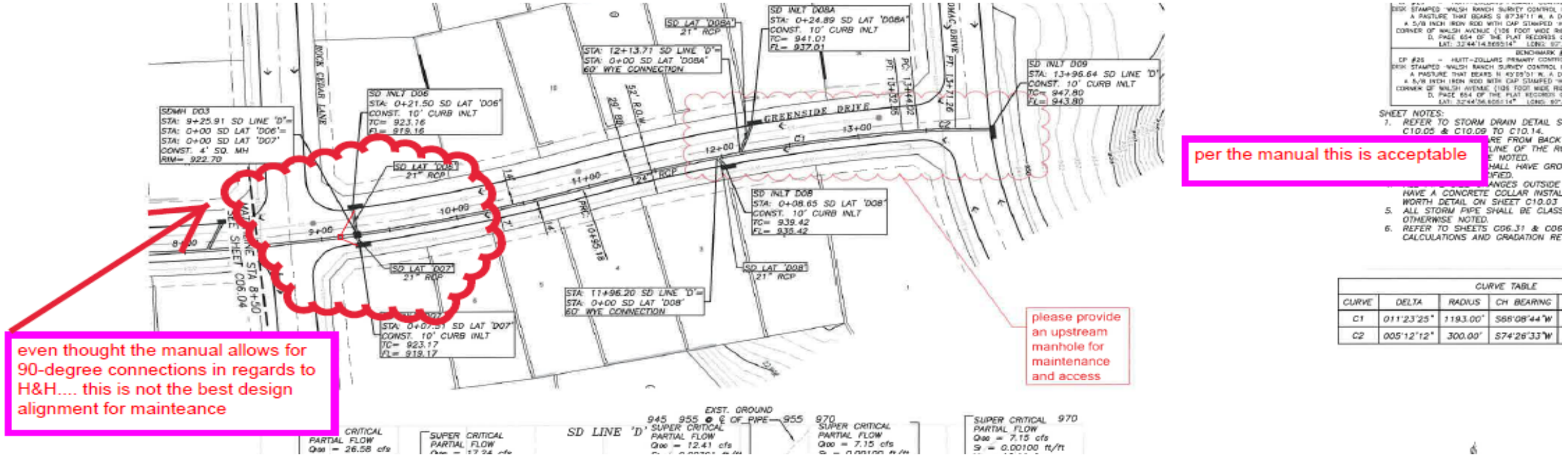
Manholes

Manholes shall be located at intervals not to exceed 550 feet for pipe 54 inches in diameter or smaller. For pipes sixty (60) inches in diameter and larger or equivalently sized boxes, the maximum interval is 800 feet. Manholes must be installed at the upstream end of a system and where a storm drain leaves the pavement, unless the outfall is within fifty (50) feet of the roadway and directly accessible. Manholes shall preferably be located at street intersections, sewer junctions, changes of grade and changes of alignment. When the storm drain is a concrete box instead of an RCP, four (4) foot diameter manhole risers may be installed instead of vaults to provide access. In all cases, steps or ranges shall be installed from the ground surface to the flowline of the pipe.

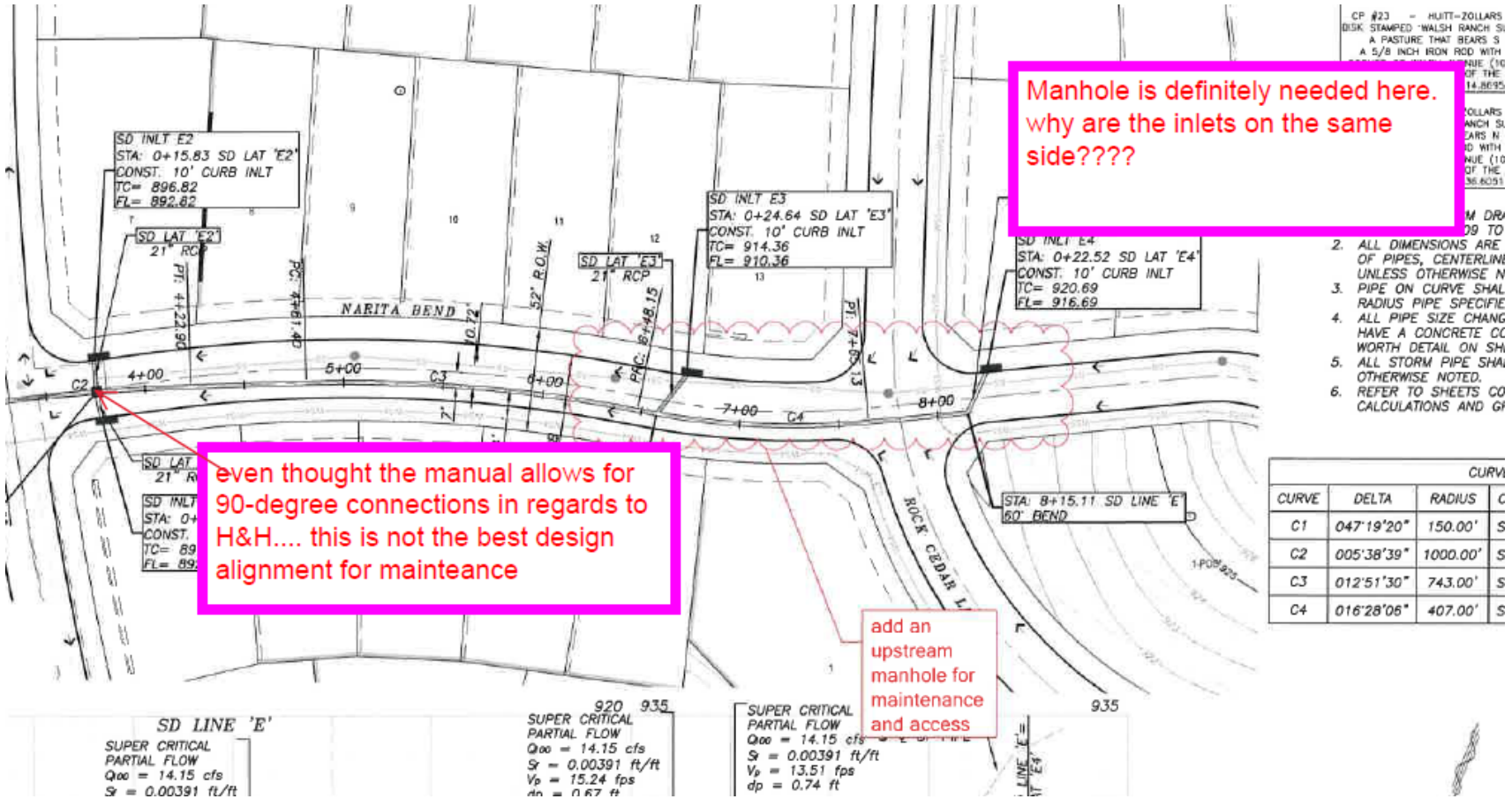
FORT WORTH®



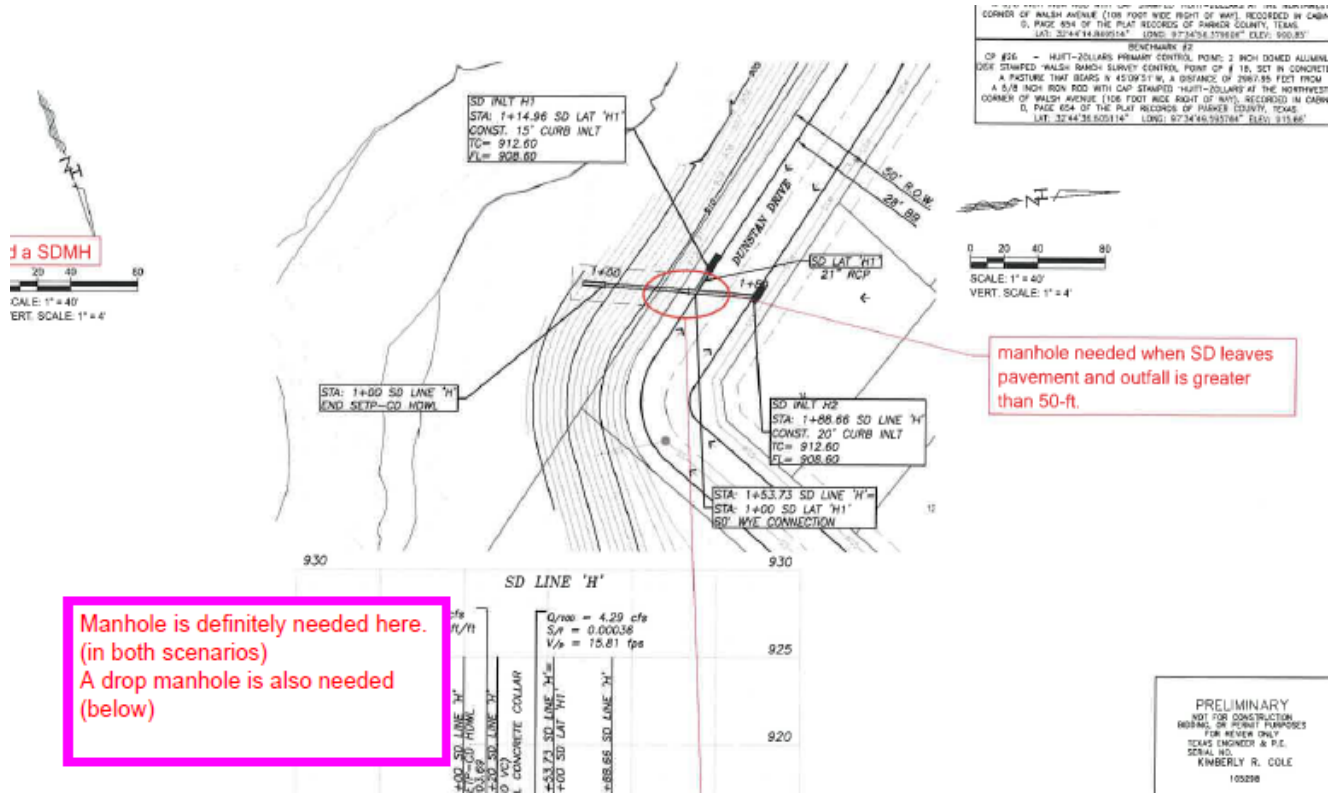
Manhole Locations & Feedback from Field Ops



