



## **Flood Hazard Assessment Report Hill Gulch, Larimer County, Colorado**

**January 24, 2013**

**Prepared by:** Al Albin, Dave Drouillard, and Dave Wolff.

**Purpose:** The purpose of this report is to summarize the findings of our (NRCS) site evaluation of the Hill Gulch Area in relation to potential flooding that could be expected from the Hill Gulch and Watha Gulch Watershed after the High Park fire.

**Background:** Wildfire burned 259 homes and approximately 87,000 acres of forest land west of Fort Collins, Colorado in June 2012. Larimer County asked NRCS for assistance in evaluating the risk to structures in the Hill Gulch area and make recommendations for mitigation of potential losses.

**NRCS Evaluation Team:** Al Albin, Dave Drouillard, and Dave Wolff.

**Hill Gulch Watershed:** Hill Gulch and its tributary Watha Gulch drain a large watershed of over 5 square miles. Much of the watershed burned and at least two homes were lost along with several out buildings. Hill Gulch flows from the south under Highway 14, through the community of Poudre Park to the Poudre River.

**Assets and Resources at Risk:** There are two residences on the south side of Highway 14, upstream of the highway bridge, and four residences on the north side of the highway that are near the channel (see Site Plan). These residences are at risk, to differing degrees, of flooding and in at least one case, personal safety is a very serious concern. There are several mobile homes, cabins and a general store that may be at risk should flood water leave the channel in significant quantities and overtop the highway. Highway 14 would be impacted by flood water potentially causing damage to the highway along with the deposition of sediment and debris. This would pose a hazard to travelers and require cleanup and repair. Sediment, debris, and contaminants transported to the Poudre River by flood flows would negatively impact the resource which includes municipal and irrigation water supplies.

**Assessment of the Conditions:** A large precipitation event occurred a few weeks after the fire. Water left the banks south of the highway in part due to debris lodging in the bridge opening. Water left the stream bank nearly reaching the home at 17 Wonderful Pl., east of the channel, and deposited charred, woody debris on the property. Flood water topped a sand bag barrier at the garage at 10049 Poudre Canyon Highway, the residence on the west side of the channel just upstream of the highway bridge. The water level came up about 1 foot on the side of the house. A large amount of charred debris was deposited around the house and on the driveway. Water flowed across the highway east of the bridge leaving minor amounts of debris on adjacent properties.

North of the highway, water topped the bank in at least one location leaving debris in a small field and near a home on the west side of the channel at 48 Poudre River Road.

**Investigative activities:** A reconnaissance of Hill Gulch was conducted from the Poudre River to about ½ mile to the south, upstream. Four cross sections were measured in the channel between the highway and the Poudre River. Two cross sections were measured south of the highway near the residences. Another cross section was measured at a potential site for a debris control structure. Members of the investigative team met with several of the potentially affected residents. The extent of previous flooding observed and reported by residents was documented. Hydrologic data developed using post fire conditions were used to estimate flooding potential along Hill Gulch at the cross section locations. The potential extent of flooding was estimated along the gulch and adjacent properties for the 25 year-1 hour flood event, 1.8 inches of rain in 1 hour, estimated to produce a flow of 1700 cubic feet per second (cfs).

**Recommendations:** The highway bridge does not appear to be in jeopardy, although the influx of large woody debris could be a problem (also see Debris Control below). The channel upstream of the bridge has significantly less capacity than the 27.5 foot wide, 7 foot tall passage under the bridge. Water in excess of the channel's capacity will leave the banks upstream of the bridge and spread out over adjacent properties. The 25 year flood event is expected to result in flow across the highway and onto the properties on the north side of the highway.

The house, at 17 Wonderful Pl. is not expected to be impacted by the 25 year if flow under the highway bridge is not seriously impeded by debris. The newly constructed garage in back of the house could be impacted by flood flows. A row of concrete blocks placed upstream of the garage from the hillside extending past the front wall of the garage would serve to protect the garage from direct impact of flood water and debris.

