DRAFT

# U.S. Army Corps of Engineers
# Sacramento District

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# Truckee Meadows Flood Control Project Reconnaissance Report

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July 1997

MONTGOMERY WATSON/CH2M HILL JOINT VENTURE

28 July 97

Leonard -

Enclosed are 3 copies of Montgomery Watson's draft Basis of Design for Truckee Meadows Investigation. Please review and return comments to me by 5 Aug 97. Any questions, please give me a call at (916) 557-6782.

Thanks,

Donna Heran.

Comments by the 5th.

Mtg. 8:30 AM Mon.

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| | |
|---|---|
| acre-feet | af |
| cubic feet per second | cfs |
| flood insurance study | FIS |
| Operations and maintenance | O&M |
| River Mile | R.M. |
| standard project flood | SPF |
| U.S. Army Corps of Engineers | COE |

# Executive Summary

MONTGOMERY WATSON/CH2M HILL JOINT VENTURE

# Executive Summary

## INTRODUCTION

In 1985, the U.S. Army Corps of Engineers (COE) released a Feasibility Report and environmental impact statement that described a project to control flooding in the Truckee Meadows of northern Nevada (Figure ES-1). The project was designed to convey a flow of 18,500 cubic feet per second (cfs) through the Truckee River channel with levees, floodwalls, channel excavation, and bridge replacement, as needed.

The project was subsequently authorized by Congress in the 1988 Water Resources Development Act. Following a reevaluation of project costs in 1991, the project was reclassified to the "deferred" category because the benefit/cost ratio dropped below 1.0, based on a new methodology to calculate the ratio.

The COE is conducting a reconnaissance study to assess the feasibility of reclassifying the project, based on recent data on project costs and benefits. The purpose of this reconnaissance report is to update cost data for flood control facilities similar to the authorized project that can pass three different discharges through the Truckee Meadows. The COE will use the updated cost data to prepare a new benefit/cost ratio. A benefit/cost ratio greater than 1.0 would likely lead to further engineering analysis. In the new detailed engineering analysis, other alternatives or variations to the authorized project can be analyzed.

The purpose of this Reconnaissance Report is not to develop a new flood control project or to recommend different facilities for any particular magnitude of flood. The purpose is to provide cost data for facilities to control flooding at three discharges. Although the facilities assumed in the cost estimates are similar to or build upon the authorized project, future detailed engineering analysis may study other alternative facilities.

The three discharges and associated facilities assumed in the cost analysis are:

- 18,500 cfs; facilities as defined in the Feasibility Report for the authorized project.
- 26,000 cfs; facilities assumed to be a larger version of the authorized project.
- 39,800 cfs; facilities based on the conceptual alternative presented in the Feasibility Report.

This Reconnaissance Report also presents order-of-magnitude costs associated with spillway improvements at Stampede Dam and Prosser Creek Dam for the COE to use in the benefit/cost analysis.

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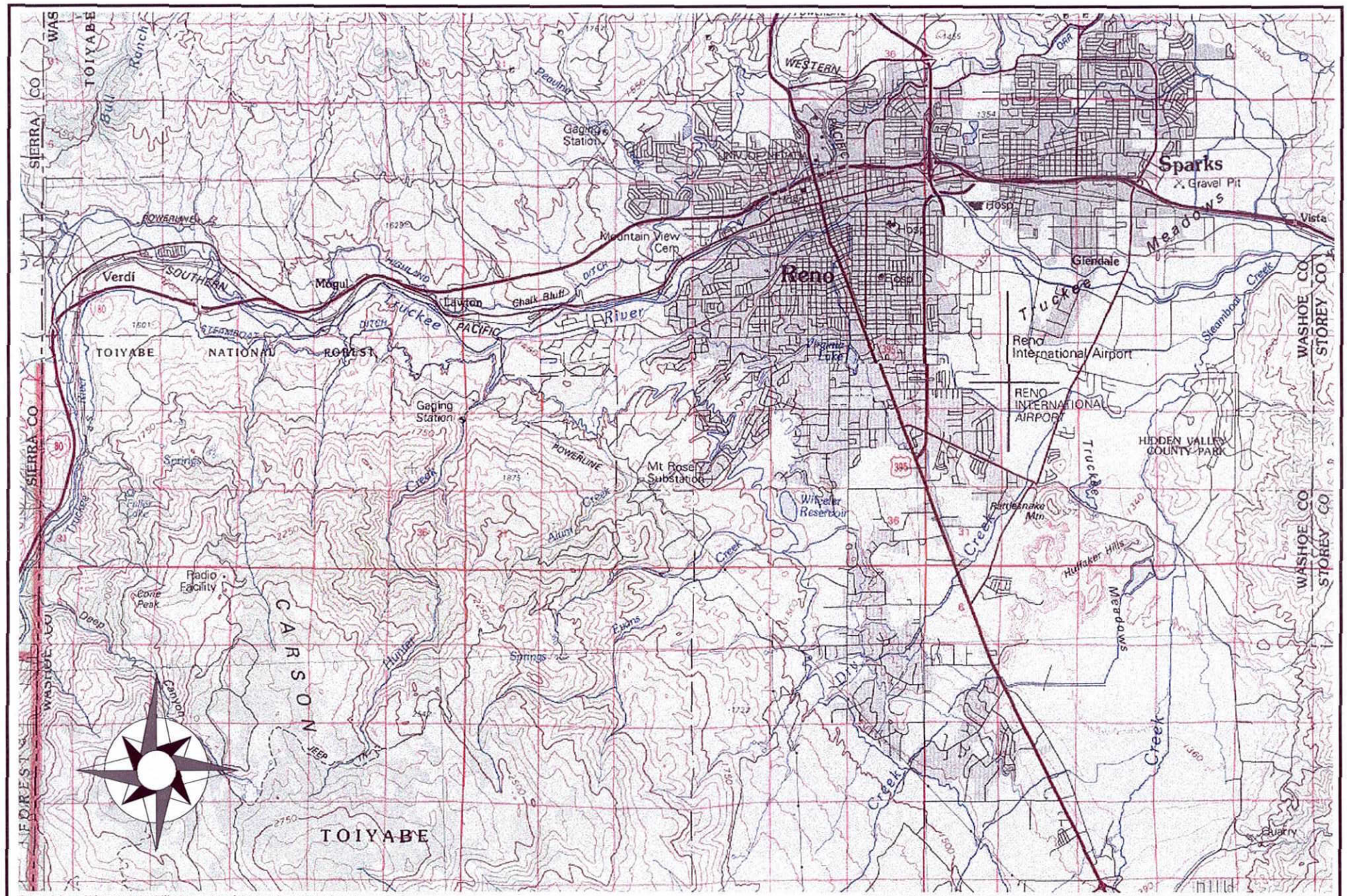


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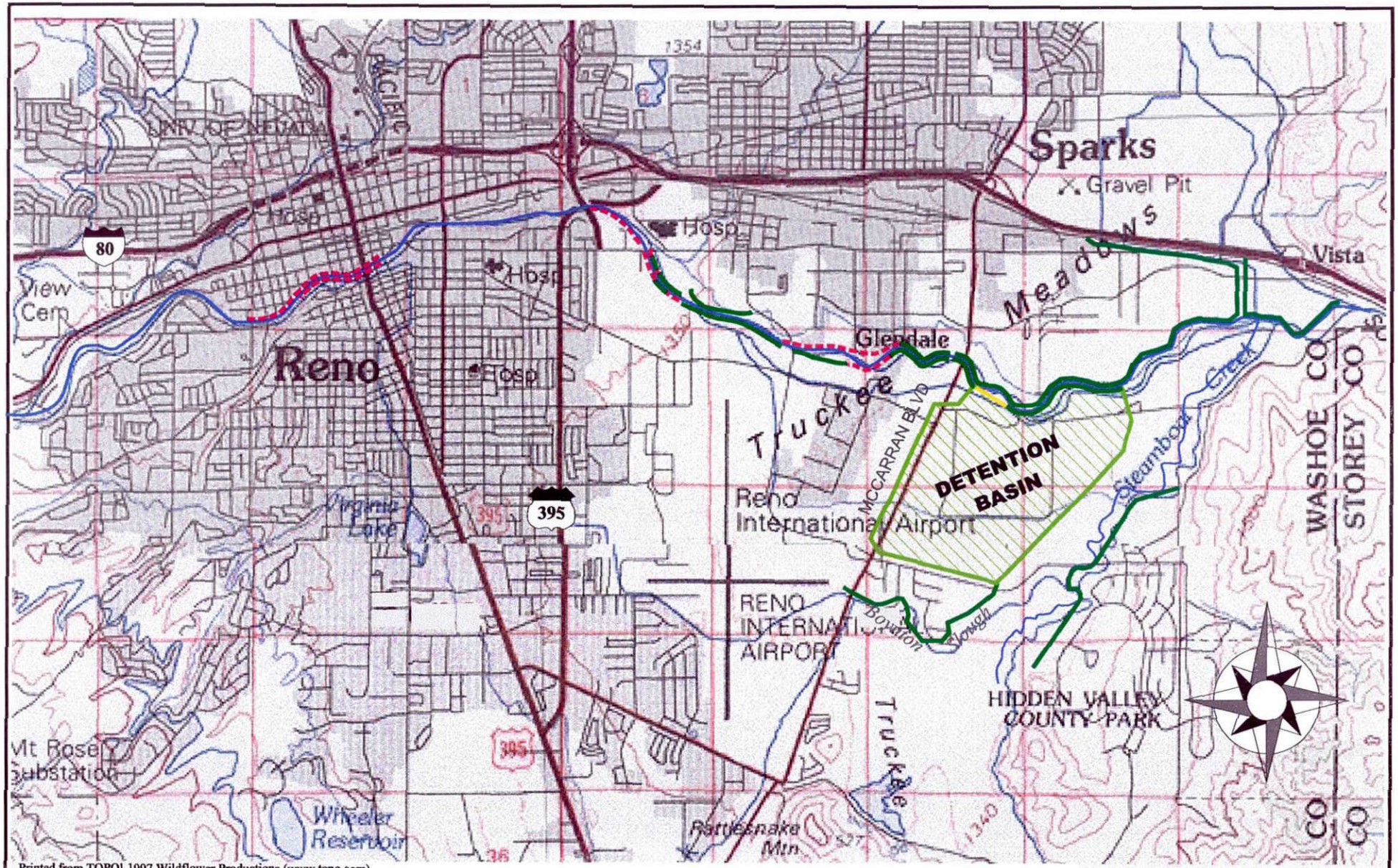
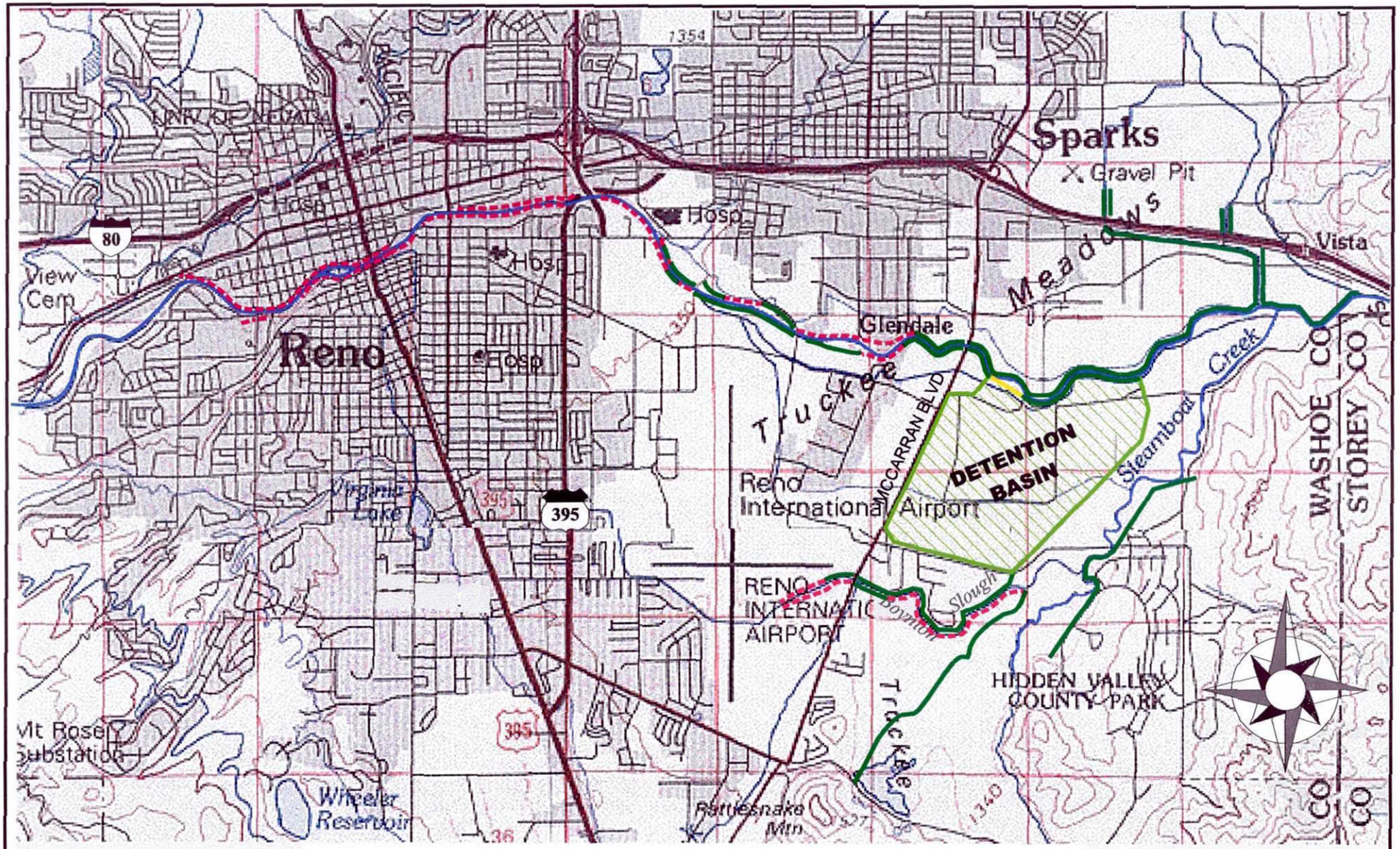
**FIGURE ES-1**
**RECONNAISSANCE REPORT STUDY AREA**
U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA




**LEGEND**

- Levees
- Flood Walls
- University Farms Detention Basin

**FIGURE ES-2**
**AUTHORIZED FLOOD CONTROL PLAN**
*U.S. ARMY CORPS OF ENGINEERS*
TRUCKEE MEADOWS, NEVADA

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## LEGEND

- Levees
- Flood Walls
- University Farms Detention Basin

**FIGURE ES-3**
**26,000 CFS FLOOD CONTROL PLAN**
U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA

Several issues related to potential alternative flood control facilities are also discussed in this Reconnaissance Report. These issues include: potential alternative detention basin sites; channel improvements in Reno, Sparks, and Vista; and the impacts of a flood control project on internal drainage.

