DRAFT

FINAL DRAINAGE REPORT POWERS BOULEVARD – STATE HIGHWAY 83 AND SHOUP ROAD IMPROVEMENTS

CDOT PROJECT STU M240-081
September 10, 2003

Submitted to
COLORADO DEPARTMENT OF TRANSPORTATION
REGION II
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DRAINAGE CERTIFICATION:

I hereby certify that this report for the drainage design for Powers Boulevard North Extension was prepared by me (or under my direct supervision) in accordance with the provisions of the Colorado Department of Transportation Drainage Design Manual, and was designed to comply with the provisions thereof. I understand that the Colorado Department of Transportation does not and will not assume liability for drainage facilities designed by others.

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INTRODUCTION

Project Location

This drainage report presents a supplement to the final drainage report for Powers Boulevard North Extension from Briargate Parkway to State Highway 83 (Sta. 603+85.80 to Sta. 760+67.08) located within the limits of the City of Colorado Springs, El Paso County, Colorado as shown in Figure 1: Vicinity Map. This extension is known as CDOT Project STU R200-107. This first supplemental report amended prior information presented in the "Final Drainage Report Powers Boulevard North Extension" (Reference 9) for drainage structures north of Powers Boulevard Sta. 721+00. These changes were made due to the realignment of State Highway 83, associated entrance and exit ramps, and revisions in the hydraulic grade line criteria. This current report continues with the design of the interchange of Powers Boulevard and State Highway 83, and also includes the realignment of Shoup Road with State Highway 83. This portion of construction is known as CDOT Project STU M240-081.

Site Location and Description

The Colorado Department of Transportation (CDOT) is extending Powers Boulevard to the northwest through Sections 16, 21, 22, 26, 27 and 35 of Township 12 South, Range 66 West of the 6th Principal Meridian. The extension traverses gentle rolling prairie grasslands and will cross a north tributary of Pine Creek, the main tributary of Kettle Creek, and the upper tributary of the Elkhorn Basin. Also included in this construction is the realignment of State Highway 83 from the Powers Boulevard intersection to the Shoup Road intersection. State Highway 83 is within the upper tributary of the Elkhorn Basin and then crosses over Black Squirrel Creek. The soils in the project area are predominantly Peyton and Pring soils. See Figure 2: Soil Classification Map. The Natural Resources Conservation Services (NRCS) of El Paso County (Reference 12) refers to these types of soil as hydrologic soil type B, which are relatively poor draining soils with high runoff potential.

Construction of the entire Powers Boulevard project is planned in two phases. Phase I will consist of construction for parts of the mainline roadway and ramps from north of Briargate Parkway to realigned State Highway 83. In addition, ramps and a revised intersection to Old Ranch Road will be constructed in the Phase I project. Phase II will consist of roadway construction for the mainline Powers Boulevard between Briargate Parkway and Union Boulevard and near Old Ranch Road.

Construction of the Powers Boulevard and State Highway 83 intersection will occur in three stages. Stage I (Pre-Interim Condition) will consist of construction of Powers Boulevard to Sta. 749+00, the beginning of the northbound off ramp (Ramp E) and the beginning of the southbound on ramp (Ramp F). The first supplemental drainage report described the drainage structures involved in this first stage of construction.

Stage II (Interim Condition) will consist of realigning State Highway 83 from Powers Boulevard to Shoup Road and the completion of Ramp E and F from Powers Boulevard to State Highway 83. This supplemental drainage report will describe the drainage structures involved in this second stage of construction. Stage III (Ultimate Condition) will consist of continuing Powers Boulevard north, the southbound off ramp (Ramp G) and the northbound on ramp (Ramp H). The first supplemental drainage report analyzed both conditions, interim and ultimate, to size drainage structures for the worst case scenario within the first stage of construction within the Elkhorn Basin. This supplemental drainage report will continue to use this analysis for the interim condition for the Elkhorn Basin at the State Highway 83 and Powers Boulevard intersection. A separate analysis for the Black Squirrel Creek Basin will be shown in this drainage report. An additional drainage report (to be published separately) will describe the drainage structures involved in the third stage of construction.

