PRELIMINARY INVESTIGATION REPORT
on the

Middle Fork Popo Agie River through Lander

Prepared by

Natural Resources Conservation Service

For

Popo Agie Conservation District
City of Lander
Fremont County

DECEMBER 20, 2001

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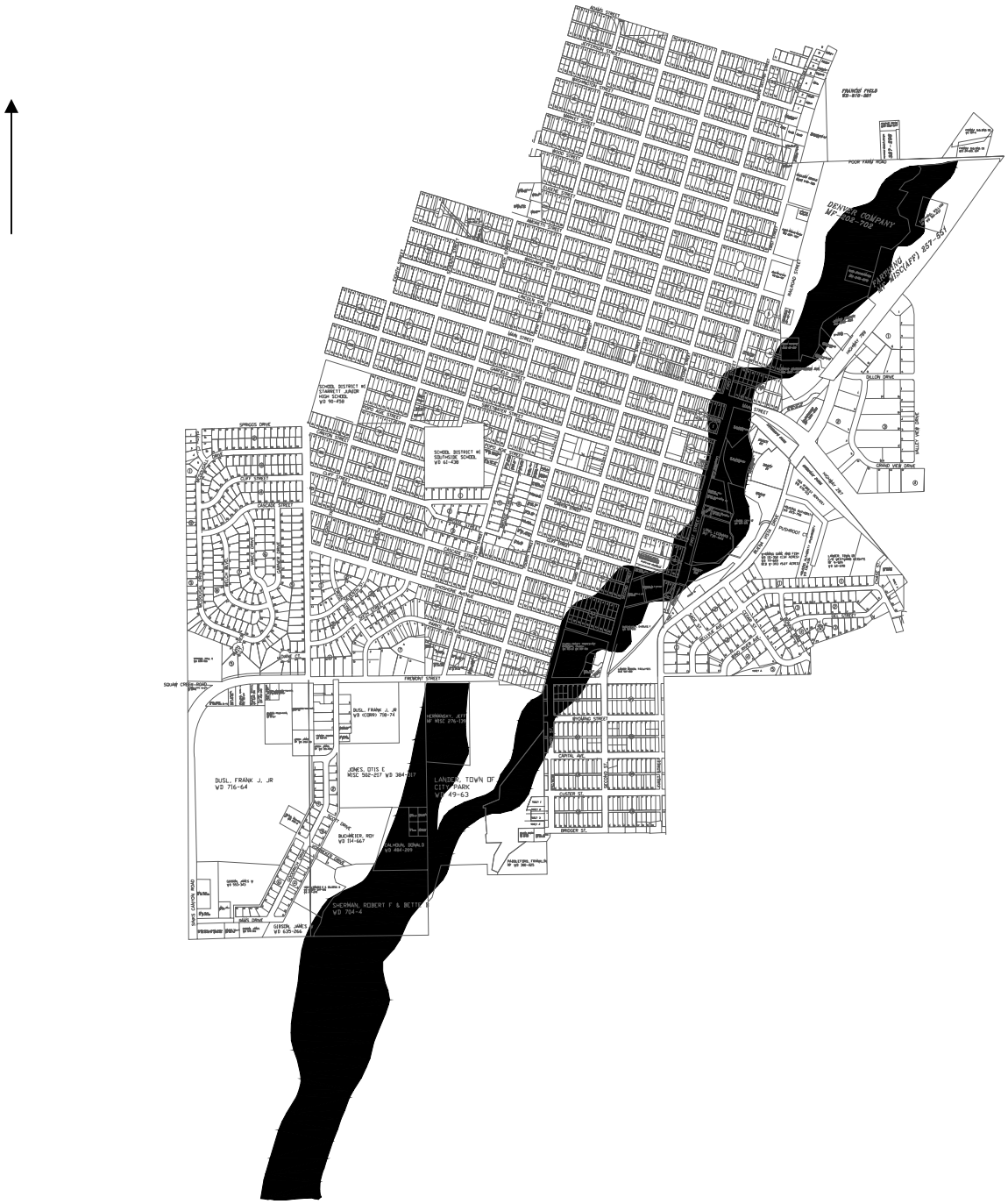
FIGURE 1 – LOCATION OF MIDDLE FORK OF THE POPO AGIE WATERSHED FLOOD CONTROL PROJECT BOUNDARIES



PROJECT MAP

Flood Control Project Boundaries

INTRODUCTION

The Natural Resources Conservation Service in Casper, Wyoming, received a request, dated October 7, 1996, to assist the Popo Agie Conservation District in the development of a watershed planning effort. The Conservation District request listed the following concerns: flood prevention, watershed protection, agricultural water management, water quality, and water quantity. Riparian restoration and streambank stabilization were included as additional concerns.