The house at 10049 Poudre Canyon Highway, on the south side of Highway 14, is at the greatest risk of flooding and damage from debris. Significant effort will be required to protect this home. A barrier constructed 2 ½ feet high on the upstream side of the garage and along the sides of the house will protect these structures from the direct force of the 25 year event. This calculation is based on the assumption that flood flows are able to pass through the gate next to the garage and continue down the driveway. Obstruction of flood flows at the gate either by a constructed barrier or the accumulation debris will result in raising the level of flooding elsewhere. Some effort has been made in the past to armor the stream bank at this location. Some of the rock-filled wire gabions constructed on the bank have been damaged. They should be reconstructed in order to provide protection for the stream bank. Given the unpredictability of the magnitude of precipitation events, it may not be practical to provide complete flood protection at this house. Regardless of the protection, this house should be evacuated if a flood event is likely. Due to the potential loss of the structure and loss of life from flood flows, consideration of moving the house or buying and demolishing the house is recommended.

North of Highway 14, the channel banks are the primary defense against flood damage for the properties near the channel. Some effort has been made in the past to construct berms along the banks of the gulch. Deteriorated portions of these berms should be mended. Small trees and brush growing in the channel contribute to restricting flow and should be cut down and removed.

The house at 48 Poudre River Road could be flooded if flows overtop the channel bank. A barrier at least 1 ½ feet high constructed across the south and east sides of the house would serve to protect the house from the direct impact of flood water and debris by diverting flows to either side of the house. The barrier could be constructed of sandbags or large concrete blocks. The owner may consider constructing a barrier to prevent water from flowing into the basement on the north side of the house. A sandbags barrier 1½ feet high could be constructed across the driveway at the top of the slope going down to the basement. This barrier could also be constructed using large concrete blocks with sandbags placed to fill gaps to prevent flood water from flowing between and around the blocks. A barrier could also be constructed against the basement wall but it would have to be nearly the full height of the wall to be effective. Flood flows can be expected to pass on both sides of this house during a large flood event. It would be best to evacuate this house if a flood event is likely.

The houses immediately east of the channel and north of the highway are less likely to be flooded during a 25 year event. House number 9998, the house closest to the highway, could be subject to water levels 0.4 feet above the floor level. A sandbag barrier at least 1 foot high placed along the south and west sides of the house is recommended.

The guest house, number 9996, is not expected to be directly affected by a 25 year event. There could be some water flowing down from locations upstream where overbank flows might occur. It may be wise to have some sandbags nearby so that they could be placed in front of the door to prevent water from entering the house during a flood event.

The 25 year event is not expected to reach the floor level of the house closest to the river.

About 300 feet east of the highway bridge there are several mobile homes, cabins, and the general store. These structures and residents could be affected by flows that come out of the channel upstream of the bridge, flow across the highway and into the properties on the north side of the road. The depth of these flows is not expected to be great but the ground slopes toward these structures which puts them at risk.

The owner of these properties may wish to consider placing a barrier along the driveway on the west side of the property to direct the flow away from residences and other buildings. Concrete highway barriers would work nicely. The barrier could also be constructed of sandbags. The owner should consider having some sandbags near the front of the general store to place across the doorway if flooding should occur.

**Debris Control:** Flood Flows in Hill Gulch are capable of transporting large rocky and woody debris. The construction of a debris control structure should be considered to prevent large material from being transported onto people's property and/or potentially blocking flow under the highway bridge. The suggested location for the debris control structure is approximately 1100 feet upstream of the Highway 14 bridge. This location is about 150 feet upstream of the burned bridge.

A design for a debris control structure approved by NRCS is included with this report. There are other design approaches that could be utilized depending on the needs and resources of the community. A debris control structure could be constructed of logs or structural steel members embedded in concrete. The advantage of a log structure is the abundance of available material nearby. Also these log structures will gradually decay as the years pass and the forest recovers lessening the need for such structures. The advantage of the structural steel trash rack is that they are relatively quick and easy to construct. They are very durable and effective but may have to be physically removed after the threat of debris flows has past. A design other than that presented here should be approved by a qualified engineer.

A debris control structure would have to be cleared of debris following a flood event in order to remain effective. Someone would have to accept the responsibility of clearing the trash racks.