## FACILITIES

### Authorized Project

The authorized project facilities proposed in the 1985 Feasibility Report were checked for reasonableness and the construction quantities were calculated. Cost spreadsheets were developed to estimate the current total costs of the previously authorized facilities. Finally, the COE methodology for developing annualized costs was applied to the total construction costs to estimate an annual cost for the project. The estimated construction costs exclude the cost for land and mitigation, and represent a reconnaissance-level estimate. The authorized project included a detention basin in the University Farms area to detain water that would otherwise flow past Vista and down the Truckee River Canyon. This basin was included as mitigation to offset the impact of the flood control facilities that constrain floods to the river channel, preventing floodplain storage from occurring. Without the natural floodplain storage, the downstream peak flow could be increased.

The facilities assumed for the authorized project are shown in Figure ES-2.

### 26,000 cfs Facilities

To estimate the facilities needed to convey 26,000 cfs, this analysis assumed a larger version of the authorized facilities. This assumption is made only for cost estimating purposes; it is not a recommended project. Detailed engineering in the next phase of the project may propose alternative features to accommodate this flow.

The authorized facilities must be increased in height and length to accommodate this larger flow. Specifically, additional facilities would be needed at the upstream end of the project and on Steamboat Creek. This analysis also included the University Farms detention basin. The assumed facilities for this larger version of the authorized project are shown in Figure ES-3.

### Standard Project Flood

A conceptual alternative to pass the standard project flood was presented in the Feasibility Report. The project involved levees, detention basins, and a bypass channel to convey water around Reno. Preliminary costs were developed for this alternative that were unreasonably high, and the alternative was dropped from further consideration. This reconnaissance report updates the preliminary costs in order to

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provide a third cost/discharge point for the COE to use in the economic analysis. No new facilities or designs for this alternative were considered.
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## COSTS

The cost estimates used in this reconnaissance report are based on calculated material volumes using unit cost estimates from current construction. The costs are developed at a reconnaissance level and will be refined during the detailed engineering phase. The costs for the authorized project and the 26,000 cfs facilities are presented with and without the detention basin at University Farms. The cost without the basin represents the cost without mitigation. Detailed engineering at later phases of this project may determine that mitigation is available elsewhere or is not needed.

All costs presented are based on October 1996 costs.

### Authorized Project

The total project costs associated with the authorized project are $81.8 million. Using the COE methodology, the annualized project cost is estimated to be $8.1 million (Table ES-1).

### 26,000 cfs Facilities

Enlarging the authorized project to pass a larger flow is expected to increase project costs because of the height of facilities and the addition of new facilities. The estimated project cost for facilities to pass 26,000 cfs is $98.4 million with an annualized cost of $10 million (Table ES-1).

### Standard Project Flood Facility

The conceptual alternative to pass the standard project included four subalternatives that had different configurations of levees, detention basins, and the bypass tunnel. The total project cost for the conceptual alternative varied from $213.8 to $ 239.5 million, depending on the subalternative. The annualized costs range from $16.2 to $17.1 million.

### Stampede Dam and Prosser Dam Spillway Improvements

The COE conducted a hydrologic analysis of raising the spillways at Stampede Dam and Prosser Creek Dam to provide additional flood control benefits downstream. The spillways were assumed to be raised 5 feet and 10 feet, respectively. The analysis is discussed in the Attachment 1 "Office Hydrology Report." This Reconnaissance Report provided an order-of-magnitude cost estimate for these spillway improvements.

The costs to raise the two spillways 5 feet and 10 feet ranged from $7.4 million to $54.6 million for Prosser Creek Dam, and from $9 million to $33 million for Stampede Dam (Table ES-2).

**Table ES-1**
**Annualized Cost Estimate for the Authorized Project and the Enlarged Project**

| Type of Cost | Authorized Project (18,500 cfs) With Detention Basin | Authorized Project (18,500 cfs) Without Detention Basin | Enlarged Project (26,000 cfs) With Detention Basin | Enlarged Project (26,000 cfs) Without Detention Basin |
|---|---|---|---|---|
| First Cost | $81,759,580 | $73,831,328 | $98,384,552 | $90,456,243 |
| Annualized Capital | 6,034,671 | 5,449,487 | 7,261,759 | 6,676,571 |
| Annualized O&M | 1,867,286 | 1,513,458 | 2,482,899 | 2,065,906 |
| Annualized Interest | 90,000 | 80,000 | 100,000 | 90,000 |
| Annualized Replacement | 116,487 | 103,544 | 129,430 | 116,487 |
| TOTAL ANNUAL COSTS: | $8,108,444 | $7,146,489 | $9,974,088 | $8,948,964 |

**Table ES-2**
**Annualized Cost Estimate for the Raising the Spillways at Stampede Dam and Prosser Creek Dam (in 1996 dollars)**

| | Prosser Creek Dam | | Stampede Dam | |
|---|---|---|---|---|
| | 5-foot increase | 10-foot increase | 5-foot increase | 10-foot increase |
| First Cost | 7,429,701 | 54,675,369 | 8,987,668 | 32,980,231 |
| Annualized Capital | 548,386 | 4,035,586 | 663,379 | 2,434,269 |
| Annualized O&M | 41,839 | 307,894 | 50,612 | 185,722 |
| Annualized Interest | 10,000 | 10,000 | 10,000 | 10,000 |
| Annualized Replacement | 1,197,231 | 8,736,549 | 1,456,092 | 5,177,214 |
| TOTAL ANNUAL COSTS | 1,797,456 | 13,090,029 | $2,180,083 | 7,807,205 |

## HYDRAULIC IMPROVEMENTS

Potential improvements in the water surface elevation from Booth Street to Vista were analyzed with hydraulic modeling. The purpose of the analysis was to identify channel or floodplain modifications that could be incorporated into the project or could part of an alternative to the authorized project. Reductions in the water surface elevation could reduce the size or extent of project facilities which could reduce the cost of facilities.

### HEC-RAS Model

The hydraulic modeling was performed with the computer model HEC-RAS, developed by the COE. The model for the Truckee River was developed from existing data, collected primarily in the 1980s. The model was used to estimate the water surface elevation for 26,000 cfs. The results were then used to size facilities. This information was then used to develop cost estimates for facilities. The model results were also used to estimate potential water surface elevation improvements that could result from floodplain, channel, or bridge modifications.

### Authorized Project Channel Improvements

The authorized project proposed limited channel excavation near Booth Street, Arlington Street, and Glendale Park. The Feasibility Report provided limited information regarding the nature and extent of the excavation and results from the previous hydraulic modeling describing the modifications were not available for this Reconnaissance Report. The potential benefits of the proposed excavation were assessed using the HEC-RAS model with reasonable assumptions regarding the configuration of the excavation. The assessment was performed for a 26,000 cfs flood and was compared to the water surface profile for the enlarged authorized project.

The hydraulic analysis indicated that the improvements near Booth Street and near Glendale Park could result in localized reductions in the water surface profile, relative to the condition without excavation. The reductions in the water surface profile do not extend far enough upstream to offer a regional benefit (Table ES-3).

### Channel Capacity through Reno

Currently, the capacity of the channel through Reno is limited by the available cross section and the capacity of the bridges. Bridges, such as Lake Street Bridge, have a constricted cross section and could have a capacity of less than 10,000 cfs. The Feasibility Report proposed raising or improving the opening of the existing bridges. However, specific data regarding the changes to the bridges were unavailable.

An analysis was performed to assess the benefits of improving the conveyance through the bridges and in the channel. The analysis was performed to provide two bookends

**Table ES-3**
**Estimated Water Surface Elevations**
**with Channel Excavation**
**near Booth Street Bridge and Glendale Park**

| | River Location | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | near Glendale Park | | | | | | near Booth Street | | | |
| Model Simulation | 48.105 | 48.209 | 48.364 | 48.47 | 48.584 | 48.698 | 52.936 | 53.025 | 53.136 | 53.214 |
| Leveed Condition | 4404 | 4405 | 4408 | 4408 | 4410 | 4410 | 4513 | 4514 | 4514 | 4517 |
| Leveed Condition with Channel Improvements | 4404 | 4405 | 4406 | 4406 | 4409 | 4410 | 4513 | 4513 | 4514 | 4517 |

Note: River mile 48.105 is at the downstream end of Glendale Park
River mile 48.209 is at the downstream end of Edison Way
River mile 48.364 is at the upstream end of Edison Way
River mile 48.47 is at Marietta Way
River mile 48.584 is 600 feet upstream of Marietta Way
River mile 48.698 is 800 feet downstream of Rock Boulevard
River mile 52.936 is about 200 feet downstream of the Booth Street bridge
River mile 53.025 is about 200 feet upstream of the Booth Street bridge
River mile 53.136 is at the downstream end of Idlewild Park
River mile 53.214 is opposite Idelwild Park

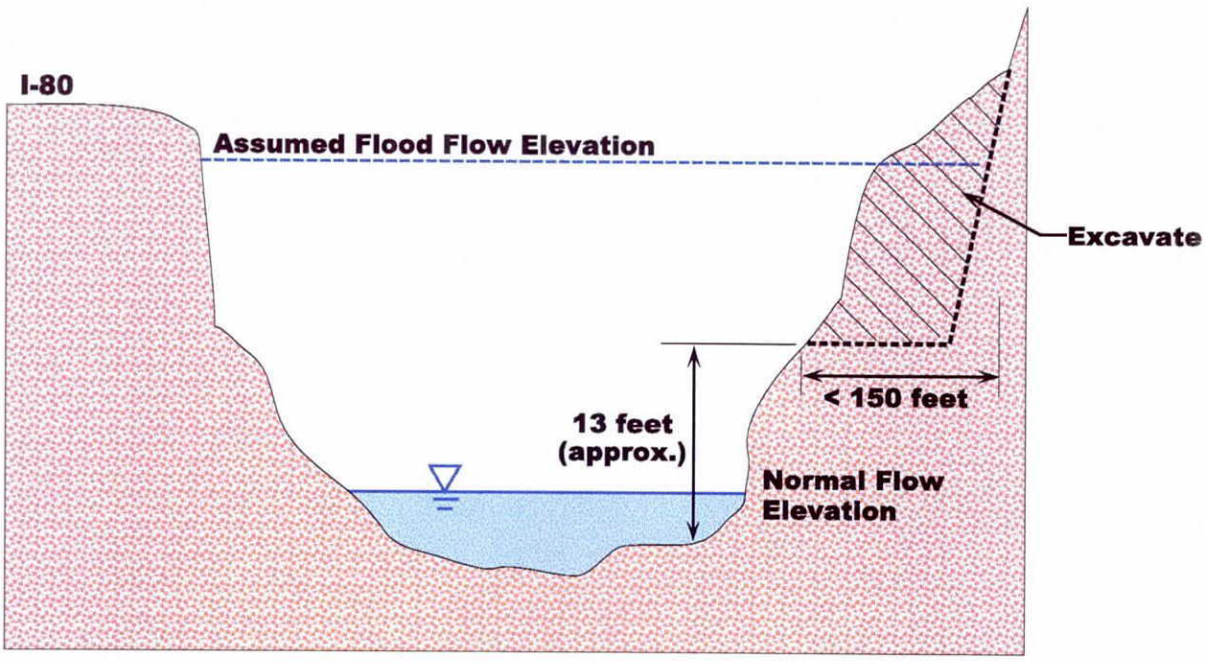
representing the potential benefits. One bookend reflects the current level of obstruction and the other bookend represents a minimum level of obstruction.

The analysis indicated that improving the conveyance through the existing bridges has a localized benefit in the downtown Reno area. The benefit could result in a reduction in the size of flood control facilities required to contain the floodflows or could allow a larger flood flow to pass through the reach before overbank flooding occurs.

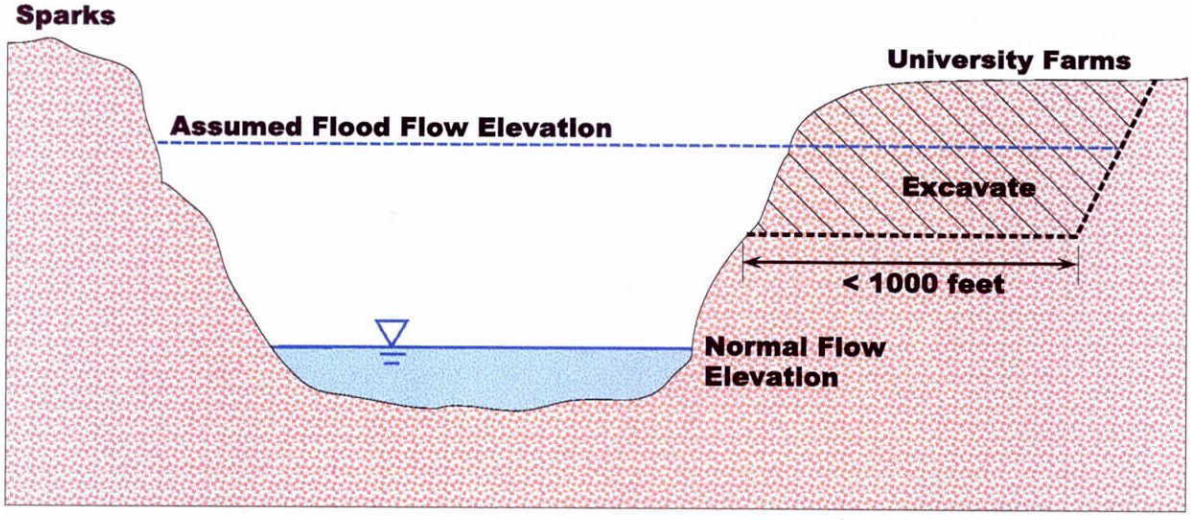
### Vista Channel Improvements

The potential benefits of improved channel conveyance near Vista was investigated through a hydraulic analysis that assumed excavation of the right overbank to provide additional cross sectional area at high flows (Figure ES-4). The purpose of the analysis was to identify the potential benefits to the water surface profile that could reduce the size or the need for authorized project facilities.