Manhole Locations & Feedback from Field Ops

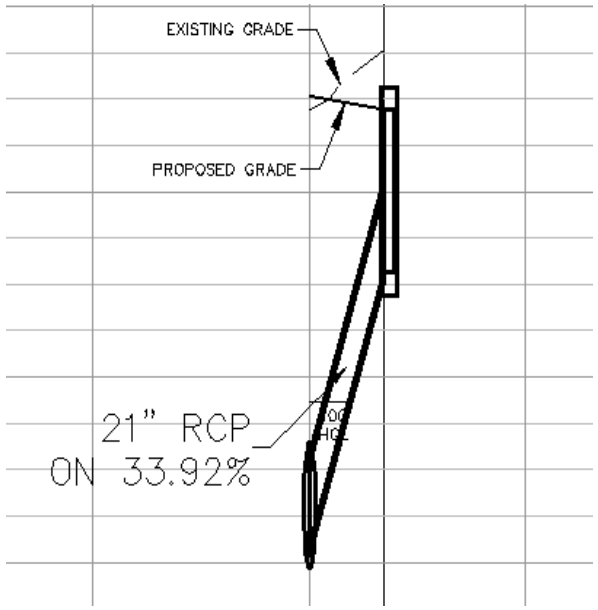


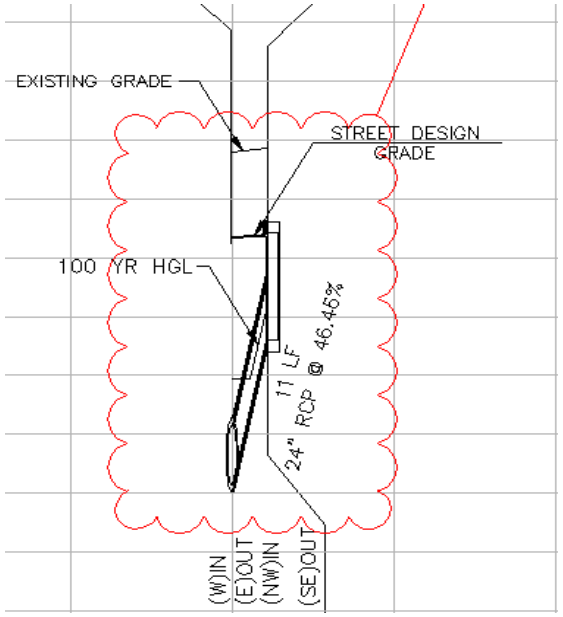
Manhole Locations & Feedback from Field Ops



Lateral Slopes

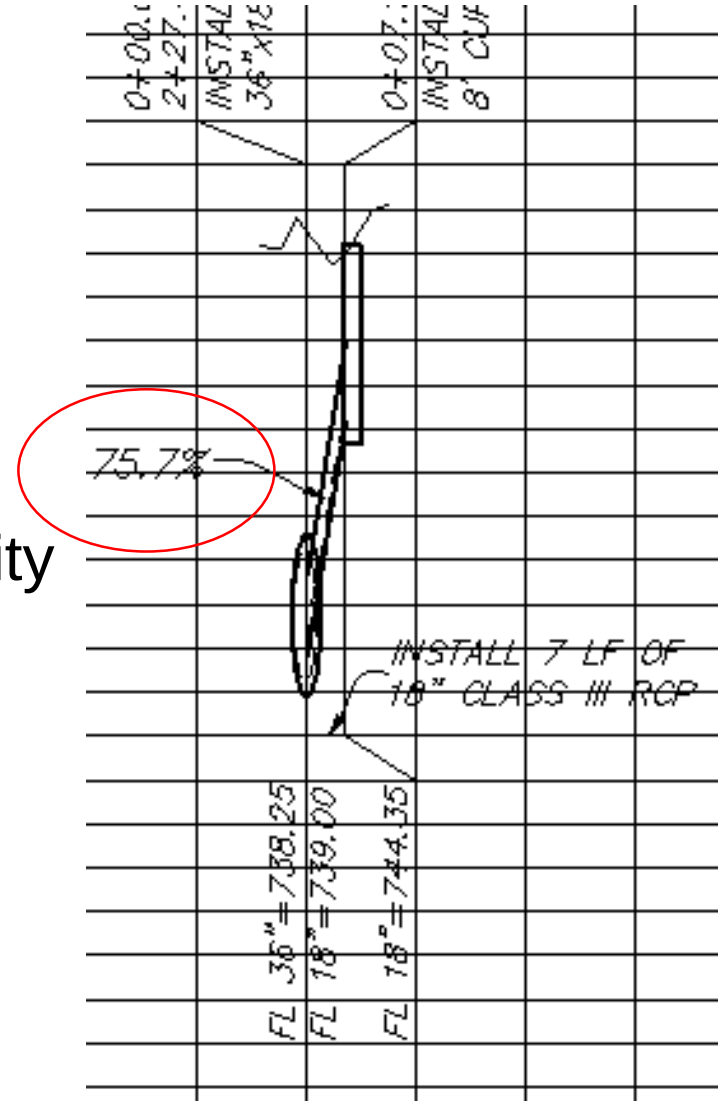
- Lateral Slopes
  - < 30% with a deeper inlet
  - Ease of access and constructability





Lateral Slopes

- Lateral Slopes
  - < 30% with a deeper inlet
  - Ease of access and constructability

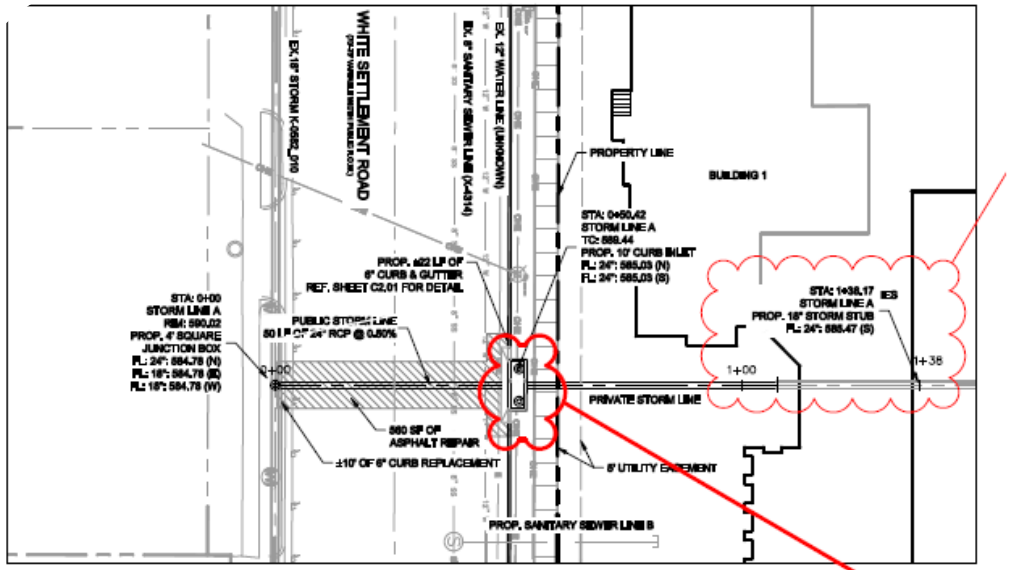


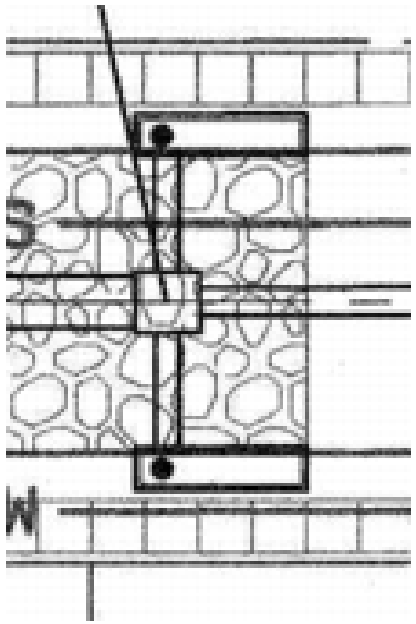
Lateral Connections & Inlets

- Lateral connection plumbed to manhole opening
- Use a standard length inlet – 10’, 15’ , 20’
- Criteria Manual page 3-79

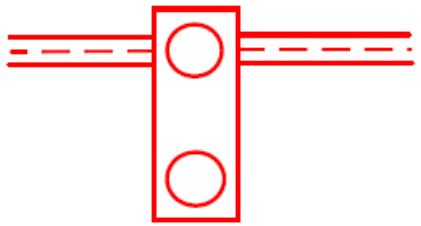
Inlets

All curb inlets shall be five (5), ten (10), fifteen (15) or twenty (20) feet in length and shall have depressed openings. Recessed inlets shall be provided on arterial streets. Proposed inlet lengths greater than twenty (20) feet must be accepted by TPW. Care should be taken in locating inlets to allow for adequate driveway access between the inlet and the far property line. Standard inlet depth is 4.5 feet at the lateral line and 4.0 feet at the opposite end, with the bottom sloped to drain to the lateral line. Manhole steps shall be installed for any inlet over five (5) feet deep. Lateral lines shall be plumbed into the inlet at a manhole opening to expedite mechanical cleaning and inspection. A storm drain main may pass through an inlet if the system configuration allows and may substitute for manhole access.