Three public meetings were held in Lander related to the Middle Fork of the Popo Agie River and resource concerns were identified and prioritized at the last of these meetings held in February of 1997. The resource concerns identified at these early public meetings were grouped into the following categories: flooding, water quality, social/economic, riparian corridors, irrigation, land use, soil, grazing lands, education, water quantity, coordination, noxious weeds, forest lands, wildlife, fisheries, air quality, and visual pollution. A meeting was held in June of 1999 to update the Lander City Council on the progress of the analysis on flooding in Lander and proposals for prevention of flood damage.

A Middle Fork of the Popo Agie steering committee was established in early 1998 and two meetings were held in March and May of 1998. This steering committee disbanded. In October of 1998, the Popo Agie Conservation District requested funding assistance, through a grant from the Wyoming Association of Conservation Districts, to expand the watershed planning effort to an overall areawide plan, encompassing the entire Popo Agie Watershed. Since that time, planning efforts on the original project area on the Middle Fork of the Popo Agie River continued in conjunction with of the expanded watershed planning process. The expanded planning effort included two additional public meetings. On March 24, 1999, the District called a meeting with Popo Agie watershed landowners to explain the watershed planning process and to ensure landowner support for the effort. On March 25, 1999, a public meeting was held and the larger, Popo Agie watershed planning effort was defined, additional resource concerns identified, and nominations made for the new Popo Agie Watershed Steering Committee.

PROJECT SPONSORS

The project sponsors are:

Popo Agie Conservation District
City of Lander
Fremont County

PROJECT OBJECTIVES

This report addresses only the flood protection and stream channel stability concerns. The objectives are to reduce or eliminate flooding threats to life and property within the city of Lander, and to restore the stream form and function of the Middle Fork of the Popo Agie within the project area. Other resource concerns may be addressed in additional phases of this project.

PROJECT SETTING

General

The total Middle Fork of the Popo Agie watershed area is approximately 125,360 acres. The lower boundary of the Middle Fork is defined by its confluence with the North Fork of the Popo Agie where the two tributaries form the Popo Agie River. The flood protection benefited area addressed in this report is the City of Lander. The stream channel stability aspect of this report will primarily benefit an area

described as the Middle Fork of the Popo Agie River from Mortimer Lane (south of Lander) to its confluence with the North Fork of the Popo Agie River (north of Lander).

The average temperature for Lander is 44.6 degrees Fahrenheit – it varies from an average of 20.2 degrees Fahrenheit in January to 70.6 degrees Fahrenheit in July. Precipitation in the watershed ranges from an average 13.53 inches in Lander to nearly 36 inches in at the higher elevations. The minimum-recorded precipitation at Lander is 5.35 inches in 1954, while the maximum reported in Lander is 21.89 inches in 1957.

The relief of the watershed is characterized by an uplifted mountain block and associated intermountain basins. The lowest point is 5,240 feet at the confluence with the North Fork of the Popo Agie. The highest point is Wind River Peak, elevation 13,200 feet, on the Continental Divide.

Geology and Soils

The Wind River Range formed during the Laramide Revolution. The Wind River Mountains have a broadly exposed granite core characterized by narrow crests between deep, glaciated gorges. The area is not typical, in that the foothills occur out in the basin away from the mountain front. This relief is the result of geologic processes that began with the formation of the mountains. After the mountains were formed, tertiary sediments were deposited in the basin. This process was followed by a period of erosion. Next, valley fill of stratified sand, gravel, cobbles, and boulders was deposited. The erosion cycles continued and most of the valley fill was carried away.