HYDROLOGIC AND HYDRAULIC ANALYSIS

Basin Description

The Interim Condition of the Powers Boulevard and State Highway 83 intersection and the realignment of State Highway 83 and Shoup Road is within two drainage basins: Elkhorn Basin and Black Squirrel Creek Basin. For the Elkhorn Basin, the interim drainage areas and ultimate drainage areas are shown for both basins in Figure 3: Elkhorn Basin Intermediate Drainage Basin Map and Figure 4: Elkhorn Basin Ultimate Drainage Basin Map. For the Black Squirrel Creek basin, the drainage areas are shown on Figure 5: Black Squirrel Creek Basin Map.

Elkhorn Basin

Elkhorn Basin is located in northern El Paso County. The Elkhorn Basin flows relatively west toward Monument Creek and eventually into the Arkansas River Basin. Elkhorn's headwaters are within the intersection of the Powers Boulevard mainline and realigned State Highway 83. There is currently no Drainage Basin Planning Study (DBPS) for the Elkhorn Drainage Basin (FOMO3400).

The Elkhorn Basin is bounded by the Black Squirrel Basin to the north and Kettle Creek Basin to the south. A semiarid climate exists within the basin. The basin covers an area of roughly 3.5 square miles and has an elevation range of 6940 to 7040 feet. See Appendix A: Hydrology - Rational Basin Calculations for Elkhorn Basin for hydrology.

Black Squirrel Creek Basin

Black Squirrel Creek Basin is in northern El Paso County and has a majority of the area within the Black Forest area. Black Squirrel Creek flows southwest towards Monument Creek and eventually into the Arkansas River Basin. A DBPS (Reference 2) was completed in January 1989 for the basin (FOMO3600).

The Black Squirrel Creek Basin is bounded by several other basin, with West and East Cherry Creek to the north and east, Kettle Creek and Elkhorn to the south and east, and Smith Creek, Monument Branch, and Middle Tributary along the west. A majority of the basin is forested while about a third is pasture or rangeland. The total basin area is approximately 10.3 square miles and has an elevation range or 6500 to 7500 feet. See Appendix B: Hydrology - Rational Basin Calculations for Black Squirrel Creek Basin for hydrology.

Channel Description

Elkhorn

Elkhorn is a small tributary to Monument Creek. Powers Boulevard crosses Elkhorn in the upper portions of the basin. The majority of the area is small swales, with non-existent flood plains.

Black Squirrel Creek

Black Squirrel Creek is a small to medium sized tributary to Monument Creek. State Highway 83 currently crossed Black Squirrel Creek just north of Shoup Road. The creek, within the project area, is a deep narrow channel with minimal vegetation on the channel bottom and well-vegetated side slopes.

Precipitation

Northern El Paso County can be described in general as high plains and foothills, with total precipitation amounts of a semi-arid region. The average annual precipitation varies from a low of 8 inches to a high of 20 inches in the higher elevations. Winters are generally cold and dry with precipitation in the form of snow. Winter storms typically track from the west to the east and the majority of the snowfall occurs in the higher mountains to the west and snowpack in the basin is generally light, therefore springtime runoff is generally light. The majority of precipitation occurs during the months of May through September from convective thunderstorms. During the summer months intense thunderstorms occur, sometimes of cloudburst intensity. Normal annual precipitation for Colorado Springs is 13.2 inches, with the normal maximum monthly amount of 2.4 inches occurring in July.

Flood History

Recorded flood histories for the Elkhorn and Black Squirrel Creek Basins do not exist. The Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) for El Paso County and Incorporated Areas shows a 100-year floodplain for Black Squirrel Creek Basin and no designated regulated floodplains within the Elkhorn Basin, as shown on Figure 6: Flood Insurance Rate Map (FIRM).