Adjust proposed inlet and/or proposed storm drain line such that the SD lines enter and exit at manhole access locations (see exampe below).



Lateral Connections & Inlets

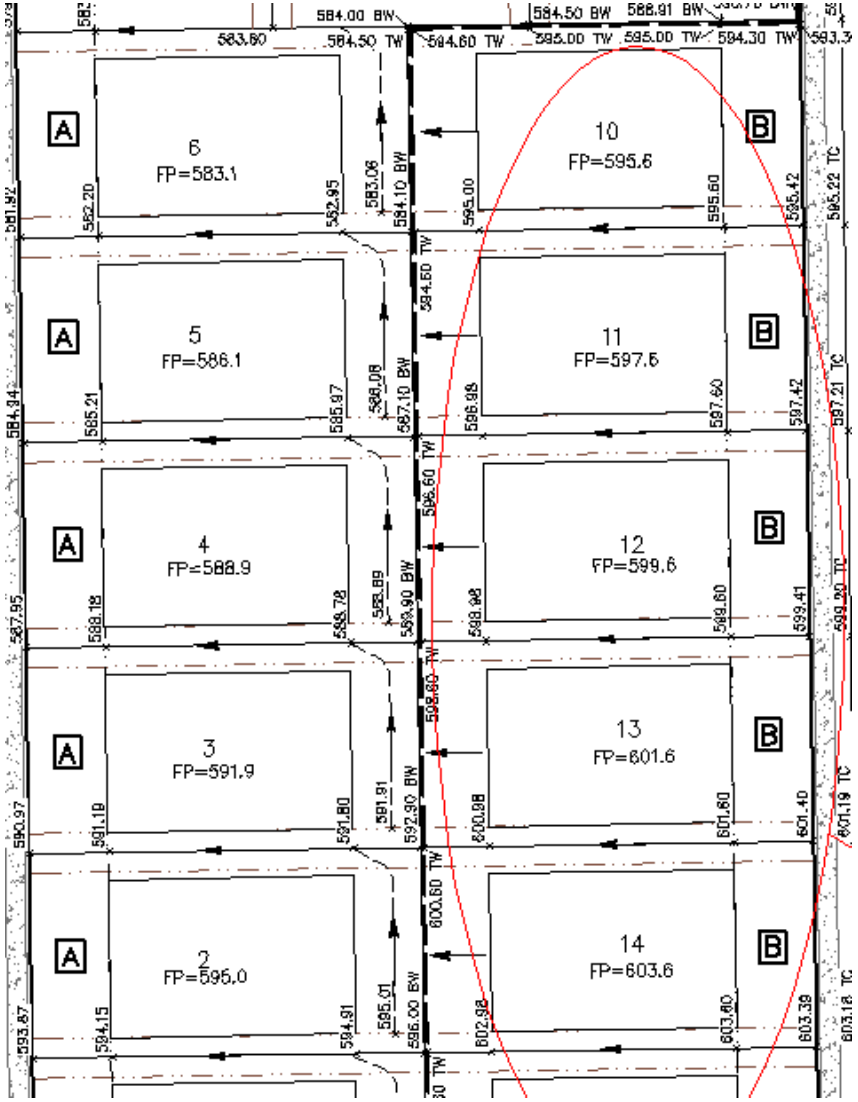
- Use a standard length inlet – 10’, 15’ , 20’
  - Use of non-standard inlet length will result revisions to a standard length, revised hydraulic tables, and an additional review

SFR Lot Grading

- Type B/C to Type A lot with contiguous lot lines
- Type C to Type A lot with non-contiguous lot lines
    - Typically HUD Block Grading Type 3
- Refer April 2018 Newsletter

SFR Lot Grading

- Type B/C to Type A with contiguous lot lines



SFR Lot Grading

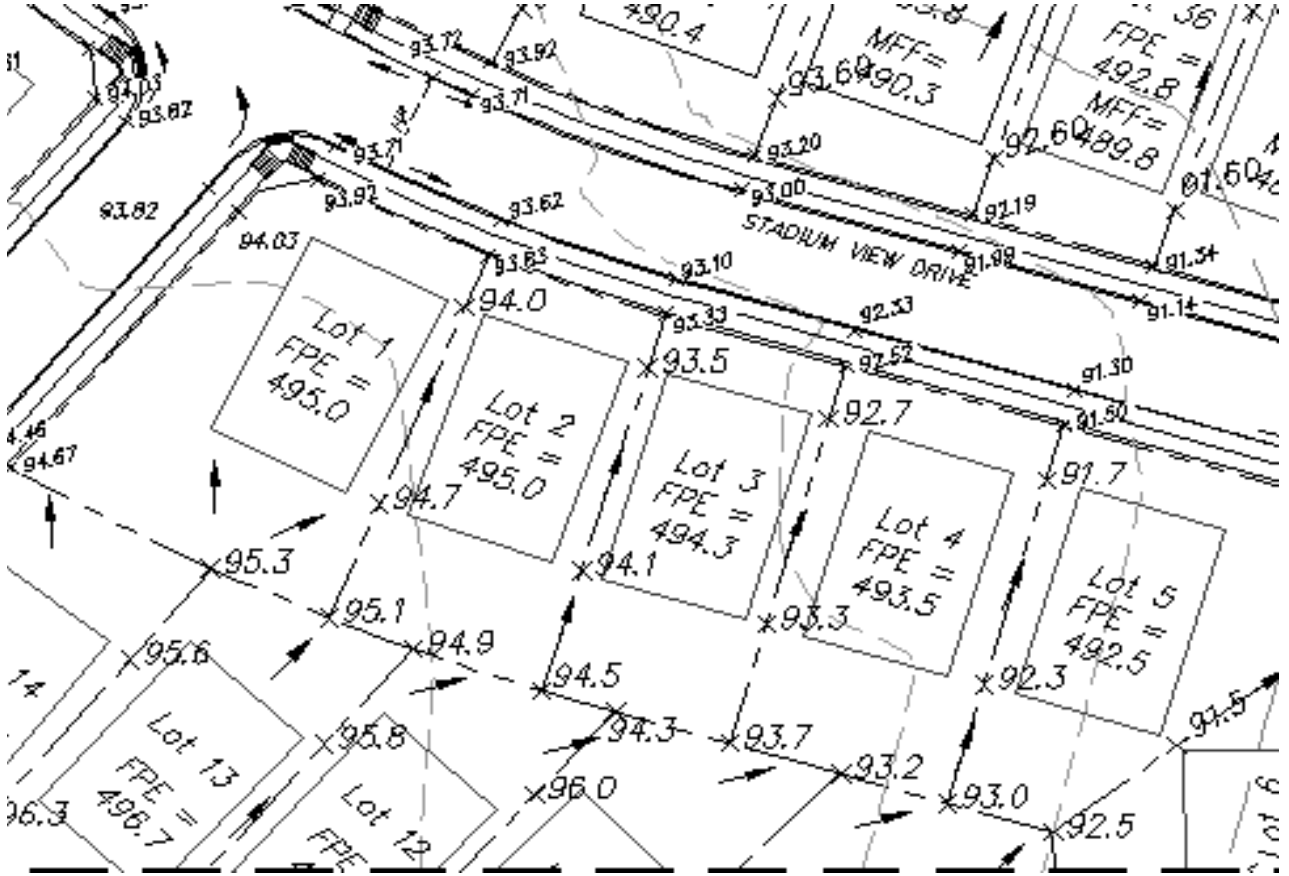
- Type C to Type A lot non-contiguous lot lines
  - Typically HUD Block Grading Type 3
  - Criteria Manual page 3-32

grading as shown in the FHA information is preferred. Type 3 and block 4 grading is allowed only if:

- a swale, flume or channel is constructed at the rear of the lot to intercept runoff; and
- runoff from 3 or more lots is collected and conveyed within an underground drainage system, swale, flume or channel contained within a dedicated easement.