**Propane Tanks:** All propane tanks that may be impacted by flood flows need to be secured or moved. The tanks can be secured by running a chain or cable through one of the feet, preferably on the upstream side and attaching it to a secure anchor point such as a large tree, a concrete footing, or a large boulder. The valve on the propane tank should be shut off when flooding is imminent.

**Cost Estimates:** A summary of recommended flood protection measures and cost estimates is attached. These figures are based on prevailing contract costs.

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John Andrews  
State Conservation Engineer

### Hill Gulch

#### Summary of Recommended Flood Protection Measures

Location	Recommendations	Estimated Cost *
As indicated on the Site Plan	Concrete blocks, 2.4'X2.4'X5', 3,800 lb  Trucking 41 concrete blocks to the site. Placement of concrete blocks Foundation preparation  Anchoring blocks Total	26 hours @ \$100/hr., \$2600, \$40 / block \$20/each, \$820 \$30/each (lower course only), \$840  \$400 \$4,660
Along drive west of general store	Highway barriers, 10 feet long, 3 feet high  Trucking 12 barriers  Placing 12 barriers Total	5 hours @ \$100/hr., \$500 \$20 each, \$240 \$740
As indicated on the Site Plan	Sandbag placement  Purchase, filling, transportation, and placement of 2400 sandbags @ \$1.50 each	\$3,600
1100 feet south of highway bridge	Debris barrier  Design included with this report	\$46,800

Total estimated cost \$55,800

\* Costs are estimated based on prevailing contract costs.





POUDRE RIVER

POUDRE CANYON HWY. 14

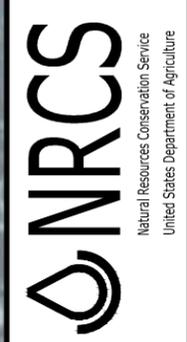
DAWN'S SHED  
 2 FOOT HIGH SANDBAG WALL  
 DAWN'S HOUSE  
 PROTECT HOUSE WITH (15) CONCRETE BLOCKS. SANDBAG BEHIND CONCRETE BLOCKS AND ACROSS YARD WHERE WATER MIGHT BACKFLOW.  
 X-SEC 1+96  
 RENTAL HOUSE  
 CHRISTY'S HOUSE  
 GARAGE  
 GARAGE  
 VACANT HOUSE  
 PROTECT VACANT HOUSE BY PLACING 1 FOOT HIGH SANDBAGS AND PLASTIC ON SOUTH AND WEST SIDE OF HOUSE.  
 X-SEC 2+86  
 GARAGE  
 GARAGE  
 BUILD UP EXISTING SANDBAG BERM WITH EARTH AND ROCK OR APPROX. (30) SANDBAGS.  
 X-SEC 3+86  
 BRIDGE 27.6 FEET WIDE 7 FEET HIGH  
 PROTECT MOBILE HOME PARK WITH (12) CONCRETE HIGHWAY BARRIERS ALONG FENCE LINE.  
 X-SEC 4+00  
 MOBILE HOMES  
 STORE

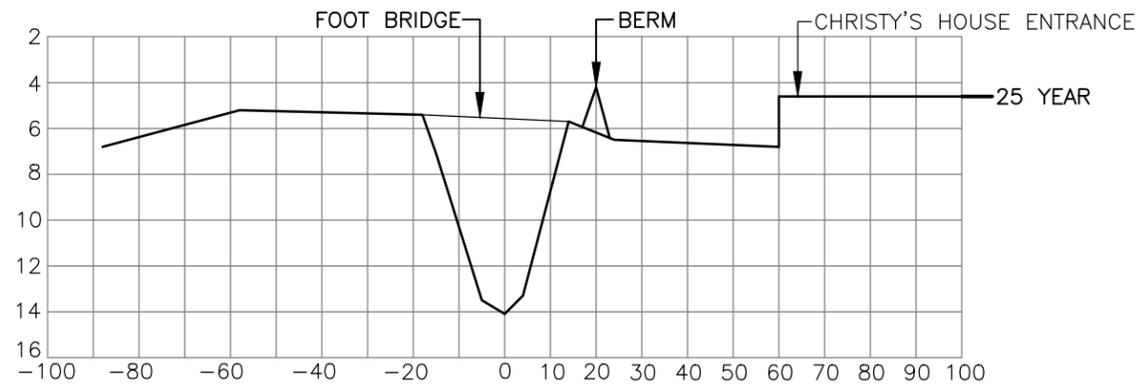
HOUSE  
 PROTECT HOUSE BY PLACING SANDBAGS AND PLASTIC 2.5 FEET HIGH AROUND HOUSE.  
 X-SEC 6+33  
 GARAGE  
 PROTECT GARAGE WITH (12) CONCRETE BLOCKS STAKED TWO HIGH.  
 X-SEC 7+37  
 HOUSE  
 NEW GARAGE  
 PROTECT GARAGE WITH (14) CONCRETE BLOCKS STACKED TWO HIGH.  
 X-SEC 8+00  
 HOUSE