Design Frequency

The design frequency is based on CDOT criteria (Table 7.2 on page 7-8 of the CDOT Drainage Design Manual-Reference 5) for multilane roads in urban areas. The 100-year storm event was used for the project, due to the urbanization of the area, for the major storm. The 5-year storm is used for any minor storm systems. Culvert outlet scour protection and channel lining are based upon the 10-year storm.

Design Discharge

Method of Analysis

The hydrology for this project is analyzed for the design storm using two methods as recommended by both the CDOT Drainage Design Manual (Reference 5) and the City of Colorado Springs and El Paso County Drainage Criteria Manual (City DCM) (Reference 3). The Rational Method is used for drainage basins less than 160 acres in size. U.S. Army Corps of Engineers HEC-HMS computer model program utilizing the SCS Unit Hydrograph Method was utilized for drainage basins greater than the 160 acres.

Run-off Coefficients

Rational Method coefficients are from Table 5-1 on page 5-8 of the City DCM (Reference 1). The 10-year storm C values were used for the 5-year storm as per the manual's recommendations. The SCS curve numbers were also taken from the City DCM (Reference 3).

Time of Concentration

The Time of Concentration (t_c) for both the Rational Method and the SCS Method were taken from the CDOT Drainage Design Manual page 7-11 (Reference 5). The time of concentration consists of the initial time (the time runoff is sheet flowing) and the travel time (time runoff is in a channel). A minimum t_c of 5 minutes was used due to urban area, as per CDOT Drainage Design Manual page 7-13 (Reference 5).

Rainfall Intensity and Depth

The rainfall intensity curves for the Rational Method were taken from the City DCM Figure 5-1 (Reference 3). Rainfall intensities of 2.96 inches and 4.4 inches for the 10-year and 100-year storm were used for the SCS method, based on the 24-hour Type IIA storm distribution. These values were taken from the City DCM Figure 5-4d and Figure 5-4e (Reference 3).

EXISTING STRUCTURES

Drainage Structures

An effort has been made to maintain as many existing drainage structures as possible. This has been done by either adding to or extending structures or by modifications to the structure itself. In some cases, the existing structure was undersized and could not handle the major storm event properly. In this case, the structure was replaced or abandoned for an alternative structure in a different location. Within this supplemental project area, the existing 15-foot corrugated metal underpass culvert under State Highway 83 north of Shoup Road will have to be replaced, due to being undersized and not allowing a habitat corridor for the Prebles Meadow Jumping Mouse (PMJM). The replacement is called out as a bridge in the DBPS (Reference 2).

Other Utilities

Other utilities that may be encountered include but are not limited to water distribution, sanitary sewer, gas and electrical lines. These utilities have been examined on a case by case basis and will be avoided where feasible and/or relocated. Any relocation of these utilities has and will continue to be coordinated with the respective utility contact.

DESIGN DISCUSSION

Introduction

The criteria has been established by reviewing the most stringent requirement of the City DCM (Reference 3) and CDOT Drainage Design Manual (Reference 5). The appropriate design storm was used to size the storm drain system based on the design frequency discussed above.

Roadside Ditches

Roadside ditches are designed using the Manning's Equation for open channel flow. Flexible linings for erosion protection were designed using Federal Highway Administration (FHWA) "Design of Roadside Channels with Flexible Lining" (Reference 8). Ditches were sized using the worst-case scenario hydrology for the interim or the ultimate condition, where appropriate.

Inlets and Storm Sewer Systems

Inlet spacing is based on the road surface area required to generate enough runoff to reach either gutter capacity, given the allowable spread, or the ditch capacity given the allowable depth for the design storm. The inlet efficiency and inlet sizing are calculated using *Haestad Methods'* FlowMaster design software for the Type C close mesh grate inlets and the Type R curb opening inlets.

Storm sewer systems were designed using *Haestad Methods'* StormCAD design software. The system is sized using the 100-year storm with the hydraulic grade line (HGL) remaining inside the storm drain

system. The 100-year storm HGL is shown on the construction plans. The storm systems were based on a worst-case scenario hydrology for the interim and ultimate conditions, where appropriate.