Two old valley fill remnants are terraces in the Lander area. One is about 50 feet above downtown Lander and is the site of the Wyoming State Training School. The other is about 150 feet higher and is the site of the airport. Erosion continues; it is more rapid in soft bedrock of the basin than in the hard bedrock of the mountains.

Most of the soils in the watershed are Boralfs, Borrolls, Orthents, and Argids. They are moderately fine textured, mainly well drained, and have a cryic to mesic temperature regime. The deep, moderately steep to steep, gravely loams (Frisco Series) are on the mountains. The shallow to deep, moderately steep to steep channery loams, loams and fine sandy loams (Farlow and Duncom series) are on mountain fronts. The deep and shallow, gently sloping to steep loams (Sinkson and Thermopolis Series) are on alluvial fans and uplands. The deep nearly level to gently sloping clay loams and loams (Lupinto and Lander Series) are on stream terraces and flood plains.

Land Use and Ownership

Land ownership within the Middle Fork of the Popo Agie watershed consists of:

	Acres
Federal Agency Withdrawal	405
Deeded (Private)	26,897
State of Wyoming	5,006
U.S. Bureau of Land Management	9,881
U.S. Forest Service	81,705
Water	919
Wyoming Game and Fish Dept.	545

Land ownership within the project area is predominately private, with a few government buildings. There are approximately 1,000 structures in the potentially flooded area of the city (100-year event).

Social and Economic

Project area demographics are listed in the following table.

	Lander	Fremont County	Wyoming
Population	7,023	33,662	453,588
Population over 65	990	3,873	47,195
White	6,387	26,766	427,061
Black	8	51	3,606
American Indian, Aleut,	525	6,222	9,479
Asian or Pacific Islander	30	110	2,806
Other	73	513	10,636
Hispanic (any race)	181	1,336	25,751
Median House value	$51,400	$50,600	$61,600
Percent high school graduate or higher	77.3%	77.5%	83%
Per capita income($)	$10,421	$9,806	$12,311
Unemployment	6.2%	9.4%	5.8%
Poverty	13.2%	19.1%	11,9%
Source: 1990 Census			

Cultural Resources

A file search of the records of the State Historic Preservation Office shows the town of Lander has two listings in the National Register of Historic Places. The US Post Office and Courthouse at 177 N. Third Street was listed on the register in 1987. The Lander Downtown Historic District, Main Street between Second and Fourth Streets, was also listed in 1987. Three historic roads or trails are also in and near Lander, the Rawlins-Ft. Washakie Road, the Lander-Lost Cabin Road, and the Ft. Thompson Road. The grade of the now abandoned Chicago & NW railroad is also classified as eligible for the register.

Known cultural resources will be taken into consideration during the planning process for any alternative selected. If additional sites or structures are identified that may be damaged or altered by project action, work will be stopped immediately until the applicable provisions of Federal and State laws dealing with archaeological and historical site preservation have been addressed.

Hydrology

Hydrology computations for the Middle Fork of Popo Agie is based on 36 years of recorded data. The United States Geological Survey (USGS) monitored the gauging station on Middle Fork for the first 14 years of record and the State Engineers Office collected the data for the next 22 years. Saw Mill Creek, an ungauged stream, discharges into Middle Fork of Popo Agie just downstream from the gauging station. Flow frequency is estimated for Sawmill Creek drainage using the equations developed by USGS (see US Geological Survey Water-Resources Investigations Report 94-4002, Page 176-179). Because of the close proximity and similar drainage configuration, flow from Saw Mill Creek was added to the flow estimated for Middle Fork to determine the flow rate through Lander. The effect of channel storage, from the mouth of the canyon to city limits, was not considered when determining the peak flow rate through town.

In addition, it is assumed that flow from the low lying tributaries between the gauging station on Middle Fork of the Popo Agie and Lander would not contribute to the peak flow.