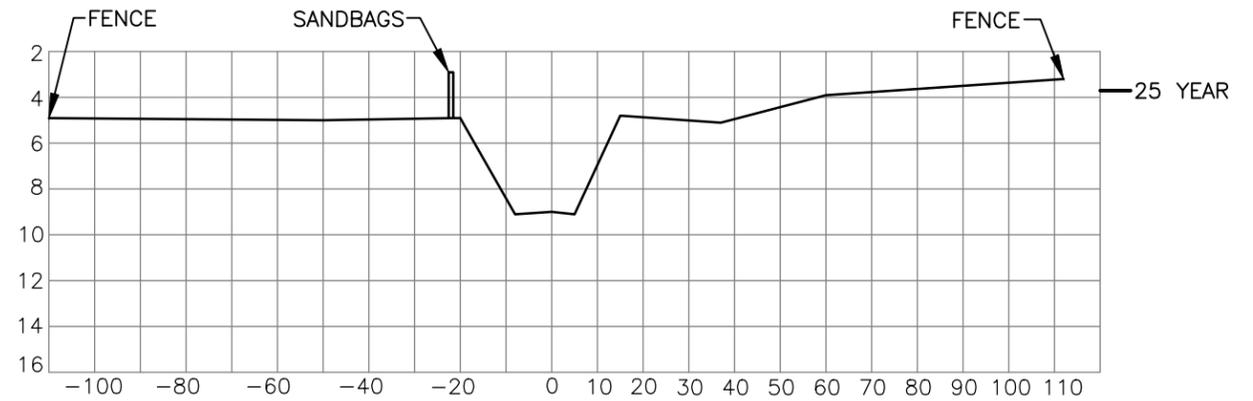
DATE	02/13
DESIGNED A. ALBIN	
DRAWN D.D. DROULLARD	
CHECKED D. WOLFF	
APPROVED	

**SITE PLAN**  
 HILL GULCH FLOOD PROTECTION RECOMMENDATIONS  
 HIGH PARK BURN AREA  
 LARIMER COUNTY

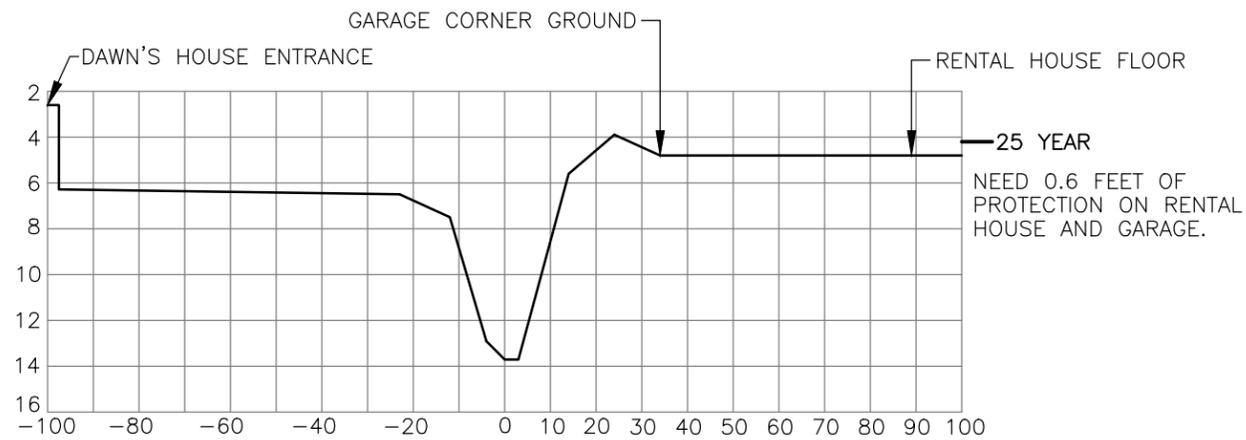




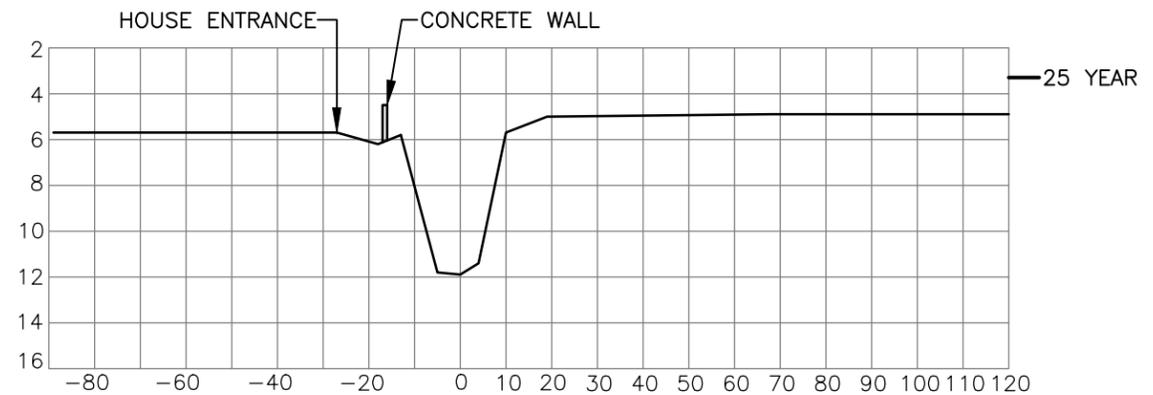