The analysis identified an improvement in the water surface profile upstream of Vista as a consequence of enlarging the floodplain cross section (Table ES-4). For this analysis, an upper bench adjacent to the channel that conveys floodwater but not average flow was assumed. This potential improvement would also benefit the Truckee River backwater conditions in Steamboat Creek and North Truckee Drain.




**TYPICAL IMPROVED CROSS-SECTION**
**VISTA IMPROVEMENTS**
**(NOT TO SCALE)**




**TYPICAL IMPROVED CROSS-SECTION**
**FOR THE LOWER TRUCKEE RIVER**
**(NOT TO SCALE)**

## FIGURE ES-4
## TYPICAL IMPROVED CHANNEL SECTIONS

U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA

**Table ES-4**
**Estimated Water Surface Elevation**
**for Downstream Channel Improvements**
**(flow of 26,000 cfs)**

| Model Simulation | River Location R.M. 45.266 | R.M. 46.431 | R.M. 46.972 | R.M. 47.605 |
|---|---|---|---|---|
| No Action (No levees) | 4393 | 4394 | 4394 | 4398 |
| Leveed Section | 4393 | 4395 | 4398 | 4400 |
| Vista Channel Improvements | 4392 | 4394 | 4397 | 4400 |
| Lower Truckee River Improvements | 4393 | 4394 | 4394 | 4397 |
| Combined Improvements | 4392 | 4392 | 4393 | 4397 |

NOTE: River Mile 45.266 is about 300 feet upstream of the North Truckee Drain
River Mile 46.431 is upstream of Deming Way
River Mile 46.972 is at Cottonwood Park
River Mile 47.605 is immediately downstream of McCarran Boulevard

### Lower Truckee River Improvements

The excavation of the right overbank in the reach from Steamboat Creek to McCarran Boulevard was analyzed using the HEC-RAS model to assess potential benefits of floodplain improvements (Figure ES-4). As with the improvements at Vista, the improvements could reduce the size and cost of flood control facilities.

The hydraulic analysis demonstrated that providing a high bench for floodwater could reduce the water surface elevation to a point upstream of McCarran Boulevard (Figure ES-4). The potential benefits increase by combining the Lower Truckee River improvements with the Vista Improvements.

### Upstream Detention Basins

The potential for small-scale detention of water upstream of Reno was investigated in this Reconnaissance Report. The types of facilities analyzed included:

- in-stream detention through small dams or proportional weirs;
- side-channel storage; and
- off-channel storage.

These options were explored at a reconnaissance level to provide an assessment of their feasibility.

In-stream detention using rubber dams or proportional weirs (a weir that passes average flows, but detains flood flows) are feasible and could help reduce the flood peak. These types of facilities would have to be constructed as a series of structures at key locations because of existing development near the river. Each facility could be sized to reduce the peak flow by 500 to 1,000 cfs. These facilities could temporarily inundate portions of the channel and areas adjacent to the channel. The available storage area could be expanded through excavation of the floodplain adjacent to the channel. The exact locations, sizes, and costs of such facilities is a function of hydraulic modeling and will be performed at the next phase of the study.

Side-stream and off-stream detention could operate by diverting peak flow, either by gravity or by pumping, to a basin along the stream channel. The basin could be excavated in floodplain land or land adjacent to the floodplain. Levees parallel with the river channel could provide additional storage. A series of basins, each storing about 1,000 acre-feet (af), could reduce the peak flow through Reno. Several sites were investigated between Idlewild Park and Truckee, in California. Several of the sites did not provide sufficient storage and were not investigated further. Two sites, North Flat, in Verdi, and Fleish, upstream of Verdi, were estimated to have about 1,600 af of storage, each. The upstream sites near the town of Truckee, referred to as Union Bend, and East Truckee, were estimated to have from 2,800 af to 13,600 af.

Detailed data were not available to estimate the depth of excavation required for any of these basins. Rough estimates of the required excavation and construction of diversion facilities indicates that excavation could be extensive and cost-prohibitive. Estimates of first costs for these basins range from about $6.4 million for the Fleish site to about $230 million for the East Truckee site. Although the costs appear to be high, reducing the peak flow through a series of basins could reduce or eliminate the need for facilities in downtown Reno and Sparks. Additional data are needed to refine the analysis of these options.

## CONCLUSIONS

Based on the information collected in this Reconnaissance Report the following conclusions are presented:

- The authorized project provides protection for a discharge of 18,500 cfs. Simply enlarging these same facilities to convey 26,000 cfs does not provide an acceptable flood control project.

- Flood control facilities that would be able to pass discharges of 18,500 cfs, 26,000 cfs, and 39,800 cfs are estimated to have annualized costs of $8.1 million, $10.0 million, and up to $17.1 million, respectively.

- Small-scale detention facilities upstream of Reno can potentially reduce peak flow and therefore could reduce the size and extent of flood control facilities in Reno. A series of facilities could cumulatively reduce the peak flow to a level in Reno similar to the flooding potential described in the Flood Insurance Study.

- Improvements to the bridges in Reno would reduce localized flooding and would increase the channel capacity through Reno. This action, combined with a reduction of peak flow from upstream detention basins, may create acceptable flood conditions in Reno.

- Localized channel excavation does not provide enough hydraulic benefit to warrant inclusion in a final flood control plan.

- Extensive overbank excavation at Vista or between Steamboat Creek and McCarran Boulevard could potentially increase the cross section available for flood flows without disturbing the low-flow channel. The hydraulic benefit depends on the size and depth of the excavation. Based on model simulations, this action could reduce the size and extent of flood control facilities required to control the Truckee River backwater, especially those facilities on Steamboat Creek and North Truckee Drain. This overbank excavation could be tied to recreational use or creation of habitat.

- The construction of levees and floodwalls can potentially exclude tributary runoff to the Truckee River. Therefore, any flood control plan should consider interior drainage and should provide appropriate facilities to keep flooding from worsening because of the project.

- City and County representatives have expressed an interest in issues such as bridges and excavation as they relate to any flood control project. As presented in this Reconnaissance Report, improvement of bridges and the channel have a beneficial effect on flood control facilities. Therefore, these types of improvements should be coordinated with local representatives to assure a balance between hydraulic conditions and local concerns.

## RECOMMENDATIONS

This Reconnaissance Report presents costs that describe three possible projects to pass three different magnitudes of floods. Hydraulic analyses are also presented that describe the possible benefits of alternative measures to control flooding. Based on the data developed for this report it is recommended that the COE:

- Conduct aerial mapping of the Truckee River and floodplain and develop new cross sections for hydraulic modeling. The mapping should extend from Vista upstream to Verdi and the cross sections should be wide enough to cover the floodplain to at least the limits of the standard project flood.

- Develop a new hydraulic HEC-RAS model for determining the limits of flooding under a selected discharge. A second model, such as UNET, capable of simulating unsteady flow and routing flood hydrographs should be developed. This model could be used to assess upstream detention options (side-stream storage or proportional weirs), and channel improvements downstream of McCarran Boulevard.

- Investigate incorporating the alternative measures to reduce peak flow or increase peak flow floodplain capacity into a flood control plan. These measures include upstream detention and increasing the floodplain cross section downstream of McCarran Boulevard.

- Although not investigated in this report, an early flood warning system could provide advance warning and could assist with flood mitigation efforts.

# Section 1
# Introduction and Project History

# Section 1
# Introduction and Project History

## INTRODUCTION

In the early 1980s the U.S. Army Corps of Engineers (COE) studied the flooding potential in the Truckee Meadows region of northern Nevada. The Truckee Meadows is a region at the foot of the eastern Sierra Nevada mountains containing the communities of Reno and Sparks, and unincorporated Washoe County. The Truckee River crosses the Truckee Meadows from west to east, leaving the meadows at Vista, downstream of Sparks (Figure 1-1).

The investigations into the Truckee Meadows flooding problems resulted in preliminary engineering design, a feasibility report, and an environmental impact statement project to control flooding (COE, 1985). The project was subsequently authorized by Congress in the Water Resources Development Act of 1988. In 1991, the COE modified some of the approved project features and recomputed the benefit/cost ratio, applying new methodology (COE, 1991). The reevaluation of the benefit/cost ratio indicated that the costs of the proposed project exceeded the benefits, and the project was reclassified to the "deferred" category.

## PURPOSE OF THIS RECONNAISSANCE REPORT

In 1996, the COE was directed to update the authorized Truckee Meadows flood control project through a new reconnaissance-level evaluation. The purpose of the reconnaissance study is to determine if there is currently a flood control project in the Truckee Meadows that is:

- economically justified (a benefit/cost ratio greater than 1.0);
- locally supported;
- implementable; and
- incorporates current conditions.

Although a reconnaissance level study entails a more general level of detail than the previous Feasibility Report, it is an appropriate level of study to determine whether there is federal interest in a project.

This reconnaissance report will provide a sound basis for decision makers to determine whether reclassification of the authorized project is appropriate or if additional studies or cost data are required to resolve the issue of benefit/cost ratio for a project. Future

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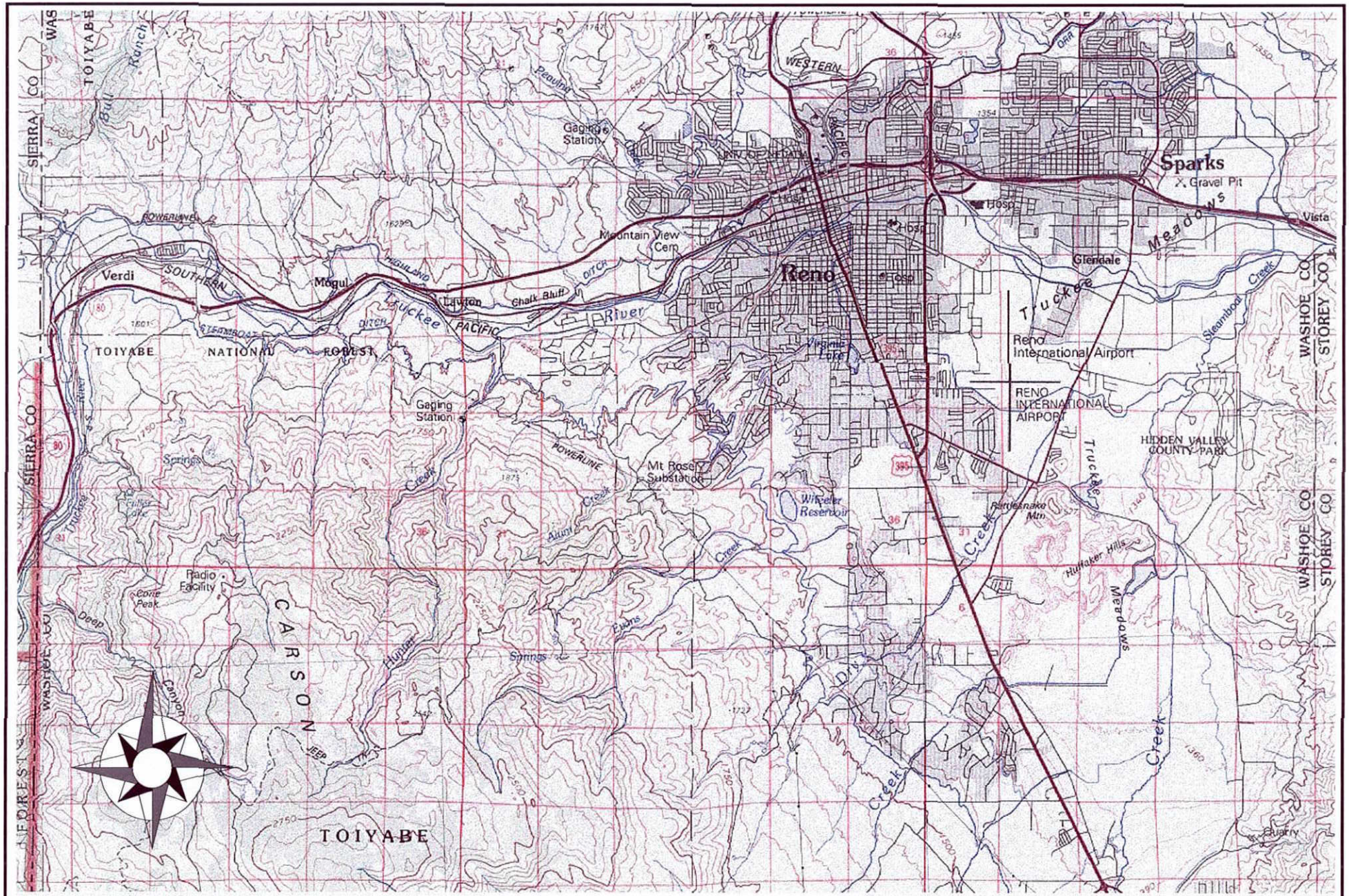


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**FIGURE 1-1**
**RECONNAISSANCE REPORT STUDY AREA**
U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA

studies may investigate other alternatives or may suggest different facilities for flood control.

## SCOPE OF THE RECONNAISSANCE REPORT

The scope of this study is primarily to update the costs of the previously authorized project and to estimate the costs of a project with similar facilities that would handle a larger flow. This reconnaissance report will estimate project costs (in 1996 dollars) for:

- the authorized project to pass 18,500 cubic feet per second (cfs),
- a larger version of the authorized project to pass 26,000 cfs; and
- costs for a project to pass the standard project flood (SPF) (39,800 cfs, as determined in the Feasibility Report).

The methodology used by the COE to estimate project benefits relies on data that relate the magnitude of a flood to the costs of facilities to control that flood. Typically, three data points are used in the analysis of project benefits. For this analysis, the COE will use the cost of facilities to handle floods of 18,500, 26,000, and 39,800 cfs.

Costs will be developed for the authorized project, because that project received congressional authorization and was the project scheduled for funding/construction process ended in 1991. Updating this project restarts the process with a project when at one time was acceptable to Congress.