Peak flow rates at the confluence of Saw Mill Creek and Middle Fork of Popo Agie for the various frequencies through Lander are as follows:

Percent chance exceedance	Reoccurrence Interval (year)	Flow Rate (cfs)
1	100	5600
2	50	4300
4	25	3600
10	10	2800
50	2	1010

Both flooding caused by water overflowing the main channel through town, and flooding caused by Dickinson Creek overflow were considered. Dickinson Creek floods when the main channel capacity is exceeded near and above the existing diversion. Dickinson Creek contributes to flooding in the area from First to Fifth Street bounded by Fremont on the South. Main channel capacity can be exceeded and overflow into the residential area from Third to First Street. Because of the land slope, once the main channel is overtopped, flow tends to continue in a northerly direction through town. Flood level for various frequencies was determined for the area between First and Fifth street bounded by main street on the North and Middle Fork of the Popo Agie on the south.

Flow in the main channel will probably exceed the channel capacity at the 25 year frequency about 1 mile upstream from Fremont Street – overflow from this area ends up in Dickinson Creek. At Fremont Street and below, flow will probably exceed channel capacity somewhere between the 25 and 50 year frequency.

Flow is restricted at the Second Street Bridge and at the bridge on the main street into town. The Second Street Bridge is more restricted than the Main Street bridge, however the Main Street bridge will most likely be overtopped slightly during a 1 percent chance storm – the bridge should have adequate capacity for more frequent storms. It is likely that the Second Street Bridge will be improved in the future without project. Any improvement will likely contain all but the 1- percent chance storm.

Stream Channel

The Middle Fork of the Popo Agie has seen many changes in recent history within the project area. Some of these man made changes include: flood control dikes, encroachment and housing development of the flood plain, channel straightening, channel deepening, and relocation, rock armoring of the river banks, as well as dewatering of the river by irrigation and municipal use. The river alterations above, and through the town of Lander, have resulted in channel instability. This instability has led to additional manipulation of the channel and banks of the stream, exacerbating the problem.

During flood events a large bedload is transported down the channel. Major runoff events could further disrupt the current conditions.

Wildlife/Fisheries

The fish and wildlife resources of the Popo Agie watershed are as diverse as the geologic landscape in which they reside. The upper watershed, the Wind River Mountains, has seen minimal impact by man

and is about as pristine as when the first settlers arrived into the country. Down slope into the foothills, the landscape starts to take on a much different appearance, encroachment by municipal and agricultural elements has displaced some of the fish and wildlife.

Through Lander, and downstream, the watershed has been impacted by man, but remains relatively intact, however the fisheries habitat has degraded to such a point that many of the native fish species have been extinguished from the system. Some of the identifiable problems are:

1.) Decline in quantity and quality fish habitat;
2.) Increasing water temperatures;
3.) Lack of water due to significant diversion withdrawals;
4.) Impacts have resulted in a wide, shallow river with very little pool and cover habitat.

Threatened and Endangered Species

The project area is in an urban setting and there are no known threatened or endangered species, therefore, none of the alternatives proposed will have an impact on threatened or endangered species.

Past Flood History

Flooding in the downtown area has been a problem in the past. The most recent severe problem occurred in 1963 – the 1963 event was about a 100-year frequency storm. The rain-on-snow event caused much flooding and street damage. According to newspaper accounts, local residents have observed flood damages in 1891,1892,1893,1896,1917, and 1923.

The National Weather Service in Riverton describes the 1963 flood as follows:

> *"The extremely warm late spring temperatures and heavy rain that fell on June 14 through June 17 were the causes of this major flood for Lander. The Lander airport received 3.27 inches of rain during the four-day period with 1.8 inches falling on June 14th, between 9 PM and midnight. Extensive damage occurred between 2nd and 4th streets and from City Park to Main Street. Three hundred to 400 homes and businesses were damaged. The Red Cross and Small Business Administration declared Lander a disaster area by June 20th. The peak reading of the middle fork of the Pope Agie River Sinks Canyon gage was 7.69 feet on June 16th. According to the "Wyoming Historical Database for Floods", the 1963 Lander flood was recorded as a 500 year flood. However, part of the flood flow was due to a semi-breach of the Worthen Meadows Reservoir, in addition to the heavy precipitation."*

Little has been written about the earlier flood events.

ALTERNATIVES

Alternative I – Future Without Project

Hydrology

Flow rates would continue to be the same as discussed in the Project Setting portion above.