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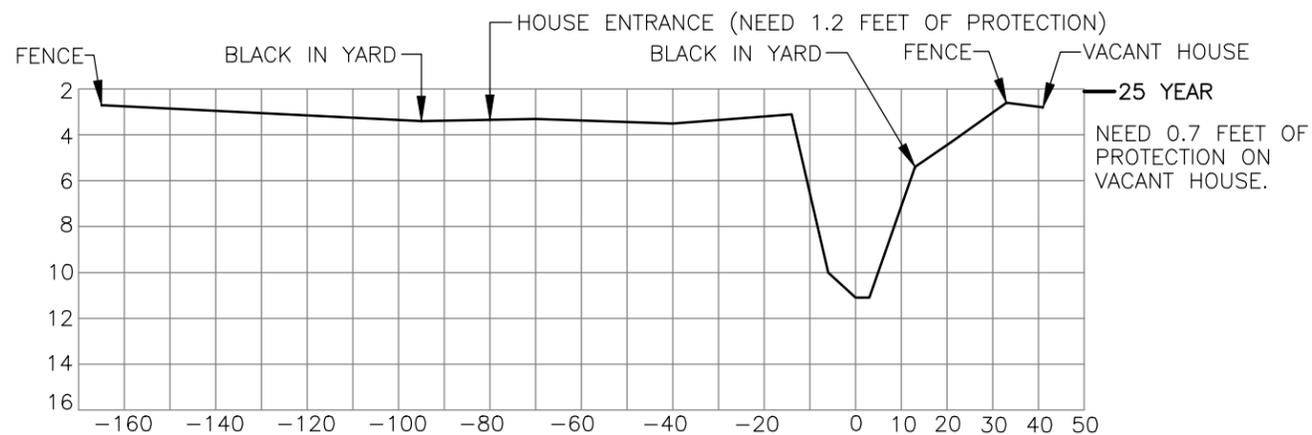
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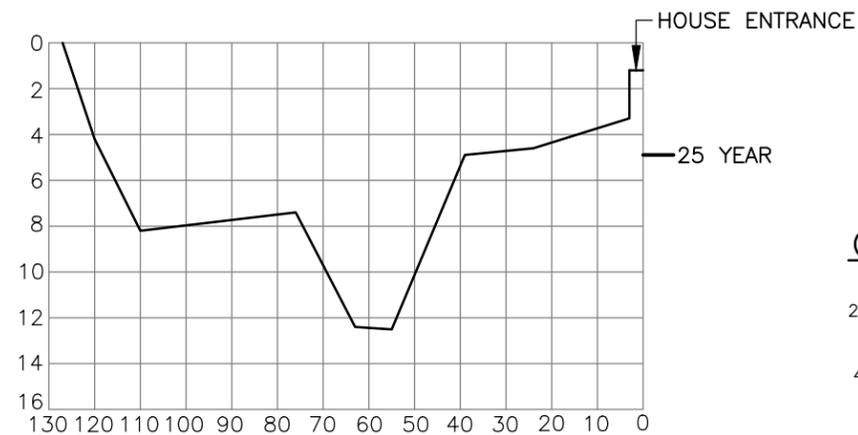
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**X-SEC 6+33**  
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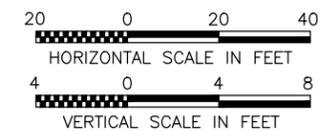