The SPF alternative was a conceptual alternative developed for the Feasibility Report. The costs for this existing alternative are updated in the reconnaissance report to reflect 1996 dollars.

The 1985 Feasibility Report did not present a project to handle floods between the approved project (18,500 cfs) and the SPF (39,800 cfs). Because this reconnaissance report does not design new facilities, the costs of a project to handle 26,000 cfs were developed assuming a larger version of the approved project facilities.

### Previously Authorized Project

The authorized project was designed to pass a Truckee River flow of 18,500 cfs through Reno and Sparks. The project included floodwalls, levees, channel excavation, and a detention basin. Costs for the approved project were determined in 1985 and were updated in 1991.

This reconnaissance-level report updates the costs for the facilities specified for the authorized project, as presented in the Feasibility Report. The analysis will not propose

modifications to those facilities, but will simply consider the facilities as presented. Future design studies examine alternatives to the proposed design.

### Standard Project Flood

The Feasibility Report presented a conceptual alternative that would pass the standard project flood, which, at the time, was estimated to be 39,800 cfs. The concept presented in the Feasibility Report involved a detention basin, levees, and a bypass channel. Costs for the conceptual alternative were also presented. This reconnaissance report updates the costs for the conceptual alternative, but does not alter the basic concept.

### Current Estimate of the 100-Year Flood

This report also estimates the costs of a project to handle 26,000 cfs. A new project will not be proposed for 26,000 cfs as part of the reconnaissance report; rather, a larger version of the previously authorized project will be assumed. This analysis will therefore upsize the authorized project to pass 26,000 cfs and will estimate the costs associated with these facilities.

## FUTURE STUDIES

If there is a project that will meet federal criteria for a flood control project, feasibility-level studies will be initiated to develop such a project. These studies will involve design and analysis of facilities contained in the authorized project and alternatives for the facilities. The types of facilities considered in a new feasibility phase will be determined as part of a public involvement process.

# Section 2
# Hydraulic Analysis

# Section 2
# Hydraulic Analysis

## INTRODUCTION

Hydraulic analyses were performed to provide data to estimate the costs for the flood control plan and the facilities needed for a larger flow. The computer model HEC-RAS was used to conduct backwater analyses to estimate the flood depth for a flood of 26,000 cfs, to assess the potential benefits of alternative flood control channels, and to assess the capacity of the Truckee River through the Reno area. In order to expedite the modeling analysis, the HEC-RAS model was divided into two reaches:

- The Reno model, extending from below upstream model Highway 395 to the boundary; and,

- The Sparks model, extending from just below Highway 395 to the Vista gage (the downstream model boundary).

The separation of the model into two distinct reaches does not compromise the results produced by the HEC-RAS hydraulics analyses.

HEC-RAS is a steady-state backwater analysis, similar to HEC-2. The primary difference between the two models is that HEC-RAS is Windows-based and performs some computations (especially at bridges) differently than HEC-2.

For this analysis, information was drawn from several previous HEC-2 modeling efforts. Some differences in water surface elevations between HEC-RAS and HEC-2 are unavoidable because of changes to certain hydraulic computations used in the HEC-RAS. No attempt was made to calibrate HEC-RAS results from the previous modeling efforts. However, modeling results from HEC-RAS were checked for reasonableness and were adjusted as necessary to reflect similar regional trends in water surface profiles as those simulated in previous HEC-2 modeling efforts.

This study will develop reasonable estimates of the water surface profiles under the conditions described above. It is not intended to update the flood insurance study (FIS) or to provide design data. The HEC-RAS modeling was performed at a reconnaissance level, consistent with the level of detail of the other components of this reconnaissance report.

## DATA SOURCES

The data used in the modeling were obtained from several sources including:

- HEC-2 data from the 1985 COE Truckee Meadows Feasibility Report (developed 1983-1985),
- Washoe County FIS (1994),
- HEC-2 data from the Washoe County FIS (downstream of Reno City Limits) (developed 1987-1988),
- HEC-2 data originally from the Washoe County FIS but modified by Harding Lawson Consulting Engineers in 1997 (Mark Forest, pers. comm.)
- HEC-2 data from a 1982 Leeds, Hill and Jewett, Inc., study (Leeds, Hill and Jewett, Inc., 1982),
- Nevada Department of Transportation bridge design information; and
- site visits by project engineers.

These data were updated with available information but still reflect information collected 10 years ago. The accuracy of the models developed from these data are consistent with the reconnaissance level of detail and are accurate enough to provide the information needed for the cost estimates in this report.

The original HEC-2 model used by the COE to develop water surface profiles for the Feasibility Report was not available for this study. Instead, many data files containing raw data and partially completed HEC-2 data sets were available. A HEC-RAS model was developed from these data for this report.

One limitation of the data was that the cross sections were often limited to the Truckee River Channel or extended just a short distance from the channel. While these constrained cross sections are acceptable when assuming a leveed channel, but they had to be extended to calibrate the model.

## ASSUMPTIONS

The assumptions associated with the HEC-RAS modeling are summarized below:

- The accuracy of the modeling reflects the reconnaissance level of detail used in the report, and

- available data are sufficiently representative of existing conditions for the modeling.

## RECOMMENDATIONS FOR FUTURE MODELING

Although the HEC-RAS modeling was sufficient for a reconnaissance-level study, detailed modeling is needed before designing facilities or modifying floodplain boundaries. The following actions are recommended prior to preparing a detailed alternatives analysis of facilities design.

- New aerial surveys of the Truckee Meadows from Stateline to Vista should be conducted.

- Detailed cross section data should be developed for the Vista to Stateline reach. The cross sections should cover the channel and floodplain to the approximate elevation inundated by the SPF.

- Hydrologic analyses of flow/frequency estimates should be finalized.

- Detailed site visits should be conducted to establish the hydraulic parameters in the channel and floodplain.

- The data should be collected into a HEC-RAS model, and an unsteady flow model such as UNET.

- All available historical flood data should be obtained. These data should include at least the February 1986 flood and the January 1997 flood. The HEC-RAS and UNET models should be calibrated to these data.

- Models should be developed with enough flexibility to add features, such as side channel or in-channel storage of floodwater.

## HYDRAULICS OF THE AUTHORIZED PROJECT

Two HEC-RAS models were developed for the Vista to Booth Street reach: the Sparks model (Vista to upstream of Glendale Avenue); and the Reno model (upstream of Glendale Avenue to upstream of Booth Street). The Sparks model used data from the FIS and was further calibrated using data from the 1986 flood. The Reno model was calibrated by matching the water surface profile of the FIS.

The water surface profile presented in the Feasibility Report for the authorized project was used in the cost estimate for the authorized facilities (Figure 2-1); no new hydraulic modeling was performed for the approved project.

## HYDRAULICS OF THE 26,000 CFS PROJECT

The levees and floodwalls proposed in the Feasibility Report for the approved project were added to both the Reno and Sparks models. The models were run for 26,000 cfs and additional levees or floodwalls were added if needed to contain the flow. The resulting water surface elevation was used in the cost estimates for facilities (see Section 4) (Figure 2-1).

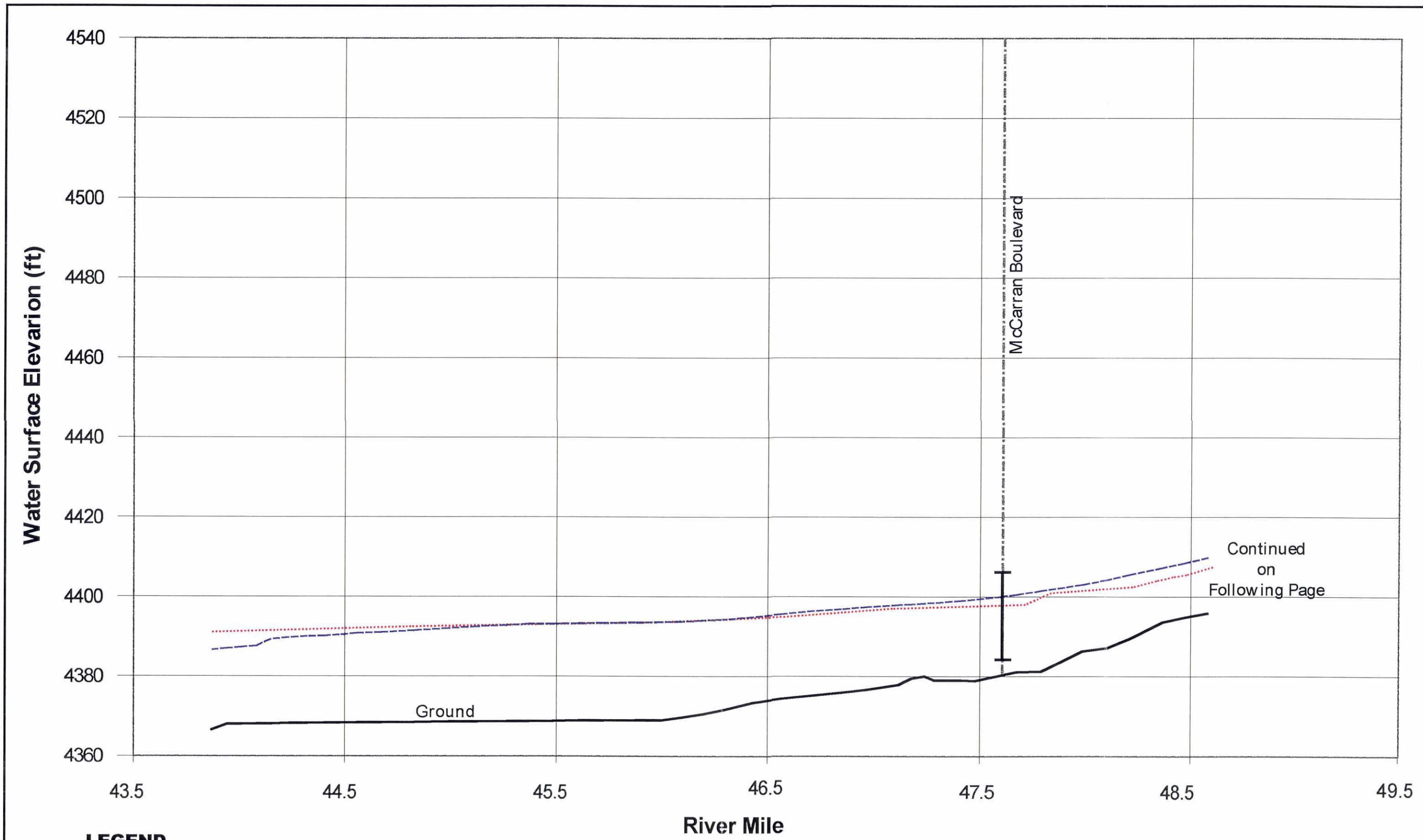


**FIGURE 2-1**
**TRUCKEE RIVER WATER SURFACE PROFILES**
U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA

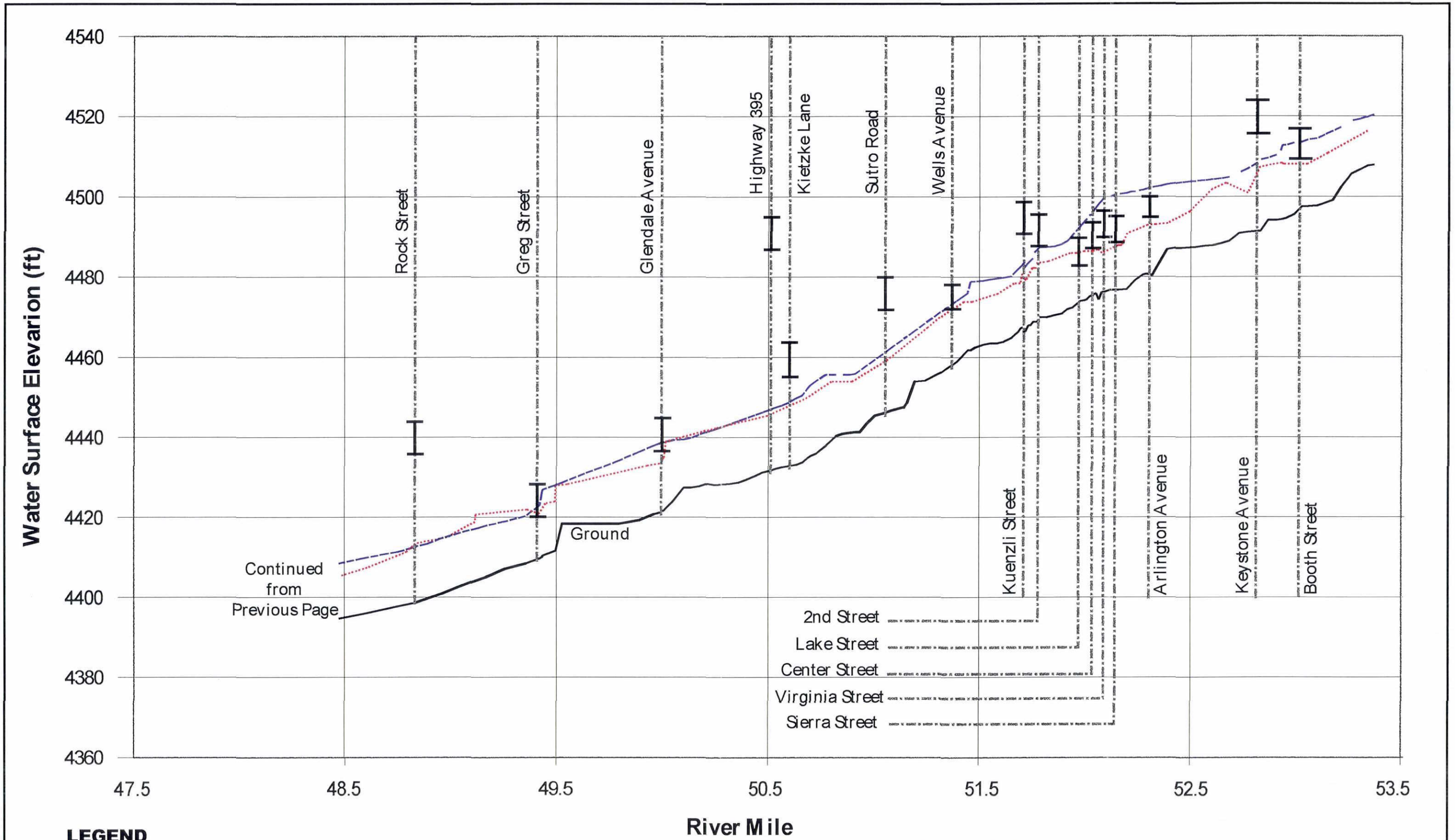


**FIGURE 2-1 (continued)**
**TRUCKEE RIVER WATER SURFACE PROFILES**
U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA

# Section 3
# Approved Project

# Section 3
# Authorized Proj ct

## PURPOSE

This section of the Reconnaissance Report updates the 1985 Feasibility Report (COE, 1985) for the proposed flood control project. The proposed project was designed to convey 18,500 cfs of flow at the Reno gage of the Truckee River through the Truckee Meadows area. The project discussed in the Feasibility Report was authorized by Congress.