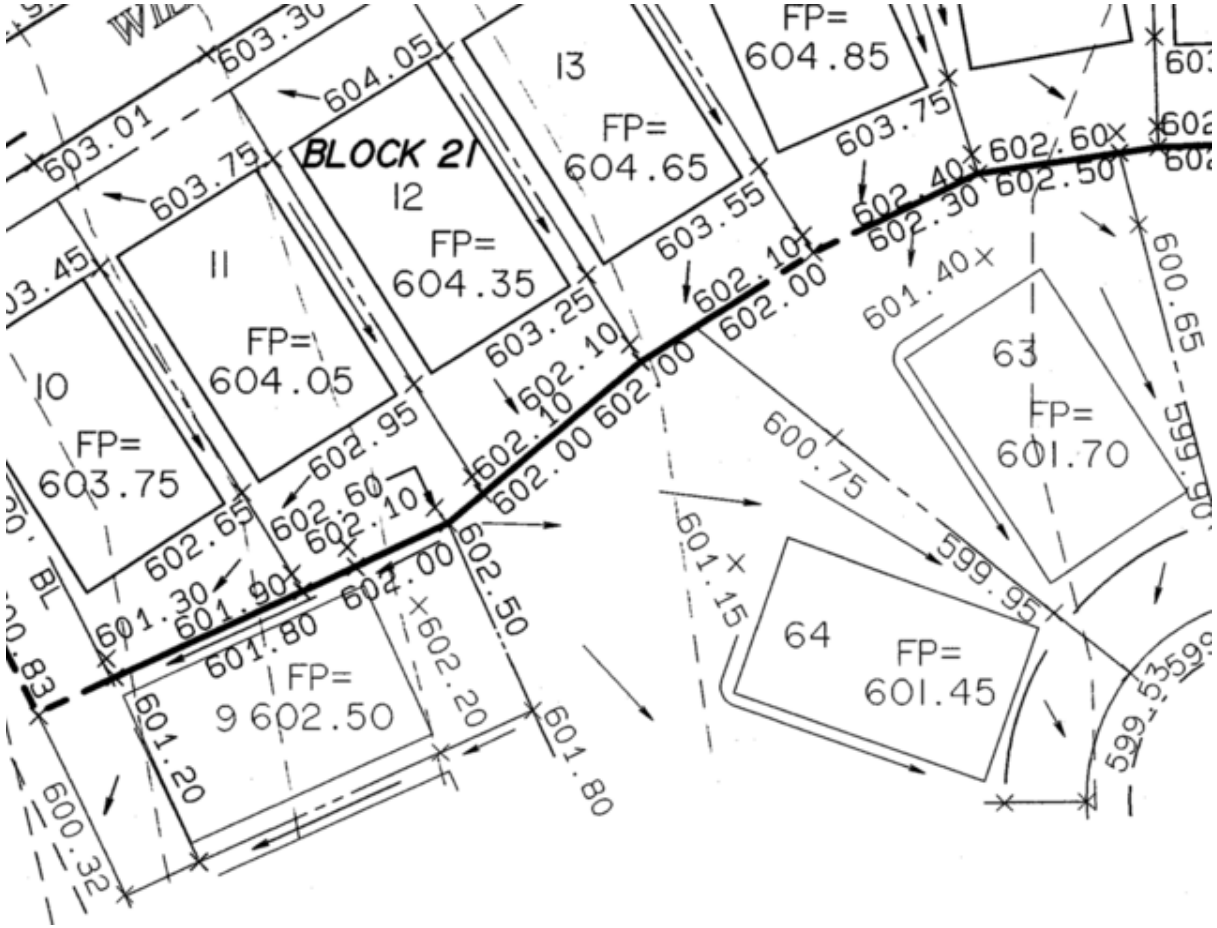
SFR Lot Grading

- Type C to Type A lot non-contiguous lot lines
- What about fence lines?



SFR Lot Grading

- Type C to Type A lot non-contiguous lot lines
- What about Lot 64?



SFR Lot Grading

- Reference April 2018 Newsletter

Single Family Residential (SFR) Lot Grading

The Stormwater Management staff worked with a group of development community representatives to clarify our current lot grading standards, improve consistency, and simplify the review process. Additionally, the current process is being reviewed to identify means for better documenting the builder's intention regarding lot grading as a part of the building permit process and some sort of certification from the builder regarding lot grading at the end of construction.

The outcome from the discussion was that Type 3 Block grading (type C lots draining to type A lots), the iSWM plan reviewer would allow up to a 5% slope in the swale in back yards (between rear building lines) without requiring a retaining wall or interceptor drainage system. The following conditions would also need to be met:

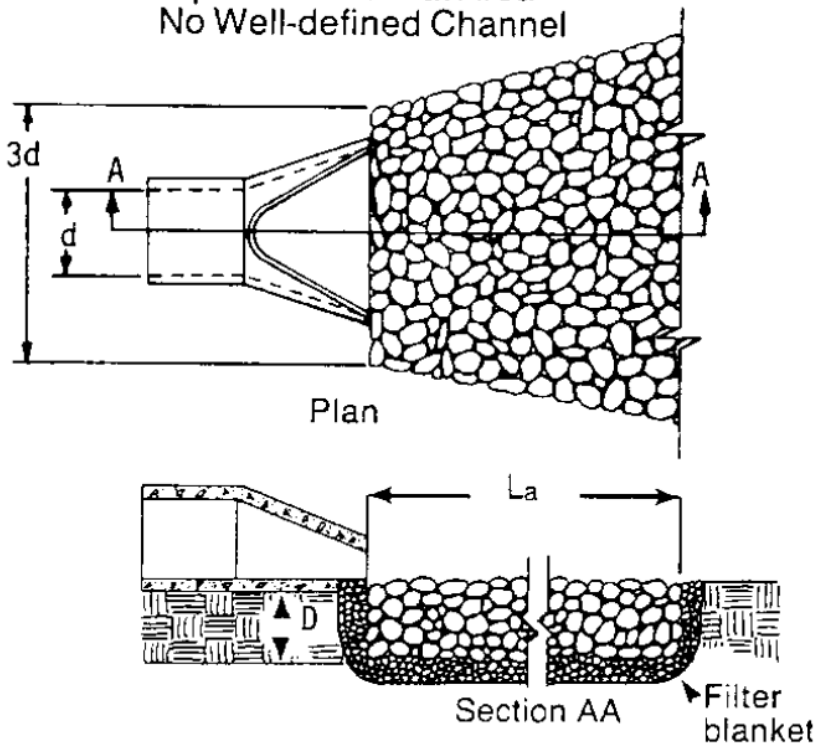
1. The swale should flatten and widen out as much as feasible before crossing lot lines in order to minimize erosion potential.
2. The design should make sure that flow is not lost to side neighbors and that flow through the swales is conveyed to the lot behind.
3. Swales shall be continuous and upstream side yard swales should align with downstream side yard swales.
4. The swale through back yard should never be less than 3 inches in depth.
5. The separation between the side yard swale flowline and finished floor elevation should be a minimum of 9 inches at the upstream end (upstream lot) of the swale and minimum 12 inches at the downstream end.
6. The design engineer shall provide standard swale details for each subdivision at section which represent the varying swale conditions.

Erosion Control at Outfalls

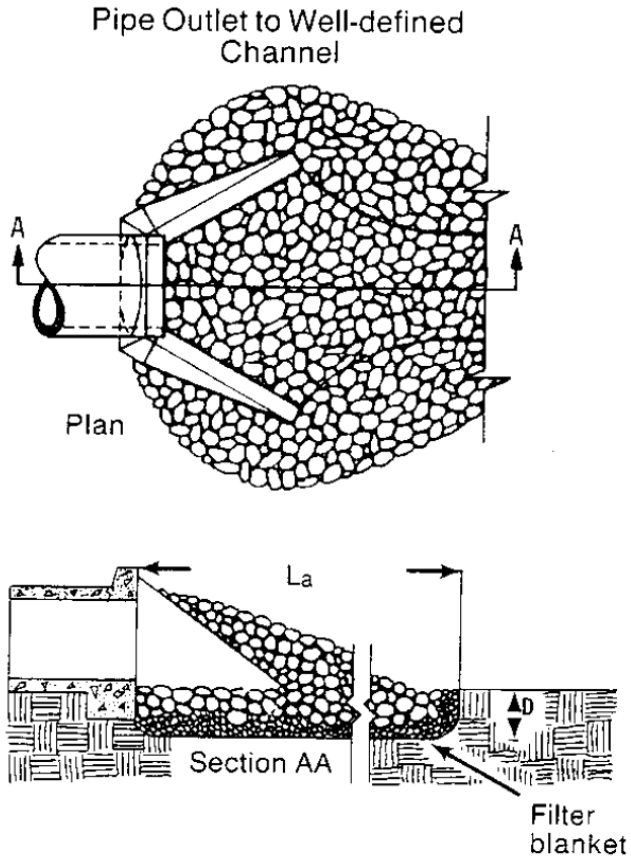
- Erosion and Sediment Protection at Outfalls
  - Properly Sized – Hydraulics Manual page HA-213 to HA-215
  - Evaluate 1, 5, and 100 year events for energy dissipation
  - Use appropriate sediment BMP