**X-SEC 2+86**  
(166.74 S.F.)



**X-SEC 7+37**  
(298.41 S.F.)

**CROSS SECTIONS**  
(LOOKING DOWNSTREAM)



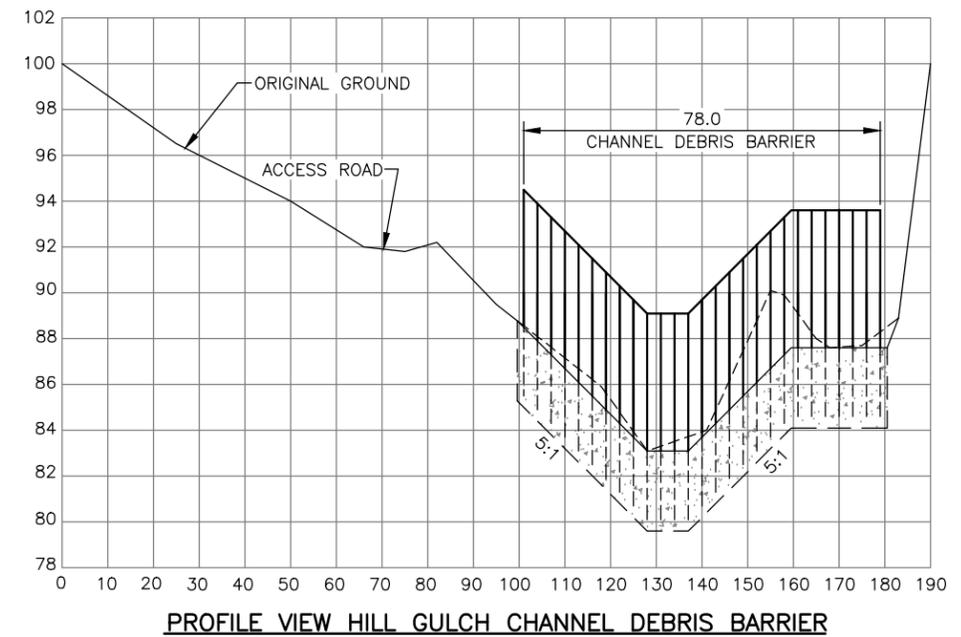
DESIGNED A. ALBIN	DATE 02/13
DRAWN D.D. DROULLARD	02/13
CHECKED D. WOLFF	02/13
APPROVED _____	