## FACILITIES

As discussed in the 1985 Feasibility Report, the flood control measures required for the 18,500 cfs flow include floodwalls, levees, channel excavation, and replacement of bridges. For this update, the features of the Feasibility Report have been broken down into nine reaches (Figure 3-1). These reaches are modified slightly from those defined in the Feasibility Report:

- Reach 1: Truckee River Upstream of Booth Street
- Reach 2: Truckee River from Booth Street to Lake Street
- Reach 3: Truckee River from Lake Street to Highway 395
- Reach 4: Truckee River from Highway 395 to McCarran Boulevard
- Reach 5: Truckee River from McCarran Boulevard to Vista (excludes University Farms Detention Basin levee along right bank of Truckee River from Station 183+50 to 122+00)
- Reach 6: Steamboat Creek and Boynton Slough
- Reach 7: University Farms Area (excludes South and West detention basin levees and inlet and outlet weirs)
- Reach 7A:University Farms Detention Basin (includes South and West detention basin levees and inlet and outlet weirs)
- Reach 8: North Truckee Drain and Peoples Ditch

Descriptions of the authorized project features, design assumptions, and construction concerns for this update follow. Figures showing a plan view of the facilities in each

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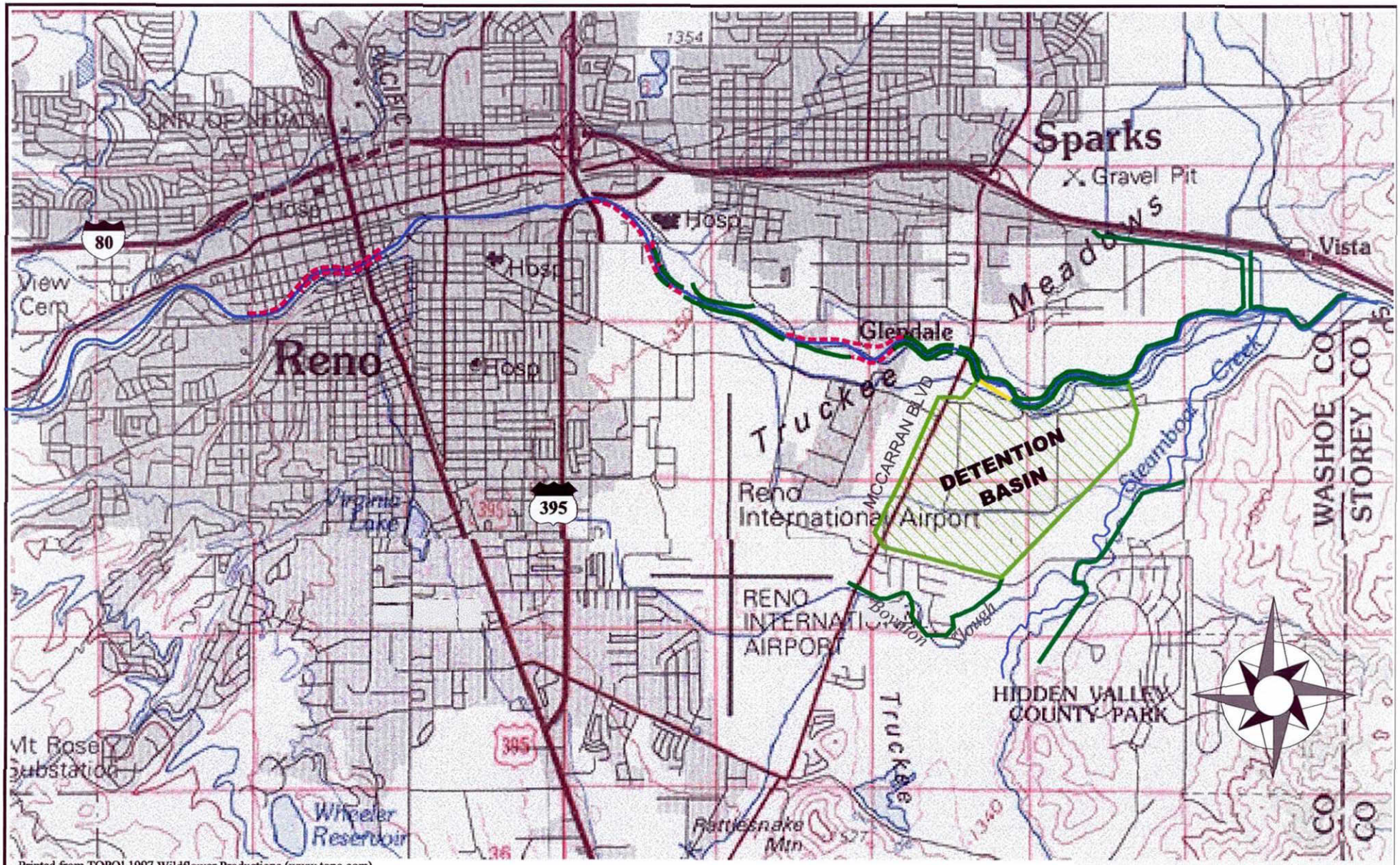



**LEGEND**

- Levees
- Flood Walls
- University Farms Detention Basin

**FIGURE 3-1**
**AUTHORIZED FLOOD CONTROL PLAN**
U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA

reach and typical cross sections were developed. These figures appear together at the end of the facilities description.

### Reach 1: Truckee River Upstream of Booth Street

Approved Features: The authorized project has no project features in this reach.

Update Assumptions/Construction Concerns: Similar to the Feasibility Report, this update does not propose project features for this reach. It was noted during field investigation that many of the outdoor decks of ground-floor apartments north of the Truckee River in the vicinity of Idlewild Park were lost and lower-level units flooded in the January 1997 flooding. Further hydraulic analysis and research needs to be performed to determine likely flood depths in this area at the 18,500 cfs flow.

### Reach 2: Truckee River from Booth Street to Lake Street

Authorized Project Features: In this reach the flood control plan is shown on Figures 3-2 and 3-3. The following features are illustrated:

- floodwall on left bank for entire reach,
- floodwall on right bank beginning at Station 464+00 and extending downstream to Lake Street,
- channel excavation just downstream of the Booth Street Bridge, (approximate length as indicated on Figure 3-2); and
- channel excavation beginning upstream of both Arlington Avenue bridges and extending to the Sierra Street Bridge.

Bridge structures on Booth Street, Arlington Avenue-North, Arlington Avenue-South, Sierra Street, Virginia Street, and Lake Street are to be replaced with larger flow capacities.

Update Assumptions/Construction Concerns: The assumptions and concerns for this reach include:

- The floodwall on the left bank between Booth Street and Arlington Avenue will be a gabion wall, as illustrated in cross section 1 on Figure 3-16. Dimensions shown for the gabion wall were assumed to be constant for the entire reach.
- The floodwall on the remainder of the left bank and the entire right bank will be a reinforced-concrete, I-pile wall constructed adjacent to the existing floodwall, as

illustrated in cross section 2 on Figure 3-16. The height of the floodwall was determined using the Feasibility Report hydraulic profiles and subtracting the indicated improvement elevations from channel invert elevations.

- The channel excavation downstream of Booth Street was assumed to have the cross section indicated in cross section 1 on Figure 3-16.

- The channel excavation at the Arlington Street bridges was assumed to be 1.5 feet deep for the entire channel excavation area, as shown on Figures 3-2 and 3-3.

- The replaced bridges were assumed to be raised and designed with a larger opening, without altering the bottom chord of the bridge at elevations as shown in the Feasibility Report. A 20-foot extension was assumed for the end of each replaced bridges to provide a ramped transition to the elevated bridge. The Center Street Bridge is currently being reconstructed and was not included in the cost estimates in the reconnaissance report. The detailed design of the bridges to be replaced including the transitions would be developed in the next phase of the project.

- Utilities on each bridge were assumed to be relocated on the new bridge. The utilities involved are listed in the attached construction estimates for Reach 2.

### Reach 3: Truckee River from Lake Street to Highway 395

Authorized project Features: The flood control plan for Reach 3 is shown on Figures 3-3 and 3-4. No Project features were required in this reach.

Update Assumptions/Construction Concerns: There are no facilities proposed for this reach.

### Reach 4: Truckee River from Highway 395 to McCarran Boulevard.

Authorized project Features: The reach flood control plan is shown on Figures 3-4 through 3-7. The following features are illustrated for the right bank:

- Floodwall from Highway 395 to Greg Street. This floodwall contains a 600-foot breakout section starting at approximately Station 303+20 to 309+20.

- Levee from Greg Street to Rock Boulevard. This levee contains two breakout sections of 1000 feet and 800 feet, starting at Stations 288+00 to 278+00 and 274+00 to 266+00, respectively.

- Levee from Station 256+00 to Station 238+00.

- Floodwall from Station 238+00 to Station 223+20.

- Levee from Station 223+20 to McCarran Boulevard.

The following features are shown for the left bank:

- Floodwall from Glendale Avenue to Station 312+00. This floodwall contains an 800-foot breakout section starting at approximately Station 321+50 to 313+50.

- Levee from Station 312+00 to Station 286+00. This levee contains a 100-foot breakout section starting at Station 302+00 to 301+00.

- Floodwall from Station 286+00, tying into Rock Boulevard. at approximately Station 277+50.

- Floodwall from Rock Boulevard. Bridge to Station 218+00. This floodwall contains a 1000-foot breakout section starting at Station 262+00 to 252+00.

- Excavation in the Truckee River channel from Station 242+00 to approximately Station 222+00 extending over the floodplain into Glendale Park.

- Levee from Station 218+00 to McCarran Boulevard.

Update Assumptions/Construction Concerns: The assumptions and concerns for this reach include:

- All floodwalls in this reach will be reinforced-concrete, inverted "T" style walls constructed as illustrated in cross sections 3,4,5, and 6 on Figures 3-17 and 3-18. The height of the floodwall above ground was determined using the Feasibility Report hydraulic profiles and subtracting the indicated improvement elevations from the ground surface elevations. The floodwalls were assumed to extend 4 feet below ground, with footing dimensions 1 foot 2 inches high by 3 feet 6 inches wide. Assume excavation required for concrete placement to be 9 feet wide by 6 feet deep.

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross section 4 on Figure 3-17. Height of the levees was determined using the Feasibility Report hydraulic profiles and subtracting the indicated improvement elevations from the ground surface elevations as shown on preliminary design topographic maps supplied by the COE. The levee inspection trench is assumed to be 9 feet wide and 6 feet deep for levees greater than 6 feet in total height. For levees less than 6 feet in height, the depth of the trench will equal the height of the levee. Assume stripping 70 feet wide the entire length of the levee.

- Breakout floodwalls in this reach will be constructed as illustrated in cross section 4 on Figure 3-17. (Also, see the attached construction cost estimates for Reach 4, and typical cross section in the Feasibility Report).

- Breakout levees in this reach will be constructed as illustrated in cross section 5 on Figure 3-18. (Also, see the attached construction cost estimates for Reach 4, and typical cross section in the Feasibility Report)

- Severe bank erosion and undermining of buildings took place on the right bank in the vicinity of Station 238+00 to Station 226+00. The cross section of the Truckee River needs to be updated and the floodwall may need to be relocated due to channel erosion that occurred in the January 1997 flood event. The location of the floodwall will depend on the future plans for the remaining structures in the industrial area.

- Excavation in the vicinity of Glendale Park (Stations 242+00 to 222+00) was assumed to cover the area indicated on Figure 3-7. The land was assumed to be excavated down to an elevation of 4950.0 so the excavation would daylight into the existing channel. The right bank of the channel would have a 2:1 slope, as illustrated in cross section 6 on Figure 3-18.

**Reach 5: Truckee River from McCarran Boulevard. to Vista (excludes University. Farms Area levee along right bank of Truckee River from Station 183+50 to 122+00)**

Authorized project Features: The reach flood control plan is shown on Figure 3-8 through Figure 3-10 and illustrates the following features:

- Right bank: Levee from McCarran Boulevard. to approximately Station 183+50.

- Left bank: Levee from McCarran Boulevard. to approximately Station 31+50, excluding the entrance of the North Truckee Drain at approximately Station 73+00.

Update Assumptions/Construction Concerns: The assumptions and construction concerns for Reach 5 include:

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross sections 7, 8, 9, and 10 on Figures 3-19 and 3-20. The height of the levee was determined using the Feasibility Report hydraulic profiles and subtracting the indicated improvement elevations from the ground surface elevations obtained from the preliminary design topographic maps supplied by the COE. The levee inspection trench is assumed to be 9 feet wide and 6 feet deep for levees greater than 6 feet in total height. For

levees less than 6 feet in height, the depth of the trench will equal the height of the levee. Assume stripping 70 feet wide along the length of the levee.

### Reach 6: Steamboat Creek and Boynton Slough

Authorized project Features: The reach flood control plan for Reach 6 is shown on Figures 3-11 and 3-12. The following feature is illustrated for:

Boynton Slough:

- Levee along left bank from McCarran Boulevard to Southeast corner of the detention basin levee as shown on Figure 3-12.

The following features are illustrated for Steamboat Creek:

- Levee along right bank ties into hillside to the East, as shown on Figure 3-12.

- Pembrook Lane Bridge raised and widened.