Stream Channel

The stream channel instability will continue to degrade the river system within the project area along with the areas immediately above, and below Lander. Potential effects include: streambed and bank erosion;

damage to roads, bridges, sidewalks, utilities, buildings, and irrigation structures; increased sedimentation in irrigation delivery systems; abrasion to irrigation pipes and sprinkler orifices. Accelerated stream velocities through town will continue to erode streambanks below town, damaging fences, pasture, hayland, and irrigation structures and delivery systems. Aggradatation of the streambed downstream will increase out-of-channel flooding, resulting in damaged crops, fences, and buildings; sediment and debris deposition on fields; and damage to irrigation systems. Sections of incised streambeds would drain water tables and induce head cutting of tributaries and small side channels.

Social and Cultural

The Middle Fork of the Popo Agie flooding problem will remain a potential hazard to safety, property, and cultural resources. This includes potential flood damage to approximately 1,000 structures. The "Downtown Historic District" is included in this number.

The stream channel degradation will continue to reduce aesthetics, property values, the stream environment and fishery, recreation, and water quality. Downstream agricultural operators will continue to incur costs associated with streambank erosion damage, flood damage, and increased maintenance on their irrigation systems.

Wildlife/Fisheries

Habitat instability of the river will continue to be a habitual problem for the entire Popo Agie River. This channel evolution will continue to have an adverse effect on native cool water fish species. There will continue to be diminished nutrients supplied to the system from large woody debris and leaf litter, which reduces the microorganism and invertebrate supply for fish forage.

The entire riverine ecology will continue to degrade reducing aquatic, stream zone, and riparian habitats for the myriad of species that depend on them.

Damages-Benefit/Cost Ratio

Damages for flood projects are calculated on a 100-year, 50-year, and 25-year flood event. The damages are calculated for each event, totaled, and converted to an "average annual damage" over the evaluation period, which in this case is 50 years. The projected average annual damages are estimated at $288,000.

Alternative II - Diversion

Alternative No.2 would be to divert approximately 1000 cfs from the Middle Fork of the Popo Agie River and construct a channel/culvert to carry the diverted flow around or through town. The diverted flow would then be discharged back to the river on the north end of town. The estimated cost for this alternative would be $4,790,000. This alternative includes rebuilding the existing flood dike along the west side of the Middle Fork of the Popo Agie River from Mortimer Lane to the Dickinson Creek diversion. The route through town would include constructing box culverts at each cross street on Fifth Street. (If the 1000-cfs were diverted in concrete pipe beneath Fifth Street, the cost for this alternative would be $9,500,000.)

Hydrology

Flow rates used for the design of this project are those described in the project setting. Flows in the main channel through town are reduced to account for the diversion of 1000 cfs.

Stream Channel

Alternative II would include practices that would restore the stream form and function, but would not attempt to restore the stream to pristine conditions. The practices would restore the proper dimension, pattern, and profile of the stream. Bank and channel erosion would be reduced to within the natural limits for the stream type. The resulting effects will improve water quality and the associated deleterious effects of sediment to the beneficial uses of the water, including irrigation and recreation. These practices will cost approximately $335,000 (this is included in the installation cost for this alternative).

Social and Cultural

Alternatives II will provide protection from flooding for public and private property. This alternative would result in a reduction of flood damage to streets and utilities, and prevent flooding of homes and businesses. This alternative would also prevent disruption of emergency services and loss of income from businesses being closed due to flooding. (All alternatives are evaluated at 100-year flood event; a greater flood event would still result in damages.)

The stream channel degradation will continue to reduce aesthetics, property values, the stream environment and fishery, recreation, and water quality. Downstream agricultural operators will continue to incur costs associated with streambank erosion damage, flood damage, and increased maintenance on their irrigation systems.

Wildlife/Fisheries

The practices used to restore the natural stability of the stream will benefit aquatic organisms and fisheries in several ways. The reduction of erosion of the streambed and banks will improve the natural physical and chemical environment that supports cold water fish and the organisms that comprise their food base. The subsequent improved water quality will reduce aggradation of the streambed downstream and thereby reduce covering food organisms, and fish eggs in spawning beds. The structures themselves will provide excellent fish habitat.