Energy Dissipators

Energy dissipators will be used to reduce flow velocities of storm water at various locations, as noted. Riprap plunge pools at culvert outfalls are based FHWA "Hydraulic Design of Energy Dissipators for Culverts and Channels" (Reference 7). These are used to reduce the exit velocity.

In cases where the exit velocity is greater than the allowable 16 feet per second as per CDOT Criteria Manual (Reference 5), an internal energy dissipator is used to create tumbling flow within the circular culvert. Energy is dissipated by having a series of internal rings inside the culvert, reducing the diameter of the culvert and causing either full flow or tumbling flow. The abrupt change in flow regime, causes an increase in flow area and a reduction in velocity to discharge the same quantity of flow. This internal energy dissipator is based on FHWA "Hydraulic Design of Energy Dissipators for Culverts and Channels" (Reference 7) and the American Concrete Pipe Association (APWA) "Concrete Pipe Handbook" (Reference 1).

Open channel drop structures are used to reduce elevation of a channel in a controlled area, keeping the main portion of the channel at a non-eroding slope. Two types of drop structures are found within this project. The first is a straight drop structure, where the elevation change occurs in a vertical drop. The flow impacts the floor of the drop structure at a pre-determined distance from the vertical drop. Floor blocks are placed downstream of the impact point to create a hydraulic jump in the flow. To complete the process, an end sill is placed at the end of this structure.

The second type of drop structure is a sloping drop, where a steep slope is used drop elevation, forcing supercritical flow. A stilling basin is created at the bottom of the drop to force a hydraulic jump before an end sill completes the structure. Both of these structures are based on FHWA "Hydraulic Design of Energy Dissipators for Culverts and Channels" (Reference 7) and Denver Regional Council of Governments (DRCOG) "Urban Storm Drainage Criteria Manual, Volume 2" (Reference 6).

RECOMMENDED DESIGN

The recommended improvements due to the construction of Powers Boulevard are shown on the construction drawing set of CDOT Project No. STU M240-081. A brief description of each improvement in the supplemental project area is listed below.

Kettle Creek Basin

A continuation of the roadside ditches along Ramp E and Ramp F will take flow towards the existing inlets in CDOT Project STU R200-107. This continuation includes the underdrains as noted. The flow from these ditches was accounted for in the design of each of these existing inlets. Please refer to URS "Final Drainage Report – Supplemental Powers Boulevard North Extension Sta. 721+00 to Sta. 749+00" (Reference 10).

Elkhorn Basin

See Appendix C: Hydraulics - Ditch Capacity / Lining for Elkhorn Basin, Appendix D: Hydraulics - Culvert Design for Elkhorn Basin, Appendix E: Hydraulics - Multiple Drop Structure Design For Elkhorn Basin, and Appendix F: Hydraulics - Inlet / Storm System Design for Elkhorn Basin for calculations on the following systems.

Line SE

At the upper portion of the Elkhorn Basin, near the intersection of the proposed State Highway 83 and the State Highway 83 Access Road, a series of inlets will be used to direct flow from the median towards the right ditch. The downstream inlet is set at 10 feet above the zero percent cross-slope (where the cross-slope transfers from a super-elevation to a normal crown) of Proposed State Highway 83, as per CDOT Drainage Criteria Manual (Reference 5).

STR-231

At the intersection of Ramp E and the proposed State Highway 83, a culvert will bring flow from the left ditch over to the right ditch. In the ultimate condition, with Ramp H being constructed, a berm at the top of the cut slope will direct flow down to this culvert. The beginning of this berm is shown at the upstream portion of the culvert. The culvert size is designed for the ultimate condition flow.

Line SC and SD

To bring the headwaters of the Elkhorn Basin under Ramp E, a significant elevation drop has to occur from the existing ground. In addition, there is no well-defined channel for the Elkhorn basin at this upstream location. A series of Type D inlets are designed in conjunction with articulated concrete blocks and a berm to form a sump area for the flow to be collected. The inlets were designed with a clogging factor and redundancy. The flow will be dropped through the inlets and out a culvert to a lower elevation to travel under Ramp E.