Erosion Control at Outfalls

Pipe Outlet to Flat Area—
No Well-defined Channel



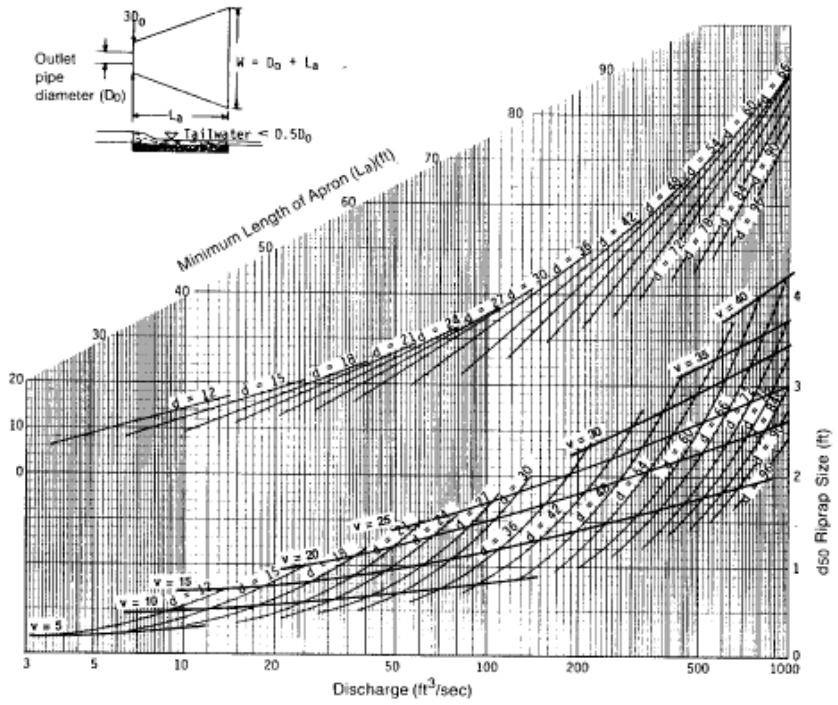
Pipe Outlet to Well-defined
Channel



Notes

1. L_a is the length of the riprap apron.
2. D = 1.5 times the maximum stone diameter but not less than 6".
3. In a well-defined channel extend the apron up the channel banks to an elevation of 6" above the maximum tailwater depth or to the top of the bank, whichever is less.
4. A filter blanket or filter fabric should be installed between the riprap and soil foundation.

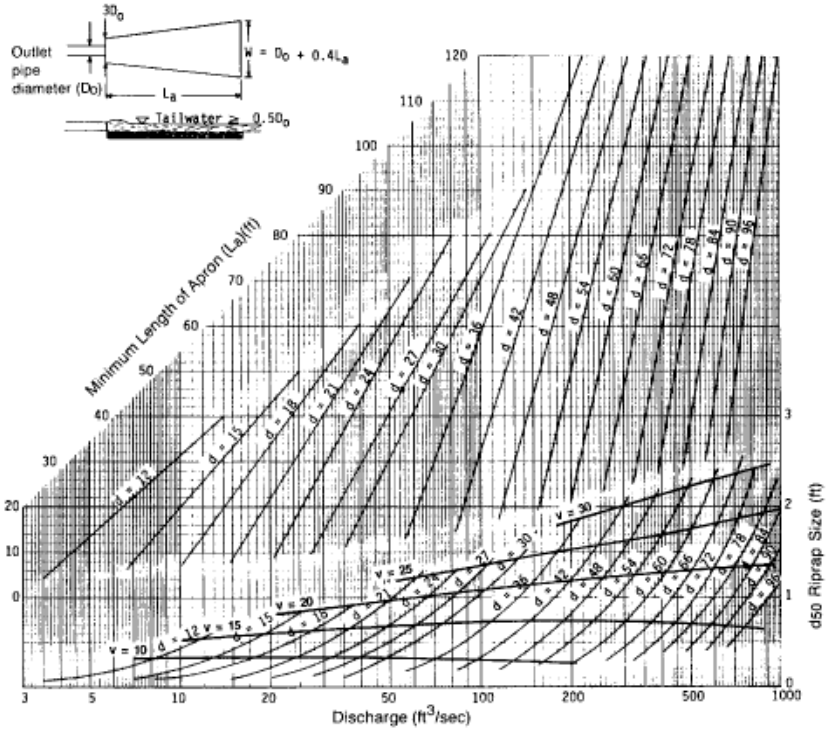
Erosion Control at Outfalls



Curves may not be extrapolated.

Figure 4.2 Design of Riprap Apron under Minimum Tailwater Conditions

(Source: USDA, SCS, 1975)



Curves may not be extrapolated.

Figure 4.3 Design of Riprap Apron under Maximum Tailwater Conditions

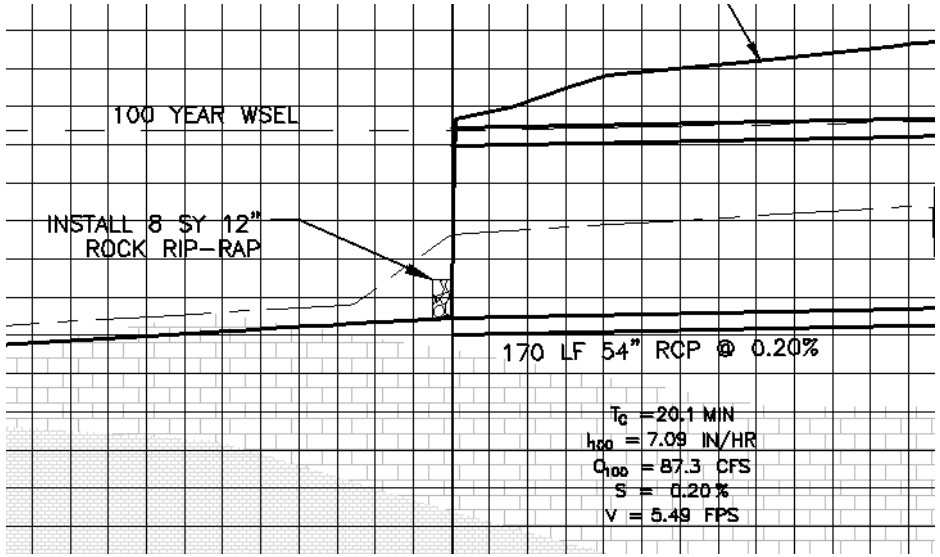
(Source: USDA, SCS, 1975)

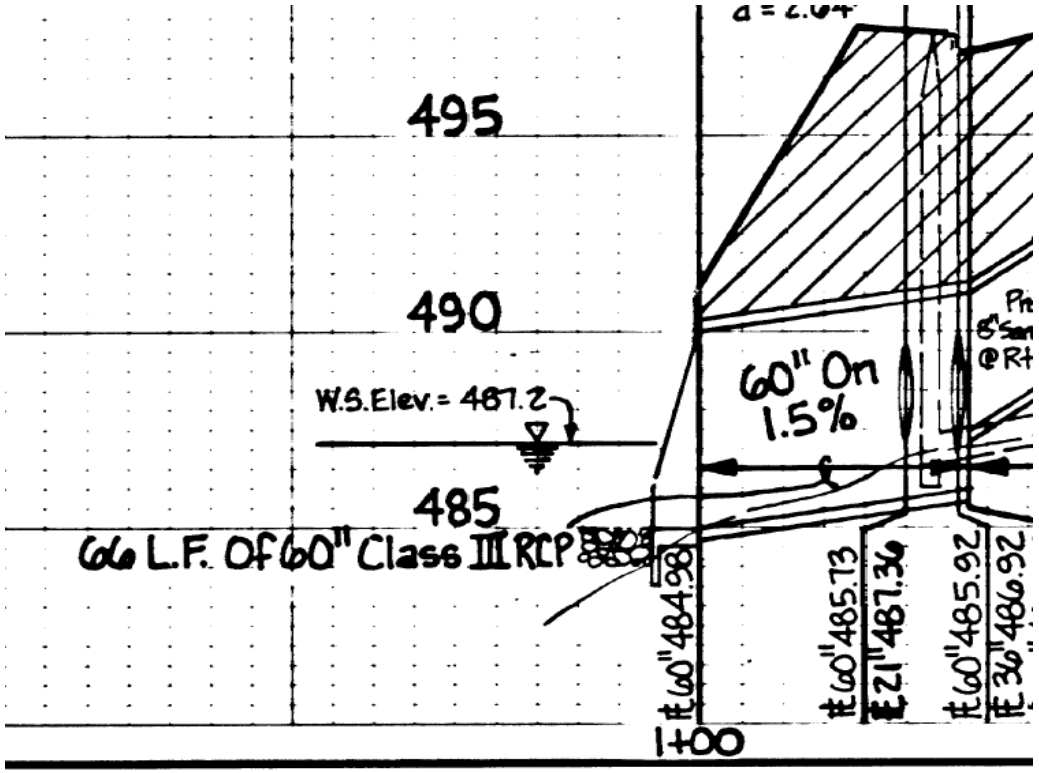
Erosion Control at Outfalls

- Properly Sized and Installed?