Update Assumptions/Construction Concerns: Assumptions and concerns for Reach 6 include:

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross section 11 on Figure 3-21. The height of the levee was determined by assuming Boynton Slough and Steamboat Creek levees were the same elevation as nearby detention basin levees and subtracting the ground surface elevation obtained from the preliminary design topographic maps supplied by the COE. The top of western and southern detention basin levees were assumed to be at elevation 4401, eastern detention basin levees were assumed to be at elevation 4400, and northern detention basin levees (south Truckee River levees) were assumed to be at 4402. The levee inspection trench is assumed to be 9 feet wide and 6 feet deep for levees greater than 6 feet in total height. For levees less than 6 feet in height, the depth of the trench will equal the height of the levee. Assume stripping 35 feet on both sides of centerline along the length of the levee.

- Pembrook Lane Bridge is assumed to be raised to convey Steamboat Creek water during floods.

Reaches 7 and 7A delineate between two project options. Reach 7 describes features required for a project to control Truckee River flooding without a detention basin and reach 7A describes features required for a project with a detention basin.

### Reach 7: University Farms Area (excludes South and West detention basin levees and inlet and outlet weirs)

Authorized project Features: The reach without a detention basin flood control facility plan is shown on Figures 3-11, 3-12 and 3-13. The following features are illustrated:

- Levee on right bank of Truckee River from Station 183+50 to Station 122+00.
- Detention basin East levee from the Truckee River to the Boynton Slough levee at Pembrook Lane.

Update Assumptions/Construction Concerns: Assumptions and concerns for Reach 7 include:

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross section 8 on Figure 3-19 and cross section 11 on Figure 3-21. The height of the levee was determined using the Feasibility Report hydraulic profiles and subtracting the indicated channel improvement elevations from ground surface elevations obtained from the preliminary design topographic maps supplied by the COE. The eastern detention basin levees were assumed at elevation 4400 and the northern detention basin levees (south Truckee River levees) were assumed at elevation 4402. The levee inspection trench is assumed to be 9 feet wide and 6 feet deep for levees greater than 6 feet in total height. For levees less than 6 feet in height, the depth of the trench will equal the height of the levee. Assume stripping 70 feet wide along the length of the levee.
- Reach 7 features include levees along Steamboat Creek and Boynton Slough designed to control backwater flooding from the Truckee River.

### Reach 7A: University Farms Area (includes South and West detention basin levees and inlet and outlet weirs with University Farms Detention Basin)

Authorized project Features: The reach flood control plan is shown on Figures 3-11 through 3-13. The following features are illustrated:

- Levee on right bank of Truckee River from Station 183+50 to Station 122+00.
- Detention basin East levee from the Truckee River to the Boynton Slough levee at Pembrook Lane.
- Excavation in the Truckee River channel and extending to the detention basin inlet weir area from roughly Station 186+00 to Station 168+00 as shown on Figure 3-13.

- Detention basin inlet and outlet weirs.

- Levee along McCarran Boulevard from Station 184+00 to Kimlick Lane and West to McCarran Boulevard.

Update Assumptions/Construction Concerns: Assumptions and concerns for Reach 7A include:

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross sections 8 and 11 on Figure 3-21. The height of the levee was determined using the Feasibility Report hydraulic profiles and subtracting the channel improvement elevations from the ground surface elevations obtained from the preliminary design topographic maps supplied by the COE. Western and southern detention basin levees were assumed to be at elevation 4401, eastern detention basin levees were assumed to be at elevation 4400, and northern detention basin levees (south Truckee River levees) were assumed to be at 4402. The levee inspection trench is assumed to be 9 feet wide and 6 feet deep for levees greater than 6 feet in total height. For levees less than 6 feet in height, the depth of the trench will equal the height of the levee. Assume stripping 70 feet wide along the length of the levee.

- The detention basin inlet weir will be reinforced-concrete as illustrated in cross section 7 on Figure 3-19. The weir crest elevation will be 4394.2 as per the Feasibility Report. There will be 200' of riprap upstream and downstream of the inlet weir at a thickness of 6 inches. (Also, see the attached construction estimates for Reach 7A, and typical cross section in Feasibility Report).

- Excavation in front of the detention basin inlet weir (Stations 186+00 to 168+00) was assumed have an area as indicated on Figure 3-19 cross section 7. The land was assumed to be excavated to cross sectional elevation of 4382.0 and that the excavation would daylight on a 2:1 slope, as illustrated in cross section 7 on Figure 3-19.

### Reach 8: North Truckee Drain and Peoples Ditch

Authorized project Features: The reach flood control plan is shown on Figures 3-14 and 3-15. The following features are illustrated for the North Truckee Drain:

- Levee on right and left bank of the North Truckee Drain from Truckee River to Interstate 80. Left bank levee will tie into Interstate 80's embankment.

- Levee on right bank will continue along Interstate 80 to approximately North Truckee Drain Station 70+60.

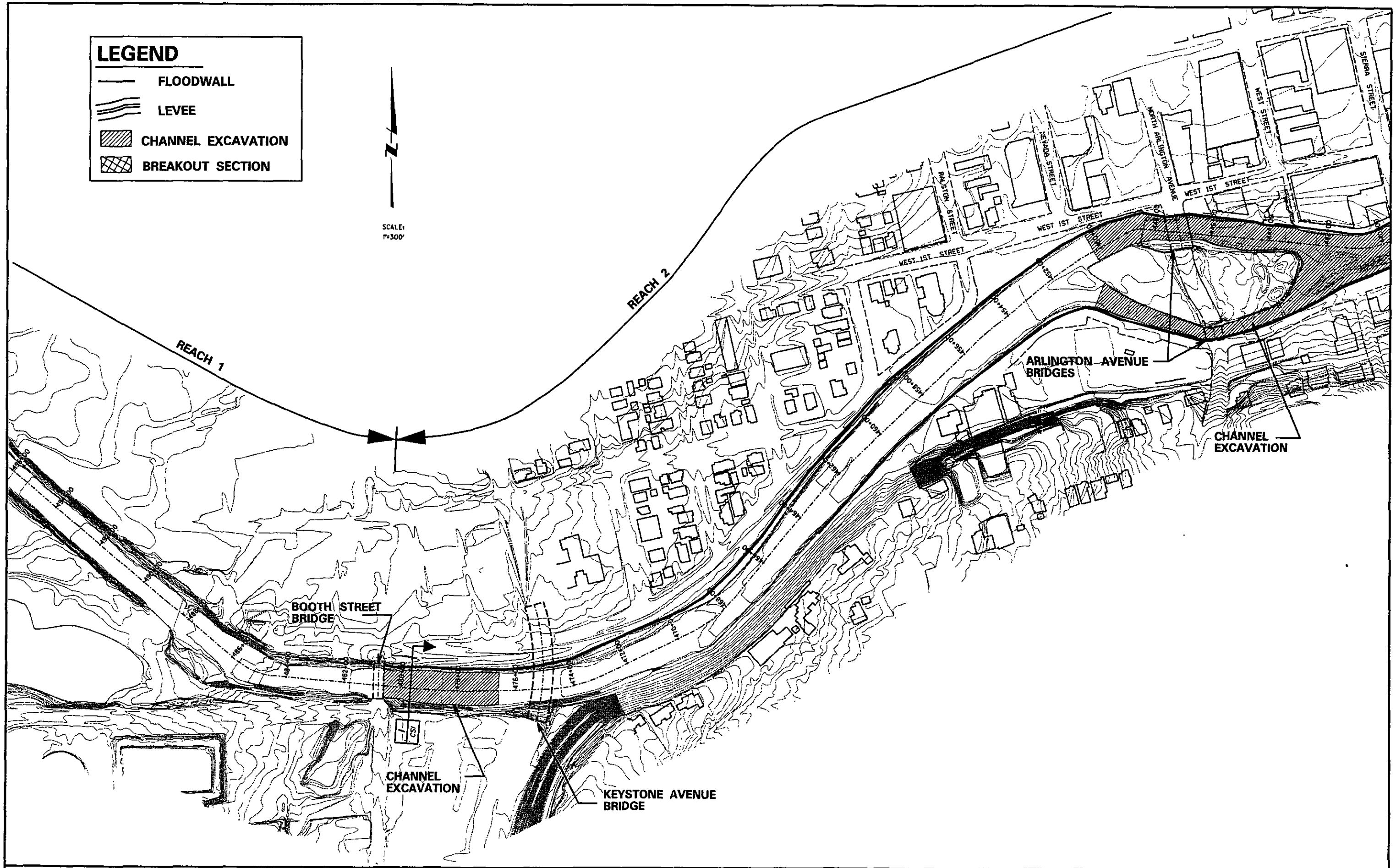
The following feature is illustrated for the Peoples Ditch:

- North-south oriented levees on right and left bank of two portions of the Peoples Ditch north of Interstate 80 starting in the vicinity of North Truckee Drain Stations 28+00 to 30+00 and 71+00 to 73+00. These levees will tie into higher ground approximately 900 feet north of Interstate 80.

Update Assumptions/Construction Concerns: Assumptions and concerns for Reach 8 include:

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross section 12 on Figure 3-21. The height of the levee was determined by assuming North Truckee Drain and Peoples Ditch levees to be at elevation 4394 and subtracting the ground surface elevation obtained from the preliminary design topographic maps supplied by the COE. The levee construction trench is assumed to be 9 feet wide and 6 feet deep for levees greater than 6 feet in total height. For levees less than 6 feet in height, the depth of the trench will equal the height of the levee. Assume stripping 70 feet wide along the length of the levee.

North Truckee Drain and Peoples Ditch levees protect the Sparks industrial area from significant flooding caused by Truckee River backwater.

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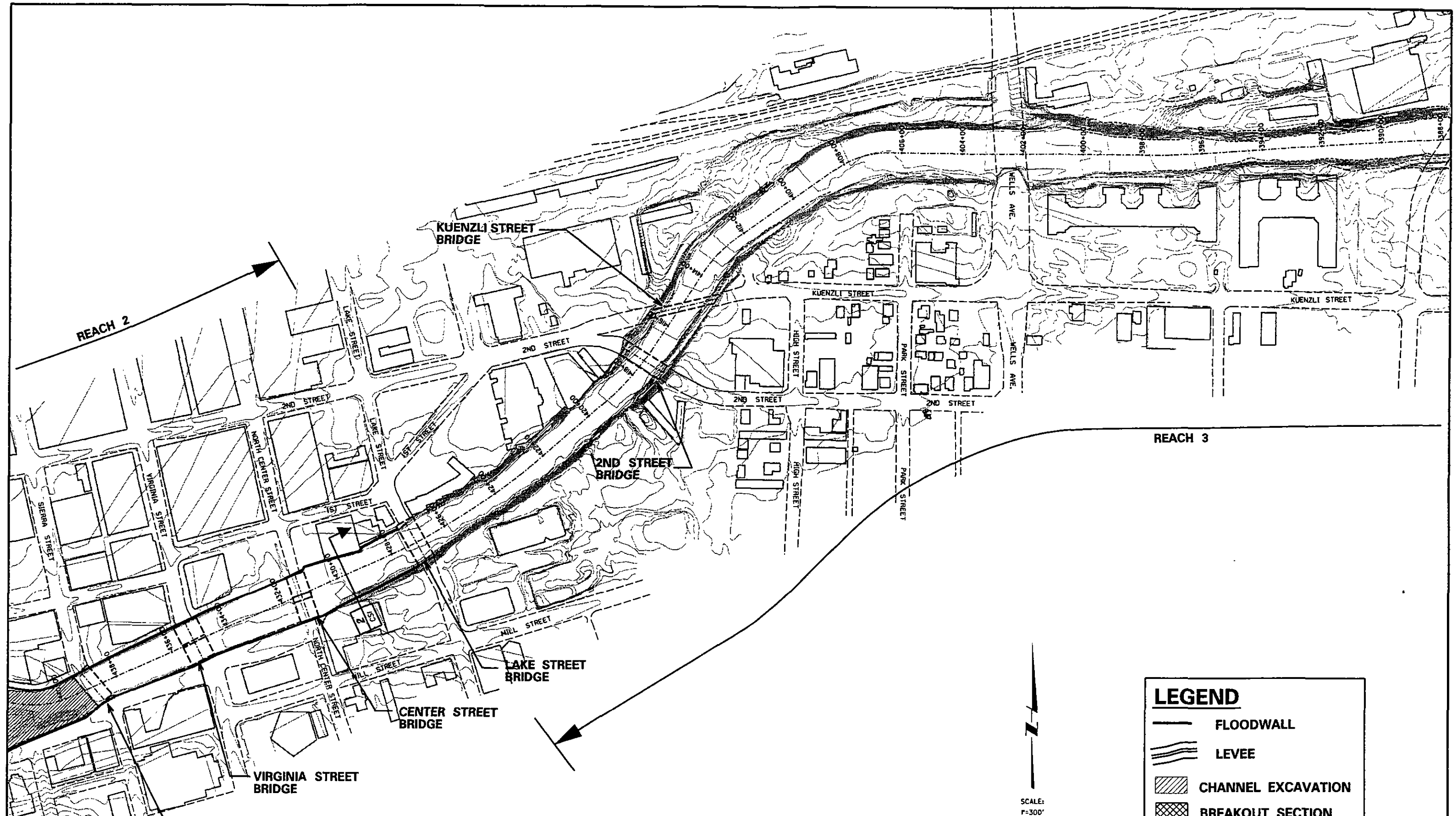
| | U.S. ARMY CORPS OF ENGINEERS<br>TRUCKEE MEADOWS, NEVADA<br>AUTHORIZED FLOOD CONTROL PLAN | FIGURE<br>3-2 |

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| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 3-3 |
| AUTHORIZED FLOOD CONTROL PLAN | |

## LEGEND

- FLOODWALL
- LEVEE
- CHANNEL EXCAVATION
- BREAKOUT SECTION

N

SCALE: 1"=300'