The outfall of the culvert, due to the slope and flow, has an exit velocity higher than the 16 feet per second allowable by CDOT Drainage Criteria Manual (Reference 5) without any internal reduction. An internal energy dissipator was designed to reduce the exit velocities to acceptable levels, as per FHWA "Hydraulic Design of Energy Dissipators for Culverts and Channels" (Reference 7). A riprap plunge pool continues this process.

The flow from line SC and SD will combine with the interceptor ditch along the top of Ramp E cut slope. The interceptor ditch is used to keep as much drainage area in the Elkhorn Basin as possible, while also reducing the possibility of erosion along the cut slope.

STR-114

A culvert will take storm water from the right side of Ramp E to the left side. A riprap plunge pool is designed to reduce velocities to non-erosive levels.

Drop Structure Area

To continue the Elkhorn Basin under future Powers Boulevard, a series of drop structures are needed. The upstream drop structures are vertical drops with floor blocks, as per FHWA "Hydraulic Design of Energy Dissipators for Culverts and Channels" (Reference 7). Boulders were used instead of the typical concrete foundation to maintain a more appealing natural look. Grouted riprap and 4:1(horizontal to vertical) side slopes complete the structure.

The downstream drop structure is a grouted sloping boulder drop on a 4:1 horizontal to vertical slope, as per FHWA "Hydraulic Design of Energy Dissipators for Culverts and Channels" (Reference 7). A plunge pool at the bottom of the structure causes a hydraulic jump to complete the structure.

STR-410

A concrete box culvert will take flow under both the future Powers Boulevard and Ramp F. In the interim condition, only about half of the ultimate box culvert will be installed. A continuation of the box culvert will take the Elkhorn Basin under Powers Boulevard in the ultimate condition. A trapezoidal channel will be installed in the same alignment and profile as the future box culvert during the interim condition.

The box culvert is sized for the ultimate condition. During the ultimate condition, other culverts will be connected to the future box culvert to take flow from future Powers Boulevard and future ramps.

Line SB

A type C inlet will take flow from the northwest side of the proposed State Highway 83. This inlet will also take the discharge from the existing corrugated metal pipe (CMP) under the existing State Highway 83. A type R inlet will take flow from the median of proposed State Highway 83 near the turn lane to Ramp F. Both of these will discharge into STR-410.

Elkhorn Basin Channel

STR-410 will discharge into the proposed trapezoidal channel. To drain, a minimal slope will be used for this channel, until the southern portion of the project where the flow will discharge into the historical channel.

Line SA

At the southern end of the project, a series of type R inlets will collect flow along the median and discharge into the existing ditch along Old State Highway 83. The downstream inlet is set 10 feet upstream of the zero percent cross-slope of proposed State Highway 83, as per CDOT Drainage Criteria Manual (Reference 5).

Black Squirrel Creek Basin

See Appendix G: Hydraulics - Ditch Capacity/ Lining for Black Squirrel Creek Basin, Appendix H: Hydraulics - Culvert Design for Black Squirrel Creek Basin, Appendix I: Hydraulics – Channel Improvements for Black Squirrel Creek, and Appendix J: Hydraulics - Inlet / Storm System Design for Black Squirrel Creek Basin for calculations on the following systems.

Line SF and SG

A series of type R inlets accepts flow from the median along proposed State Highway 83 north of the intersection with State Highway 83 Access Road. A type D inlet takes flow from the right ditch and, combining with the median flow discharges into the left ditch. This flow then flows down the left ditch of the State Highway 83 Access Road and then into the existing east ditch along the existing State Highway 83. The proposed discharge is within five percent of the historic flow at this point.

STR-703 and STR-708

A pair of culverts takes flow from the left ditch of State Highway 83 Access Road to the right ditch, back from the right ditch to the left ditch, and then along the existing ditch of the existing State Highway 83.