Erosion Control at Outfalls

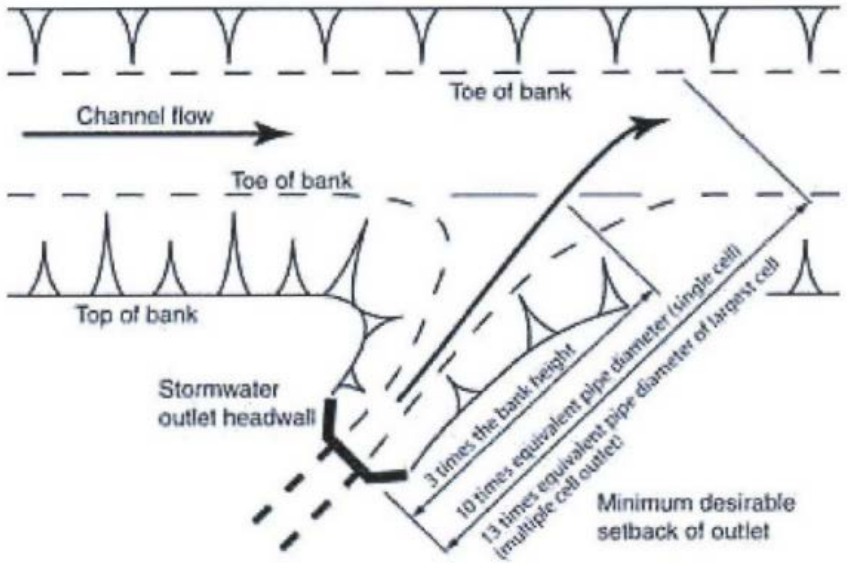
- Rule of Thumb
  - Apron length 4x-6x pipe diameter or width of box
  - D_{50} of 12” and thickness of 18”





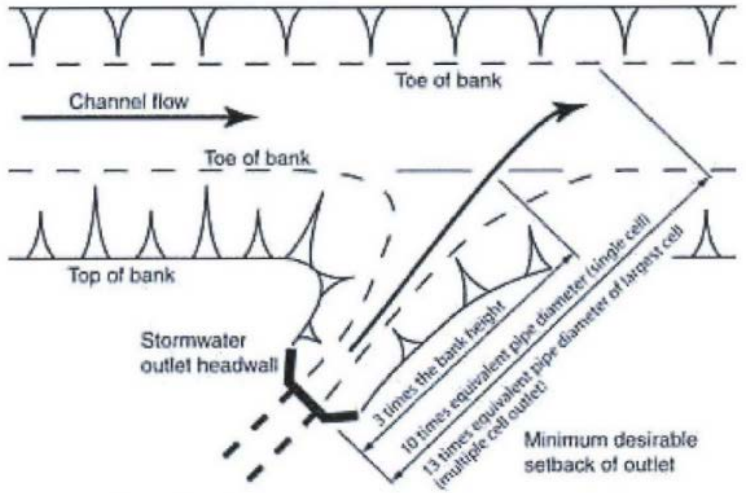
Erosion Control at Outfalls

- Consider adjacent banks



Erosion Control at Outfalls

- Consider adjacent banks

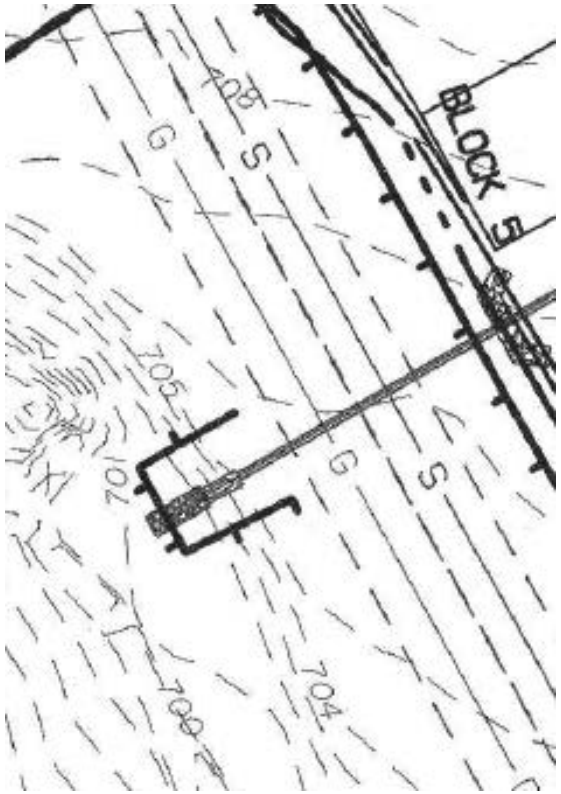


Erosion Control at Outfalls

- Evaluate 1, 5, and 100 year events
- Tailwater at 100 year event may provide a buffer not available during low flow events

Sediment Control at Outfalls

- Provide appropriate BMP
- Criteria Manual page 4-5
  - Linear controls (silt fence) not allowed in areas of concentrated flow

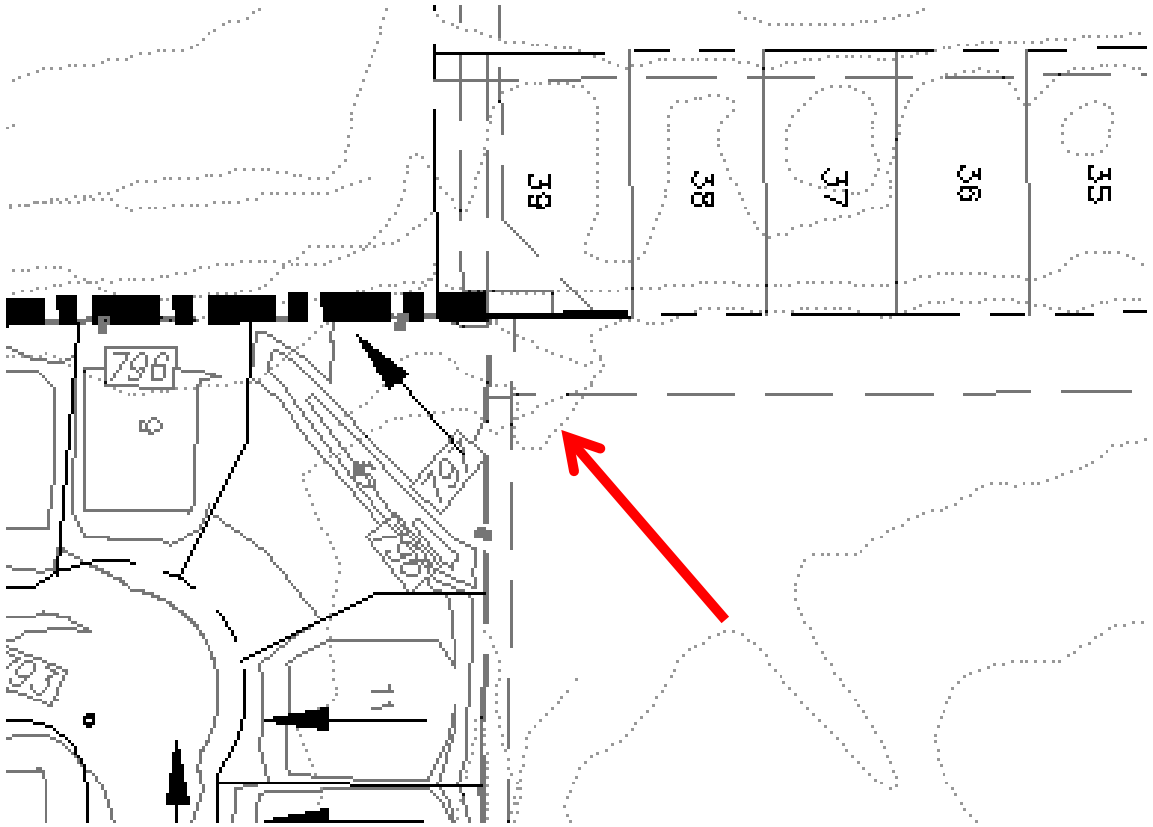



09/25/2018 13:42


01/24/2014 12:33

Sediment Controls

- Ensure existing flow paths are maintained
- Silt fence blocking existing path resulted in upstream flooding on Lot 39