**CROSS SECTIONS**  
HILL GULCH FLOOD PROTECTION RECOMMENDATIONS  
HIGH PARK BURN AREA





**PLAN VIEW**  
 20 0 20 20  
 SCALE IN FEET



**PROFILE VIEW HILL GULCH CHANNEL DEBRIS BARRIER**

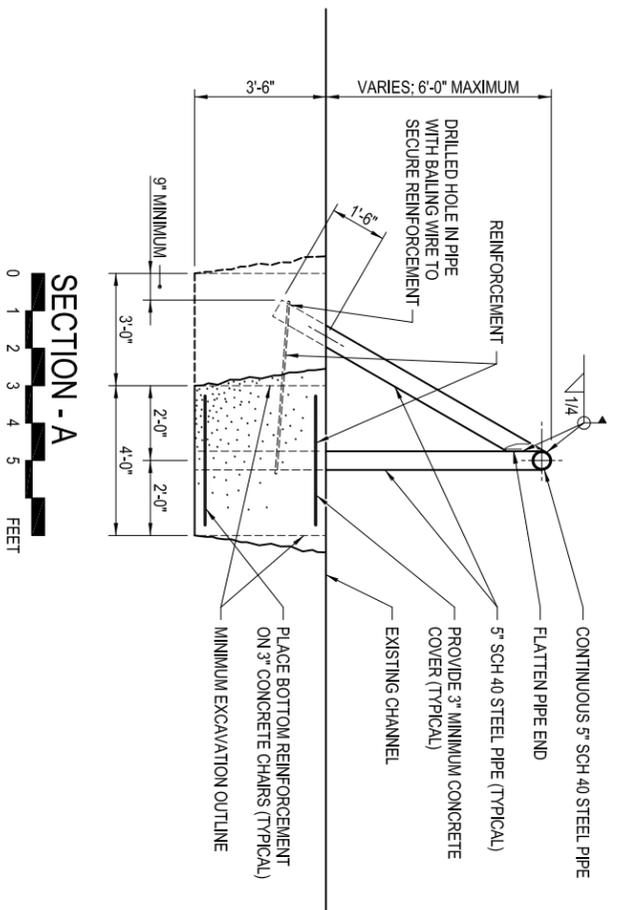
DESIGNED A. ALBIN  
 DRAWN D.D. DROULLARD  
 CHECKED D. WOLFF  
 APPROVED \_\_\_\_\_

DATE 02/13  
 02/13  
 02/13

**PLAN AND PROFILE VIEW CHANNEL DEBRIS BARRIER**  
 HILL GULCH FLOOD PROTECTION RECOMMENDATIONS  
 HIGH PARK BURN AREA  
 LARIMER COUNTY  
 COLORADO