Left Roadside Ditch Sta. 258+00

The left ditch of proposed State Highway 83 from the highpoint at Sta. 251+00 to Sta. 258+00 discharges into the existing ditch of existing State Highway 83. The proposed flow is less than historic, due to a portion of the historic drainage area being intercepted by the right ditch of proposed State Highway 83.

Line SI

A flared end section takes ditch flow from the right side of Shoup Road to the left side. This flow, in combination with the left ditch, will discharge into Black Squirrel Creek upstream of the proposed bridge. The outfall of the culvert, due to the slope and flow, has an exit velocity higher than the 16 feet per second allowable by CDOT Drainage Criteria Manual (Reference 5) without any internal reduction. An internal energy dissipator was designed to reduce the exit velocities to acceptable levels, as per FHWA "Hydraulic Design of Energy Dissipators for Culverts and Channels" (Reference 7). The outfall will be in the proposed Black Squirrel Creek channel bottom.

Sheetflow along right side Sta. 270+00

Due to the fill condition of proposed State Highway 83 on the right side from Sta. 270+00 to the end of construction at Sta. 298+49, no roadside ditch will be used. The two existing culverts taking flow from the left side of proposed State Highway 83 to the right will be removed. The existing ditch along the right side, outside of the right-of-way will have sheet flow from proposed State Highway 83 that will be less than historic, due to the removal of the existing culverts.

Line SH

A roadside ditch will take flow along the left side of proposed State Highway 83 and discharge into Black Squirrel Creek through a Type D inlet and storm system. The outfall of the culvert, due to the slope and flow, has an exit velocity higher than the 16 feet per second allowable by CDOT Drainage Criteria Manual (Reference 5) without any internal reduction. An internal energy dissipator was designed to reduce the exit velocities to acceptable levels, as per FHWA "Hydraulic Design of Energy Dissipators for Culverts and Channels" (Reference 7). The outfall will be in the proposed Black Squirrel Creek channel bottom.

Black Squirrel Creek Bridge and Drop Structures

The existing 15-foot corrugated metal underpass culvert will be replaced with a single-span bridge, as per the recommendations of the Black Squirrel Creek DBPS (Reference 2). With a low chord of 6891.89 feet, there will be over 25 feet of freeboard over the 100-year water surface elevation. No scour is anticipated as there are no piers or abutments in the channel area, nor is there any contraction.

Buried riprap protection with vegetation will be used to guide the Black Squirrel Creek into and through the proposed bridge. Vegetated gabions will replace the existing concrete slope paving in the 2:1 horizontal to vertical area. A series of small drop structures (maximum of 3.5' in height) will be used to drop the channel bottom to existing grade. The drops will be used for habitat improvement and will be installed with as minimum excavation as possible. The furthest downstream drop will be used to prevent possible headcutting of the abutments of the bridge. A small 1-foot by 1-foot key low flow opening will continue the average daily flow through the drop structures.

EROSION CONTROL

Best Management Practices (BMPs) will be utilized to minimize erosion during construction and are shown on the construction drawing set of CDOT Project No. STU M240-081 in accordance with CDOT Erosion Control and Stormwater Quality Guide (Reference 4). BMPs will be utilized as deemed necessary by the contractor and/or engineer and are not limited to the measures shown on the construction drawing set. The contractor shall minimize the amount of area disturbed during all construction activities. All materials shall conform to the CDOT Standard Specifications for Road and Bridge Construction.

In general the following shall be applied in developing the sequence of major activities:

1. Install downslope and sideslope perimeter BMPs before the land disturbing activity occurs.
2. Do not disturb an area until it is necessary for the construction activity to proceed.
3. Cover or stabilize as soon as possible.
4. Time the construction activities to reduce the impacts from seasonal climatic changes or weather events.
5. The construction of filtration BMPs should wait until the end of the construction project when upstream drainage areas have been stabilized.
6. Do not remove the temporary perimeter controls until after all upstream areas are stabilized.