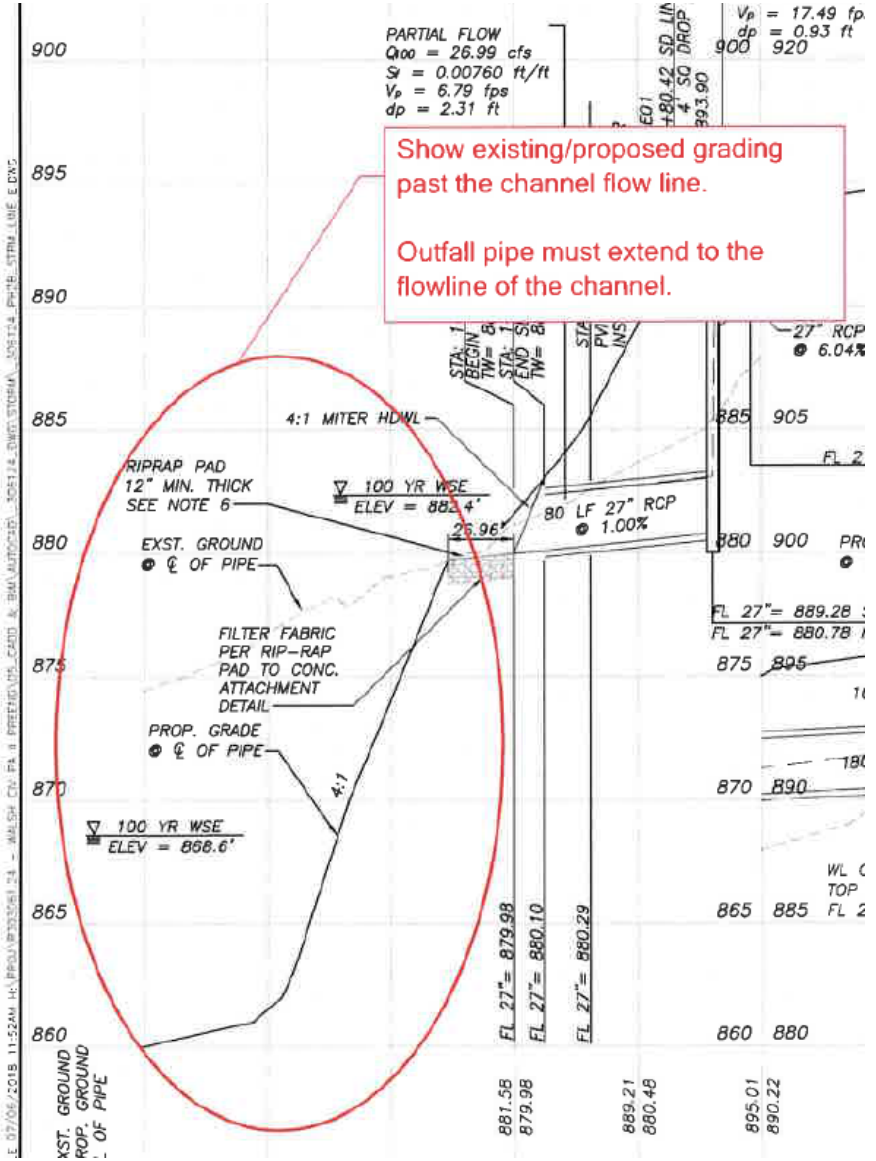


Sediment Controls

- Erosion Protection at Outfalls
  - Ensure existing flow paths are maintained
  - Resulting flooding due to silt fence across existing drainage way

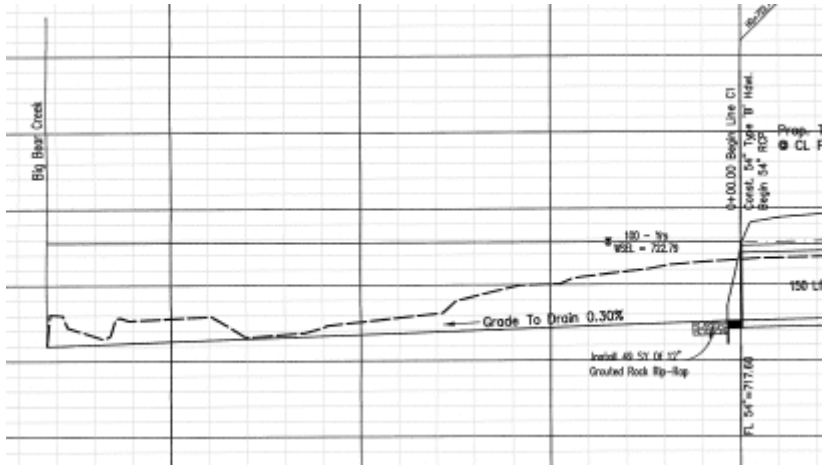
Convey Runoff to Receiving Flowline

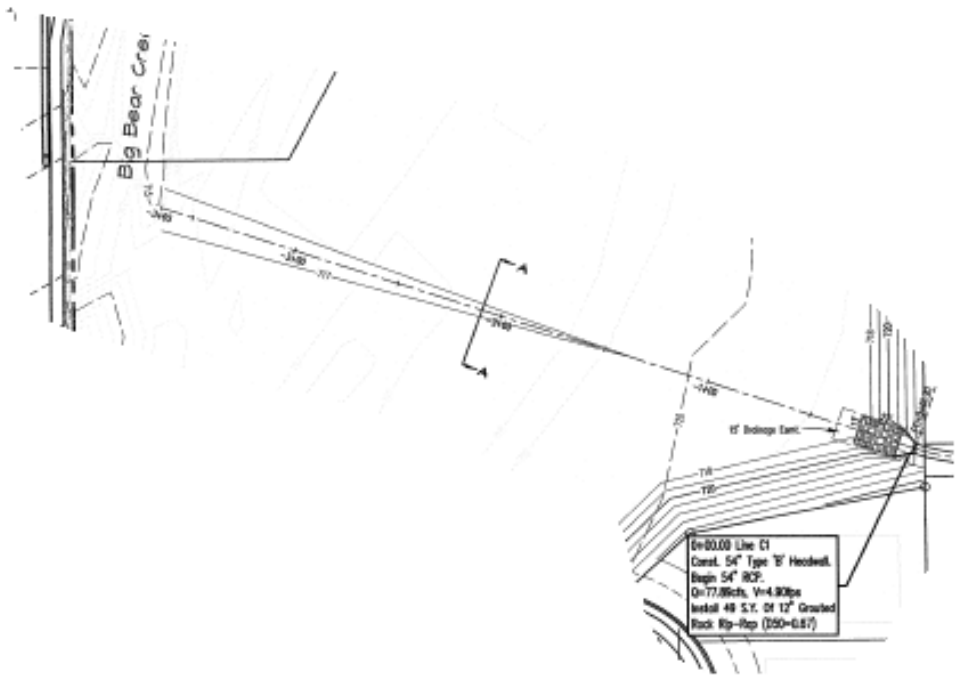
- Convey runoff to receiving flowline
  - Channel
  - Extend BMP to flowline
  - Return to sheet flow
  - Convey concentrated flow to concentrated receiving stream



Convey Runoff to Receiving Flowline

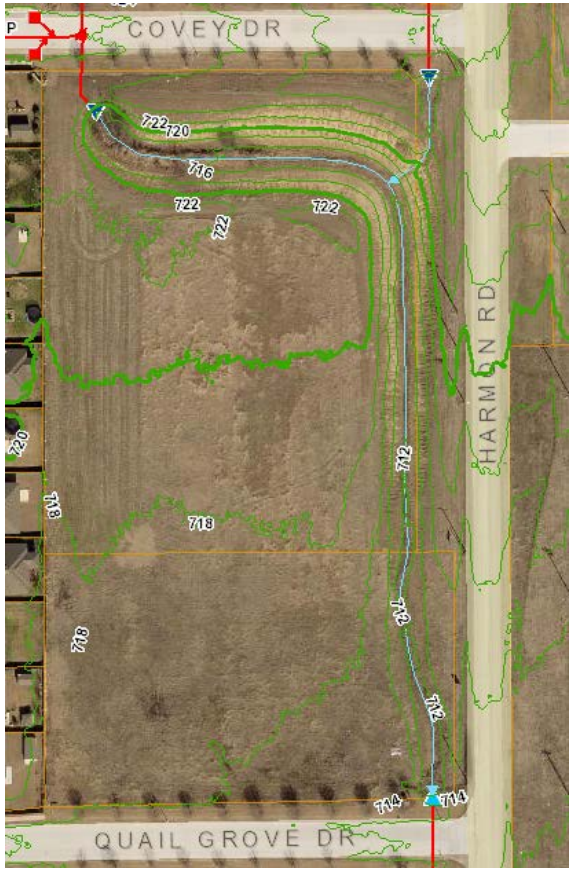
- Convey runoff to receiving flowline
  - Channel (Design)





Convey Runoff to Receiving Flowline

- Convey runoff to receiving flowline
  - Channel (Practice)



Convey Runoff to Receiving Flowline

- Channel not conveyed to a flowline, unintended channelization due to concentrated flow