Stream stabilization will allow for the reestablishment of riparian vegetation, providing food and habitat for numerous species birds and animals.

Damages-Benefit/Cost Ratio

Average annual costs are estimated at $510,198 with average annual benefits (damages avoided) at $288,000. This equates to a Benefit/Cost ration of 0.56.

Alternative III – Floodwall or Dike

Alternative No.3 would consist of rebuilding portions of First Street and Second Street between Main Street and Fremont Street to serve as flood dikes; or constructing a concrete flood wall along portions of First Street and Second Street between Main Street and Fremont Street. Either of these options would include rebuilding an existing flood dike along the west side of the Middle Fork of the Popo Agie River at Fremont Street, and from Mortimer Lane to the Dickinson Creek diversion, to contain the design flood. A flood diversion from Dickinson Creek to the Middle Fork Popo Agie would also be constructed south of the City Park. The estimated cost for this alternative would be $2,798,000.

Hydrology

Flow rates used for the design of this project are those described in the project setting.

Stream Channel

Alternative III would include practices that would restore the stream form and function, but would not attempt to restore the stream to pristine conditions. The practices would restore the proper dimension, pattern, and profile of the stream. Bank and channel erosion would be reduced to within the natural limits for the stream type. The resulting effects will improve water quality and the associated deleterious effects of sediment to the waters beneficial uses, which include irrigation and recreation. These practices will cost approximately $335,000 (this is included in the installation cost for this alternative).

Social and Cultural

Alternatives III will also provide protection from flooding for public and private property. This alternative would result in a reduction of flood damage to streets and utilities, and prevent flooding of homes and businesses. This alternative would have the potential to still have disruption of emergency services, since the bridges could still be over-topped by the floodwaters. The buildings in the ”Downtown Historic District” and business area would be protected from flood damages. (All alternatives are evaluated at a 100-year flood event, a greater flood event would still result in damages.) This alternative will require purchasing five properties that are within the floodplain of the river and moving 28 trailers from a trailer court in the floodplain.

The reduced effects of the stream channel degradation will enhance aesthetics, property values, improve stream environment and fishery, recreation, and water quality. Downstream agricultural operators will benefit from reduced damage and costs associated with flooding and reduced maintenance costs to their irrigation systems.

Wildlife/Fisheries

The practices used to restore the natural stability of the stream will benefit aquatic organisms and fisheries in several ways. The reduction of erosion of the streambed and banks will improve the natural physical and chemical environment that supports cold water fish and the organisms that comprise their food base. The subsequent improved water quality will reduce aggradation of the streambed downstream and thereby reduce covering food organisms, and fish eggs in spawning beds. The structures themselves will provide excellent fish habitat.

Stream stabilization will allow for the reestablishment of riparian vegetation, providing food and habitat for numerous species birds and animals.

Damages-Benefit/Cost Ratio

Projected average annual costs are $250,198 with average annual benefits (damage reduction) at $288,000. This provides a Benefit/Cost ratio of 1.15.

Flood Control Alternative IV - Storage

The potential to construct flood storage above the City of Lander and use the natural channel to route the flood flow through town has been considered. The only possible storage sites are located at Worthen Meadows Reservoir and at the University of Wyoming Outreach holdings south of Lander. The Worthen Meadows Reservoir is located too high in the watershed for flood control and has very limited storage capacity remaining for any additional flood storage. The University of Wyoming Outreach land could be used to construct an excavated storage reservoir, but the volume of excavation required would make this an impractical alternative.

CONCLUSION

The purpose of this preliminary investigation report (PIR) is to determine the feasibility of using PL-566 funds to prevent flooding in the Lander area and reduce further degradation of the stream channel. The findings of this report indicate that there is an economically defensible project that can be pursued using PL-566 funds. Alternative III has a positive benefit/cost ratio of 1.15. (A positive benefit/cost ratio is a program requirement for Public Law 83-566.) The engineering and project administration costs for the installation of this project will come from NRCS. If the sponsors elect to go forward with the project, the primary emphasis will be a design based on Alternative III. This does not mean that components of the other alternatives can not be included in the final plan.