Drainage Ditches

The roadside ditches will have 6:1, 4:1 and 3:1 side slopes with a typical 4' bottom width. The ditches will be seeded with native grasses to match those that exist at the site now. Plastic soil retention blanket shall be installed in drainage ditches where noted. The minimum shear stress allowable is 3.00 pounds per square foot. Straw soil retention blankets shall be installed in the remainder of the drainage ditches where noted. Erosion bales or logs shall be installed in drainage ditches where noted. The maximum spacing between bales/logs should be such that the toe of the upstream bale/log is at the same elevation as the top of the downstream bale/log. Erosion bales/logs shall remain in place until all construction is complete and/or "finally stabilized". Bales/logs shall be inspected frequently and, if needed, repair/replacement made promptly. At this time, the bales/logs shall be removed from the ditches. All material shall be installed per manufacture's installation instructions.

Slopes

Plastic soil retention blanket shall be installed where noted on slopes 3:1 or steeper facing south or west. Mulching with mulch tackifier shall be installed where noted on slopes 3:1 or steeper facing north or east. Silt fence shall be installed at the toe of fill slopes where noted on a level contour. Erosion logs shall be installed on slopes greater than ten feet in height where noted to reduce runoff length. The erosion logs shall be installed on a level contour. Disturbed surfaces shall be left in a roughened condition at all times with horizontal depressions approximately 2" to 4" deep, spaced 4" to 6" apart. Silt fence shall remain in place until all construction is complete and/or "finally stabilized". At this time, the silt fence shall be removed from the slopes. All material shall be installed per manufacture's installation instructions.

Stockpiles/Mobilizations/Winter Shutdown

Soils stockpiled for more than 30 days shall be mulched with mulch tackifier and native seeding within 14 days of stockpile construction. After any mobilization and prior to any winter shutdown, all disturbed slopes not completed shall be mulched with mulch tackifier and native seeding shall be required.

Inlet and Outlet Protection

Storm Drain Inlet Protection shall be provided at all storm inlets where noted. All material shall be installed per manufacture's installation instructions. Permanent riprap plunge pools shall be installed at

outlets where noted to dissipate energy to a non-eroding velocities (d_{50} noted). Erosion control geotextile shall be installed as bedding. All material shall be installed per manufacture's installation instructions. A concrete apron will be used at STR-410 to help establish a normal flow regime.

Concrete Washout

A concrete washout structure shall be installed for cleaning concrete trucks. The concrete washout structure shall be bermed such that water can only evaporate or infiltrate from the structure. The concrete washout structure shall be periodically cleaned out of residue and concrete.

Erosion Control Supervisor and Maintenance

The erosion control supervisor shall be a person other than the superintendent. The erosion control supervisor shall inspect at least every 14 days and after any precipitation or snowmelt event that causes surface erosion. At sites where construction has been completed but a vegetative cover has not established, these inspections must occur at least once per month.

All erosion control measures shall remain in place until all construction is complete and/or "finally stabilized". "Finally Stabilized" means that all disturbed areas have been either built on, paved, or a uniform vegetative cover has been established with a density of at least 70 percent of pre-disturbance levels, or equivalent permanent, physical erosion reduction methods have been employed. Any areas not meeting this equivalent shall be repaired according to the BMPs and re-seeded at no additional cost. Re-seeding alone shall not qualify. Accumulated sediment and debris shall be removed when the sediment level reaches one half the height of the BMP or at any time that sediment or debris adversely impacts the function of the BMP. The Contractor shall remove all sediment, mud, and construction debris that may accumulate in any public right of ways not designated before hand as a result of this construction project. All repairs, removals, and replacements stated above shall be conducted in a timely manner.