REACH 3

REACH 4

HIGHWAY 395

KIETZKE LN

KIETZKE LANE BRIDGE

SUNSHINE LN

KUENZLI STREET

KUENZLI STREET

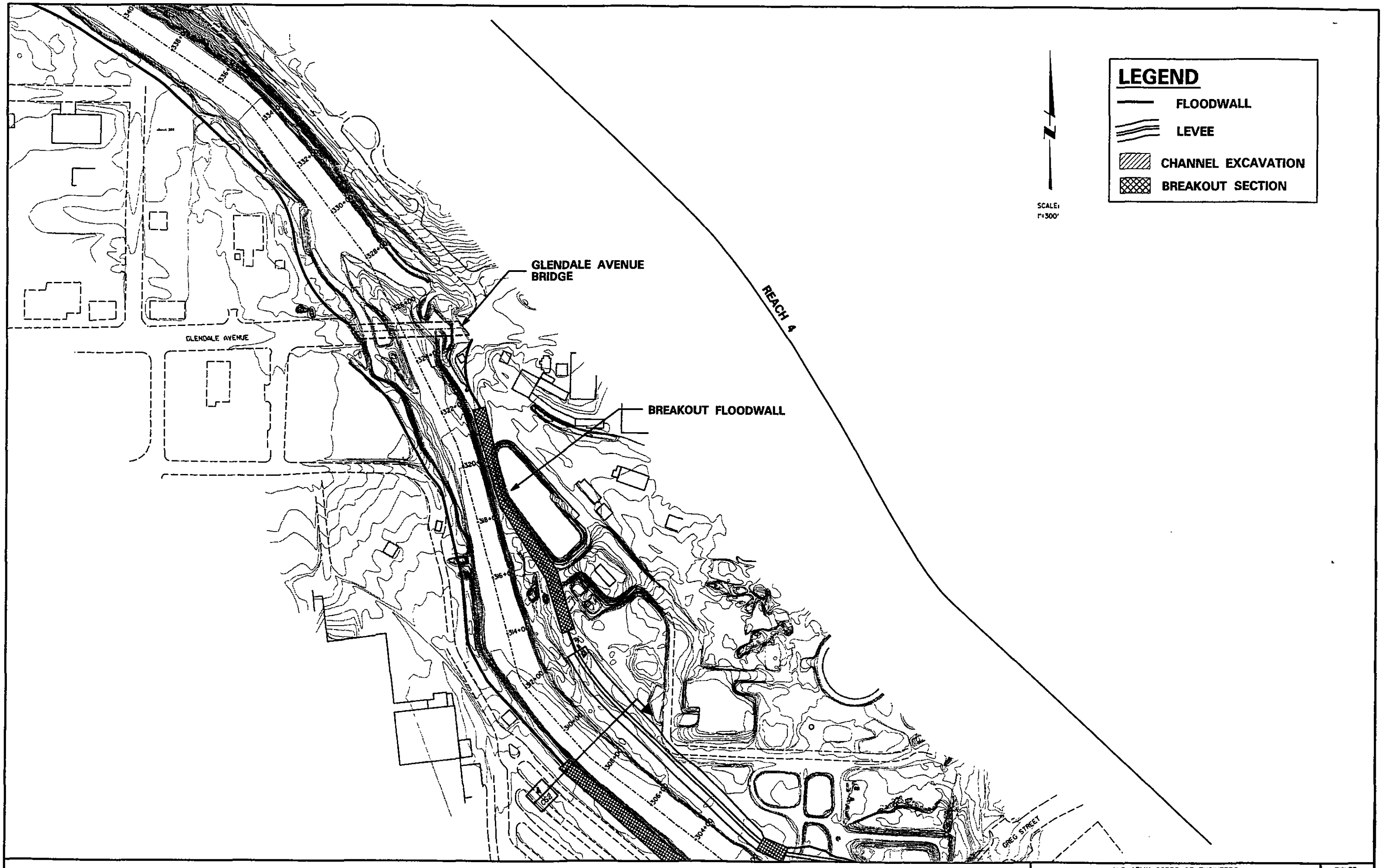
KUENZLI STREET

GIROUX STREET

MANUEL STREET

KIETZKE LN

| | |
|---|---|
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 3-4 |
| AUTHORIZED FLOOD CONTROL PLAN | |

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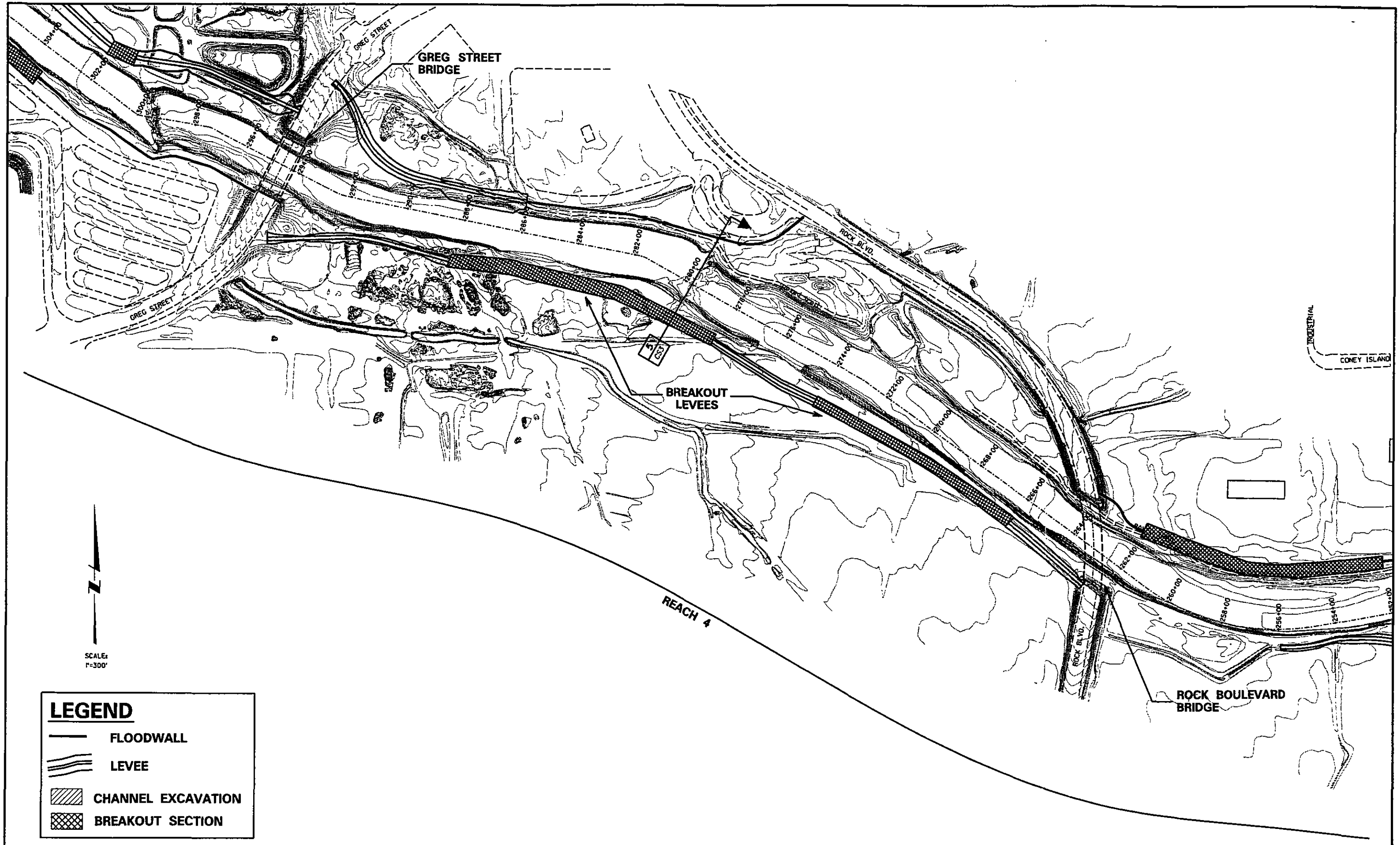
| | U.S. ARMY CORPS OF ENGINEERS<br>TRUCKEE MEADOWS, NEVADA<br>AUTHORIZED FLOOD CONTROL PLAN | FIGURE<br>3-5 |

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|---|---|---|
| | U.S. ARMY CORPS OF ENGINEERS<br>TRUCKEE MEADOWS, NEVADA<br>AUTHORIZED FLOOD CONTROL PLAN | FIGURE<br>3-6 |

Y ISLAND WAY

MARIETTA WAY

CONEY ISLAND DRIVE

LINDA WAY

CONEY ISLAND DRIVE

GLENDALE PARK

CROSS SECTION MUST BE UPDATED TO REFLECT CHANGES TO CHANNEL GEOMETRY DURING 1997 FLOOD. FLOODWALL MAY BE RELOCATED.

MCCARRAN BOULEVARD BRIDGE

NORTH EDISON WAY

NORTH EDISON WAY

REACH 4

MILL STREET

MILL STREET

REACH 5

SOUTH McCARRAN BLVD.

SOUTH McCARRAN BLVD.

KIMLICK LN.

## LEGEND

- FLOODWALL
- LEVEE
- CHANNEL EXCAVATION
- BREAKOUT SECTION

N

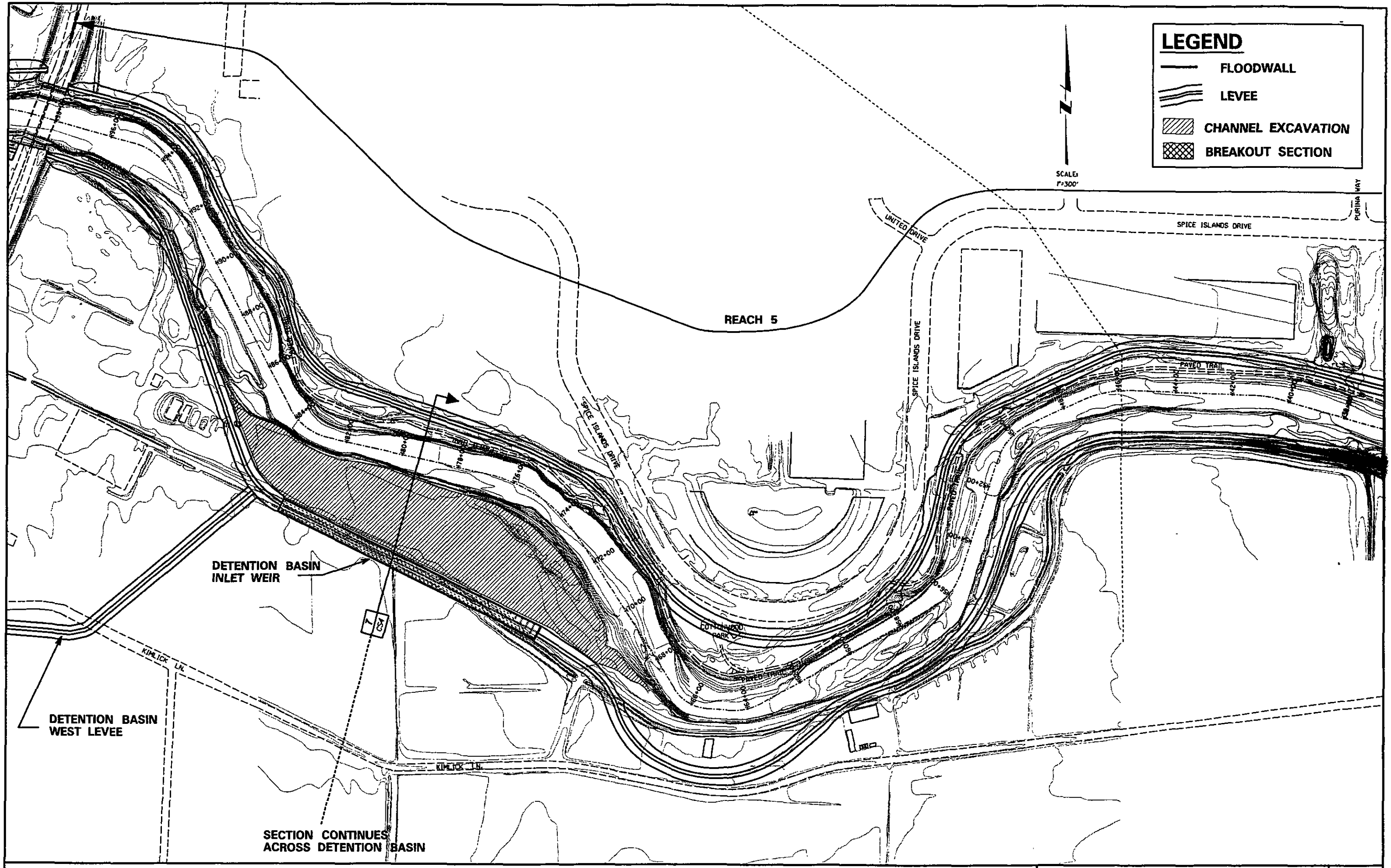
SCALE: 1"=300'

U.S. ARMY CORPS OF ENGINEERS

TRUCKEE MEADOWS, NEVADA

AUTHORIZED FLOOD CONTROL PLAN

FIGURE 3-7

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|---|---|
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 3-8 |
| APPROVED FLOOD CONTROL PLAN | |

## LEGEND

- FLOODWALL
- LEVEE
- CHANNEL EXCAVATION
- BREAKOUT SECTION

N

SCALE: 1"=300'