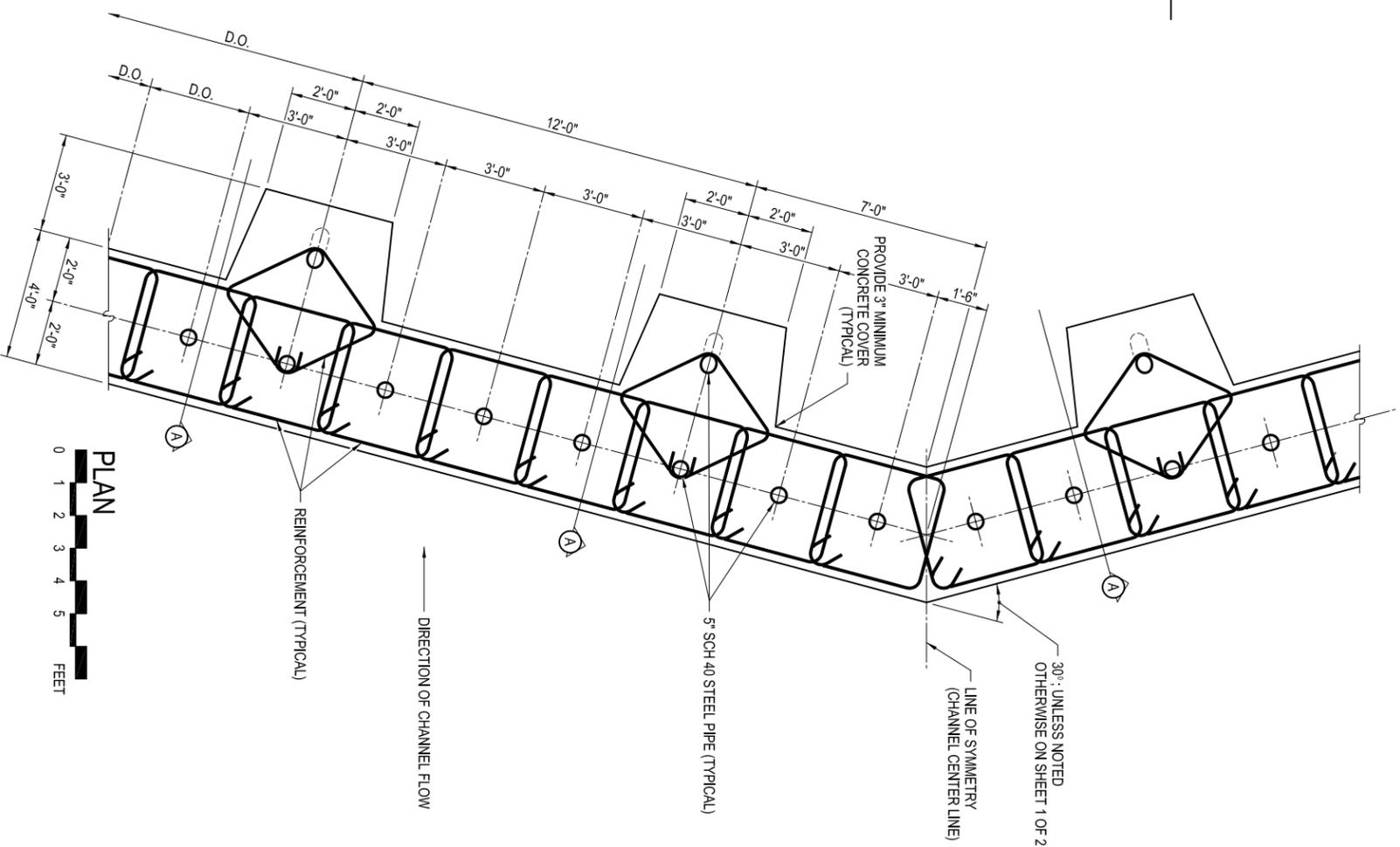
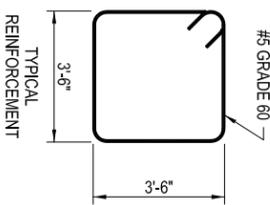


FILE NO.  
 DRAWING NO.  
 SHEET 4 OF 5



**SECTION - A**  
0 1 2 3 4 5  
FEET

- NOTES**
1. LENGTH AND ALIGNMENT OF STRUCTURE TO BE DETERMINED ON A SITE SPECIFIC BASIS. SEE SHEET 1 OF 2 FOR DIMENSIONS AND ELEVATIONS.
  2. IN LIEU OF 5" SCH 40 STEEL PIPE, STRUCTURAL STEEL TUBE SHAPES HAVING A SECTION MODULUS OF AT LEAST 4.5 IN<sup>4</sup> MAY BE USED, OR W<sub>8</sub> OR I<sub>8</sub> SHAPES HAVING A SECTION MODULUS OF AT LEAST 4.9 IN<sup>4</sup> MAY BE USED.
  3. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 LB/IN<sup>2</sup> AND SHALL HAVE A SLUMP BETWEEN 3 AND 5 INCHES. ALL CONCRETE SHALL BE VIBRATED, EXPOSED CONCRETE SURFACES SHALL BE COATED WITH CURING COMPOUND, OR WET CURED FOR 28 DAYS.



**PLAN**  
0 1 2 3 4 5  
FEET

	Designed	Drawn	Checked	Approved	Date
	Stambaugh	Stambaugh	Marine	Andrews	AUG 2012
					AUG 2012
					AUG 2012
					AUG 2012

## CHANNEL DEBRIS BARRIER

DETAILS, REINFORCEMENT, AND SECTION  
6-FOOT MAXIMUM HEIGHT



File Name  
XXXXXXXXXX  
Drawing No.  
X - X - XXXX