ANTICIPATED CONSTRUCTION PERMITS

Construction permitting is required by many agencies, depending on the location, type, and magnitude of construction activity. Below is a summary of some of the anticipated construction permits required prior to construction. **This list is meant to be a helpful starting point and is no way all inclusive of the construction permits required.** A pre-construction meeting with local/city/county departments is key to a successful beginning. A point of contact for each permit is a good way to insure that the permit is acquired, compliance is kept, and periodic inspections are completed as required. Not included in this list is local or special permits needed (e.g. grading permit, construction dewatering, waste generation and disposal, fuel and oil storage, chemical handling, wildlife protection, cultural resources, etc.)

Colorado's Stormwater General Permit for Construction Activities

A stormwater permit is required for any construction activity that disturbs at least one acre of land (or is part of a larger common plan of development or sale that will disturb at least one acre). The development is considered a "small construction site" if it will disturb one to five acres, or a "large construction site" if it will disturb five acres or more. A "large construction site" is required to obtain coverage under the "Stormwater General Permit for Construction Activities" through CDHPE. A "small construction site" can obtain a permit by either applying for coverage under the "R-Factor Waiver", a state-designated qualifying local program, or the "Stormwater General Permit for Construction Activities". A "Stormwater Management Plan" (SWMP) is required for any permit, but does not qualify for the application solely. Inspection and maintenance are major keys in the implementation of this permit.

It is anticipated that the construction of this site will require this permit.

Floodplain Development Permit

All construction in federally designated floodplain areas must obtain a "Floodplain Development Permit" from the local Floodplain Administrator. Construction includes, but is not limited to: any structures, fill, excavation, utilities or bank stabilization.

It is anticipated that the construction of the bridge and proposed channel improvements in the Black Squirrel Creek floodplain will require this permit. El Paso County Floodplain Administrator is Kevin Stilson and can be reached at (719) 327-2906.

404 Permit

Permits for Section 404 of the Clean Water Act are needed for the discharge of dredged or fill material into waters of the United States from the U.S. Army Corps of Engineers (USACE). Waters of the U.S. can include rivers, streams, tributaries, and wetlands.

It is anticipated that the construction within Black Squirrel Creek will require this permit. The U.S. Army Corps of Engineer office for this project will be the Albuquerque Distrist's Southern Colorado Rgulatory Office in Pueblo at (719) 543-9459.

Others

Colorado Demolition Permit

Any demolition or dismantling activity during construction requires a "Demolition Permit Application Form" from the Colorado Department of Public Health and Environment (CDPHE), due to the possibility of asbestos.

It is anticipated that this permit will not be required.

Air Pollution Emission Notice – Land Development

An "Air Pollution Emission Notice" (APEN) for land development is required from the CDPHE when the project is over 25 acres or takes more that six months to reach completion. The permit application for land development activities must include a "Fugutive Dust Control Plan". The dust control plan addresses how dust will be kept to a minimum at the site.

It is anticipated that given the length of construction of this project, this permit may be required.

Air Pollution Emission Notice – Hot Mix Asphalt and Concrete Batching

An "Air Pollution Emission Notice" (APEN) for either hot mix asphalt or concrete batching is required from the CDPHE for new plants, including portable sources.

It is anticipated that the construction of the bridge could use or employ a portable batch plant and may require this permit.

REFERENCES

1. American Concrete Pipe Association. 1998. Concrete Pipe Handbook.

2. "Black Squirrel Creek Drainage Basin Planning Study", January, 1989. Prepared by URS.

3. "City of Colorado Springs/El Paso County Drainage Criteria Manual" Sept. 1987, Revised November 1991, Revised October 1994.

4. CDOT. 1995 (June) Erosion Control and Stormwater Quality Guide.

5. CDOT. 1995 (July). Drainage Criteria Manual.

6. Denver Regional Council of Governments. 1969 (March). Urban Storm Drainage Criteria Manual, Volume 2.

7. Federal Highway Administration (FHWA). September 1983. *Hydraulic Design of Energy Dissipators for Culverts and Channels.* Hydraulic Engineering Circular No. 14.

8. Federal Highway Administration (FHWA). April 1988. *Design of Roadside Channel with Flexible Lining.* Hydraulic Engineering Circular No. 15.

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FIGURES

Figure 1: Vicinity Map