Convey Runoff to Receiving Flowline

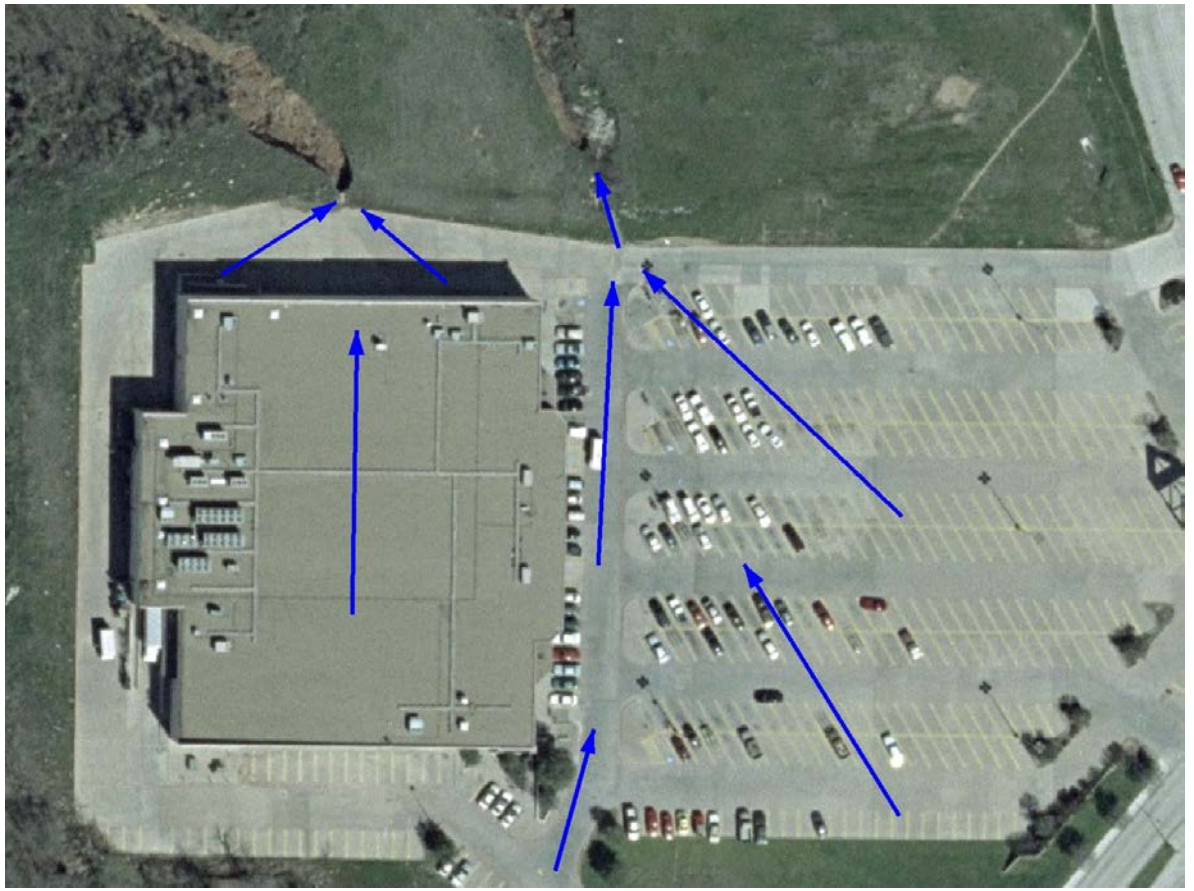
- No designed conveyance to outfall, Stormwater has cut its own path

Convey Runoff to Receiving Flowline

- No designed conveyance, Stormwater has cut its own path

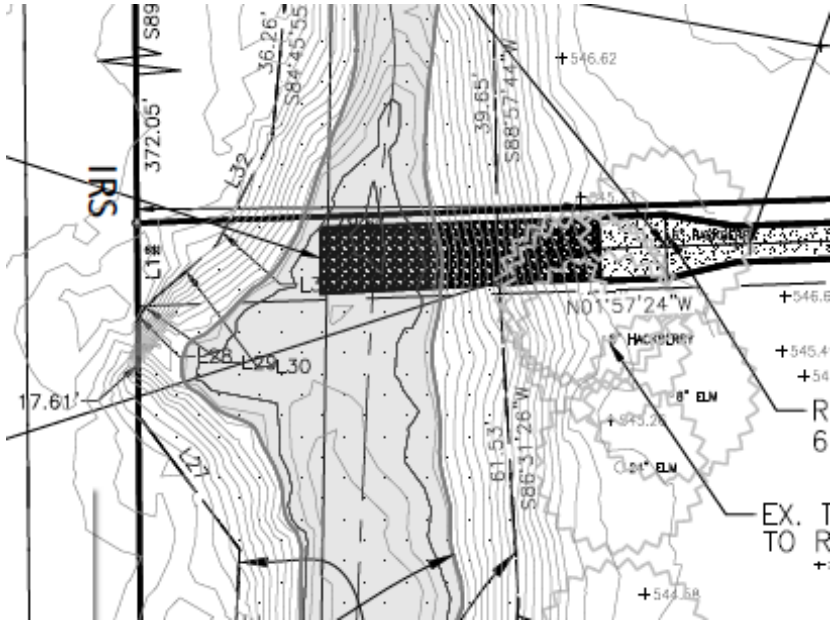
Convey Runoff to Receiving Flowline

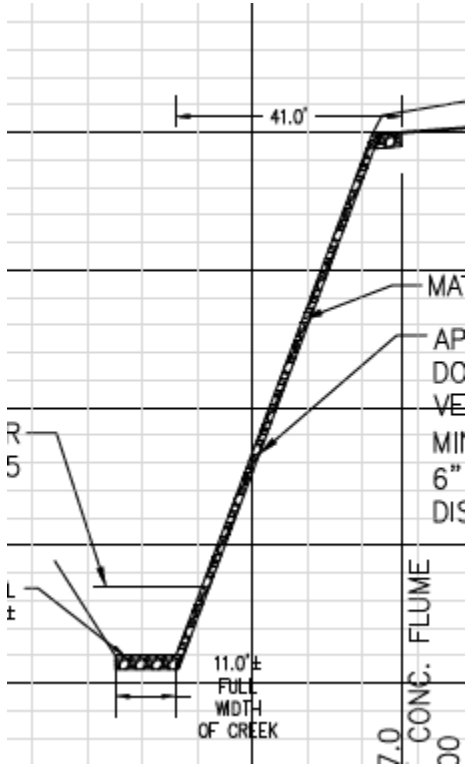
- No designed conveyance, Stormwater has cut its own path



Convey Runoff to Receiving Flowline

- Extend BMP to flowline





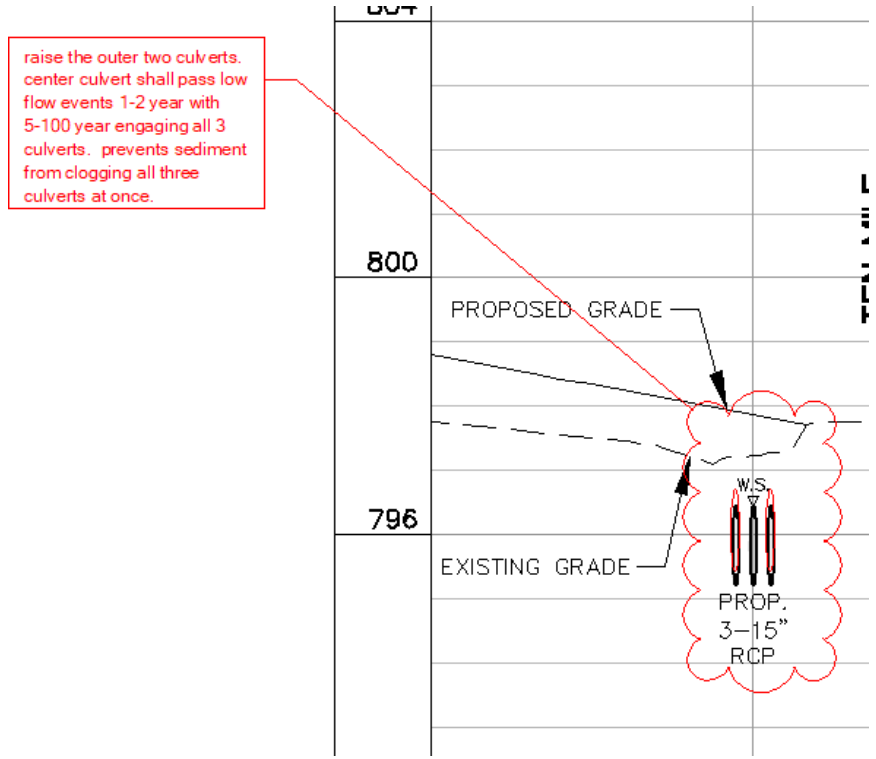
Multi-Barrel Pipes or Culverts

- Box Culverts and Parallel Runs
  - Criteria Manual page 3-55, low flow barrel at lower elevation
  - Low flow to carry 2% of 100 year event

> - For multiple barrel culverts the CFW requires the placement of one of the barrels at the flowline of the stream with the other barrels at a higher elevation to create a single flow path for lower flow and reduce sediment and debris accumulation. Where practical the low-flow portion of the low barrel(s) should convey 2% of the design 100-year discharge.

Multi-Barrel Pipes or Culverts

- Example: driveway culvert requiring adjustment



Multi-Barrel Pipes or Culverts

- Open bottom arch culverts at bankfull elevation

Multi-Barrel Pipes or Culverts

- Baffles at bankfull allow flood passage

Use CFW Standard Hydraulic Tables

- Refer the following figures in the manual
  - Figure 3.5 Curb Opening Inlets and Drop Inlets in Sump (page 3-25)
  - Figure 3.7 Computation Summary Sheet for Determining Capacity of Curb Opening Inlet on Grade (Depressed) (page 3-28)
  - Figure 3.10 Computation Sheet for Storm Drains (page 3-41)
- Ensure all data is completed

1	2	3	4	5	6	7	8	9	10	11	12	13	14
EXISTING													
EX C-1-f	0.00	#VALUE!	#VALUE!	100-yr	0.00	5	0.00	0.00	0.00		0.00	0.00	Existing 5' Curb Inlet
EX H-1-a	0.00	#VALUE!	#DIV/0!	100-yr	0.00	10	0.00	0.00	0.00		0.00	0.00	Existing 10' Curb Inlet
PROPOSED													
PRO C-1-f	0.00	#VALUE!	#DIV/0!	100-yr	0.00	10	0.00	0.00	0.00		0.00	0.00	Proposed 10' Curb Inlet
PRO H-1-a	0.00	#VALUE!	#DIV/0!	100-yr	0.00	10	0.00	0.00	0.00		0.00	0.00	Proposed 10' Curb Inlet

SUMP INLETS

Thank you