REACH 5

PAVED TRAIL

DEMING WAY

SPICE ISLANDS DRIVE

CONDOMINIUM/ COMMON AREA

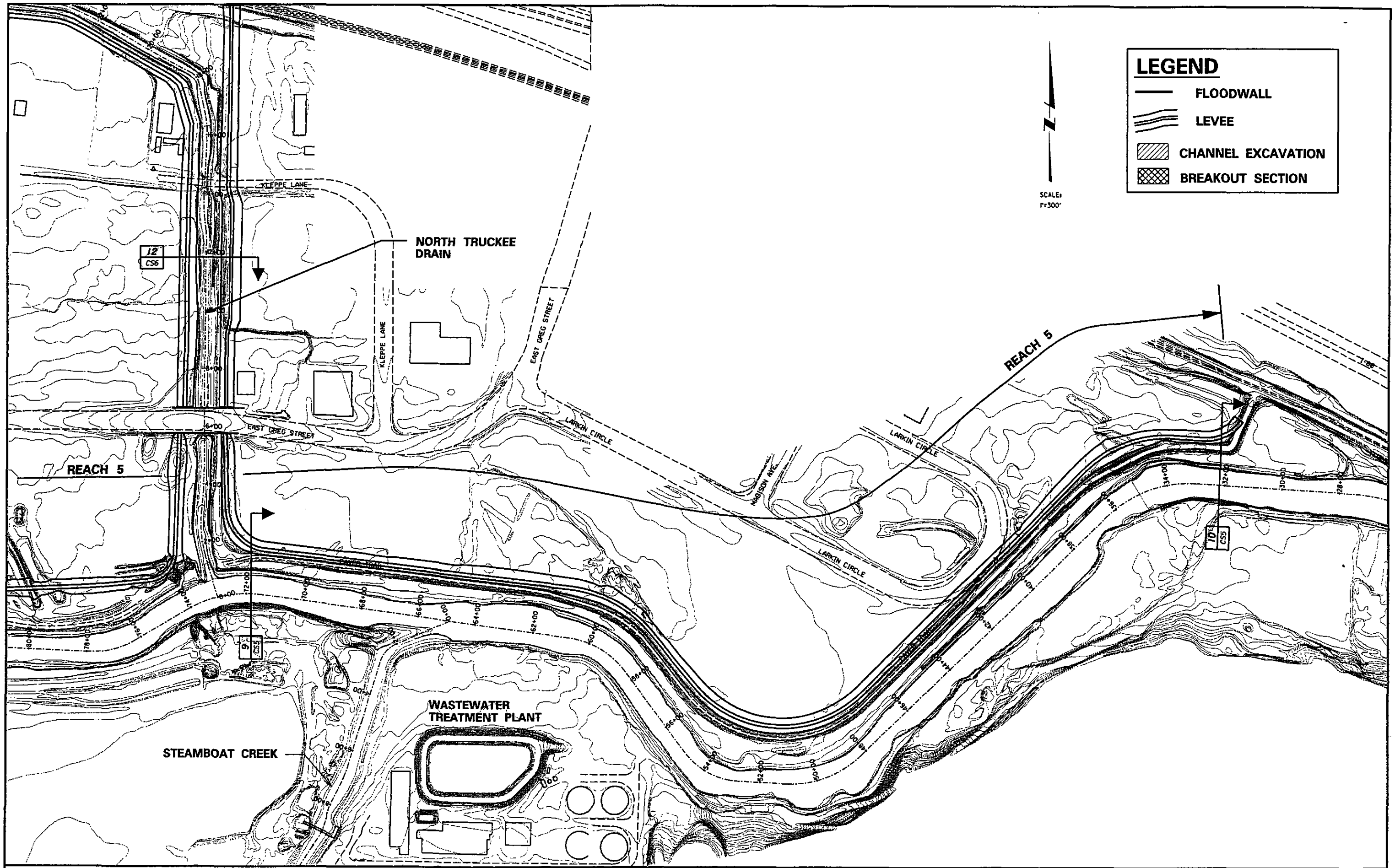
PAVED TRAIL

DETENTION BASIN EAST LEVEE

STEAMBOAT CREEK

DETENTION BASIN

| | |
|---|---|
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 3-9 |
| AUTHORIZED FLOOD CONTROL PLAN | |

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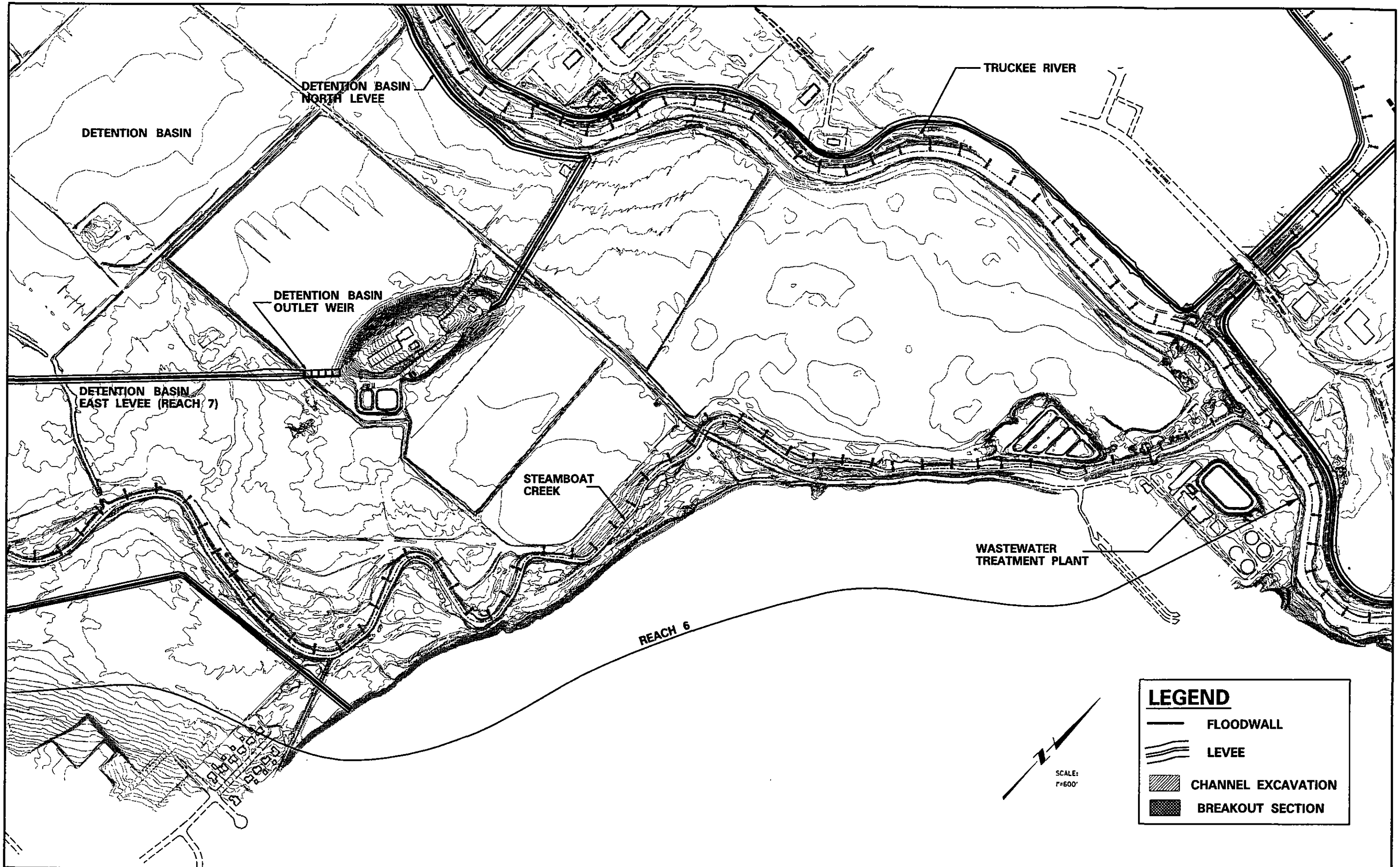
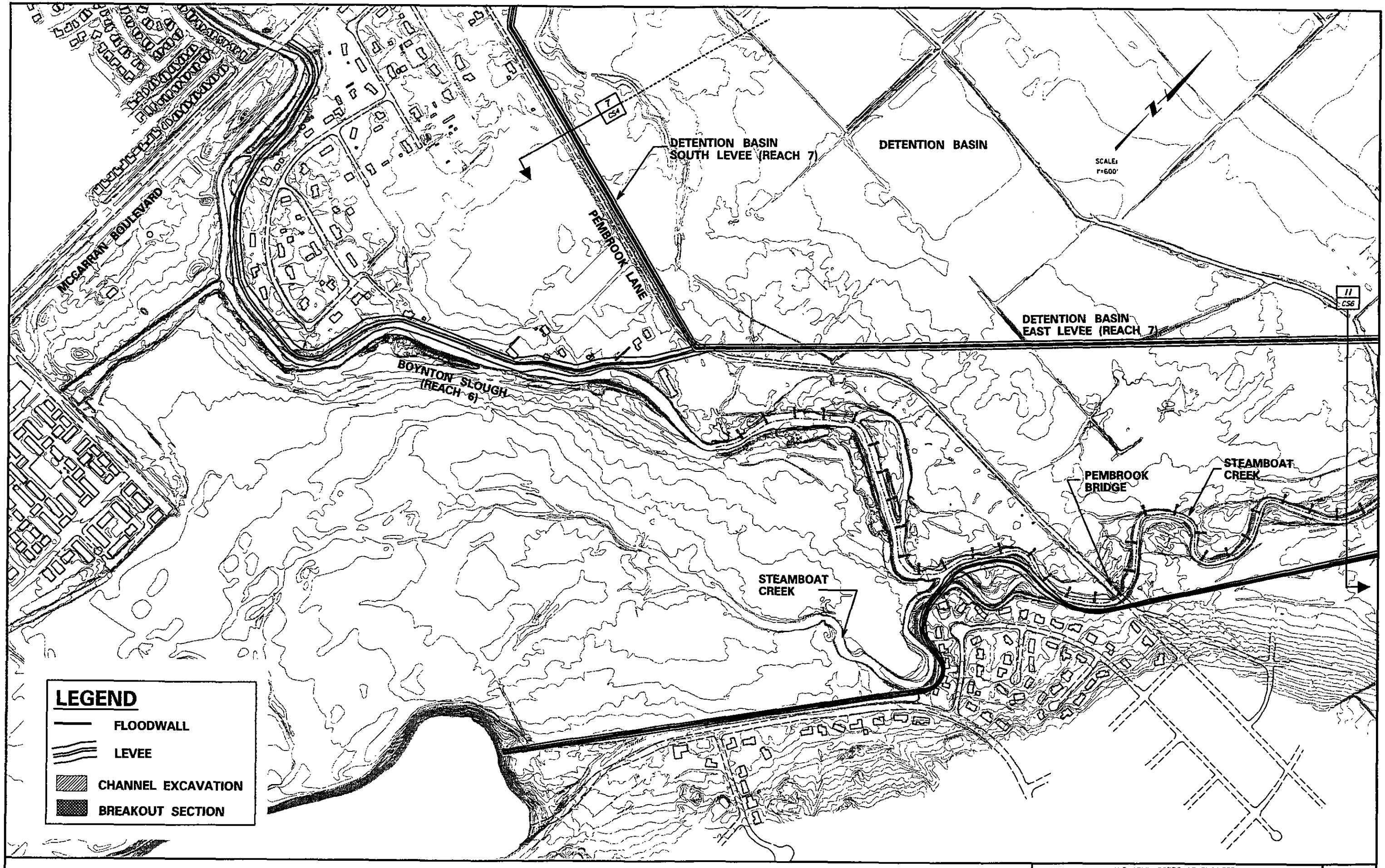
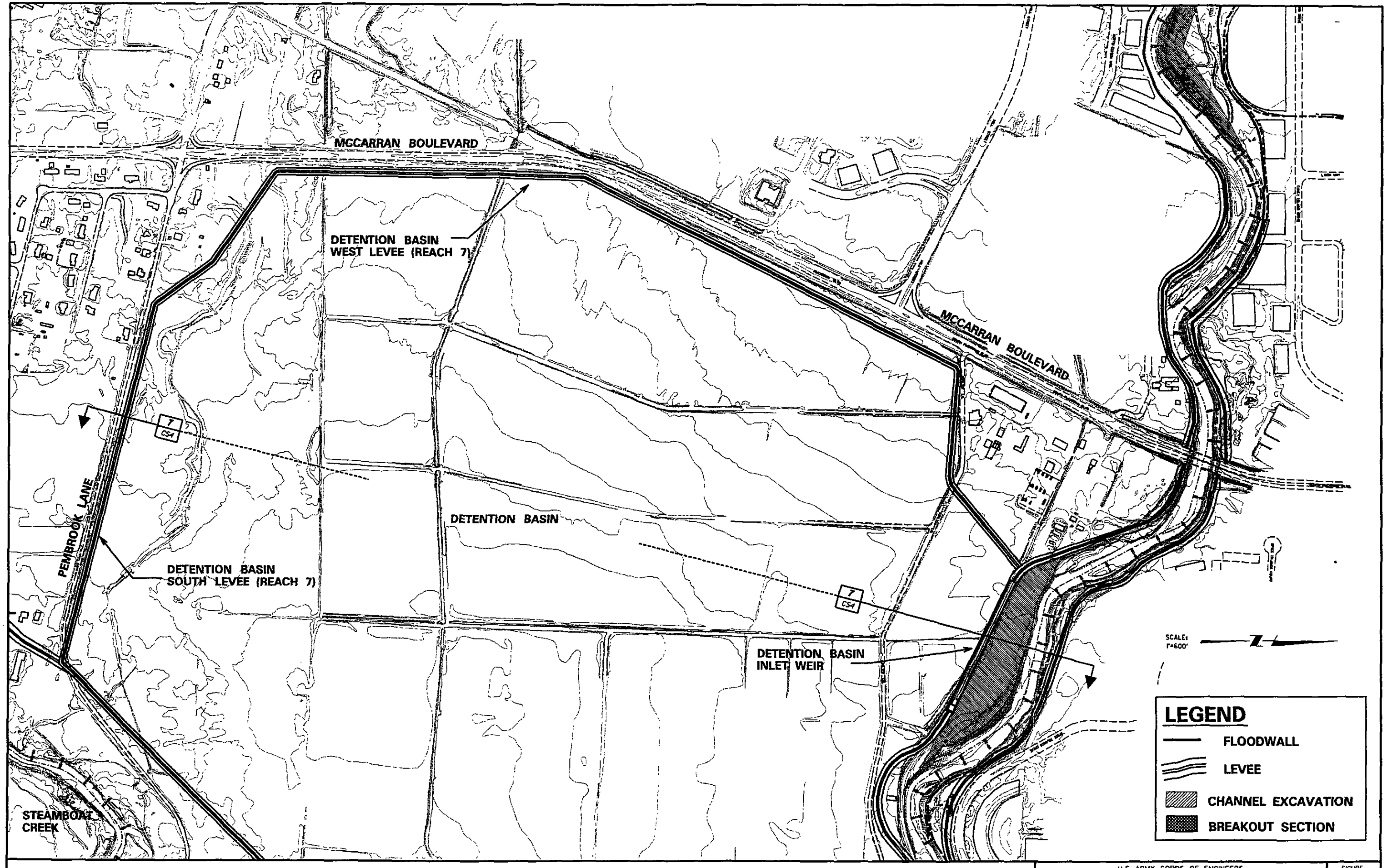
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 3-10 |
| AUTHORIZED FLOOD CONTROL PLAN | |




| | | |
|---|---|---|
| | U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| | TRUCKEE MEADOWS, NEVADA | 3-11 |
| | AUTHORIZED FLOOD CONTROL PLAN | |

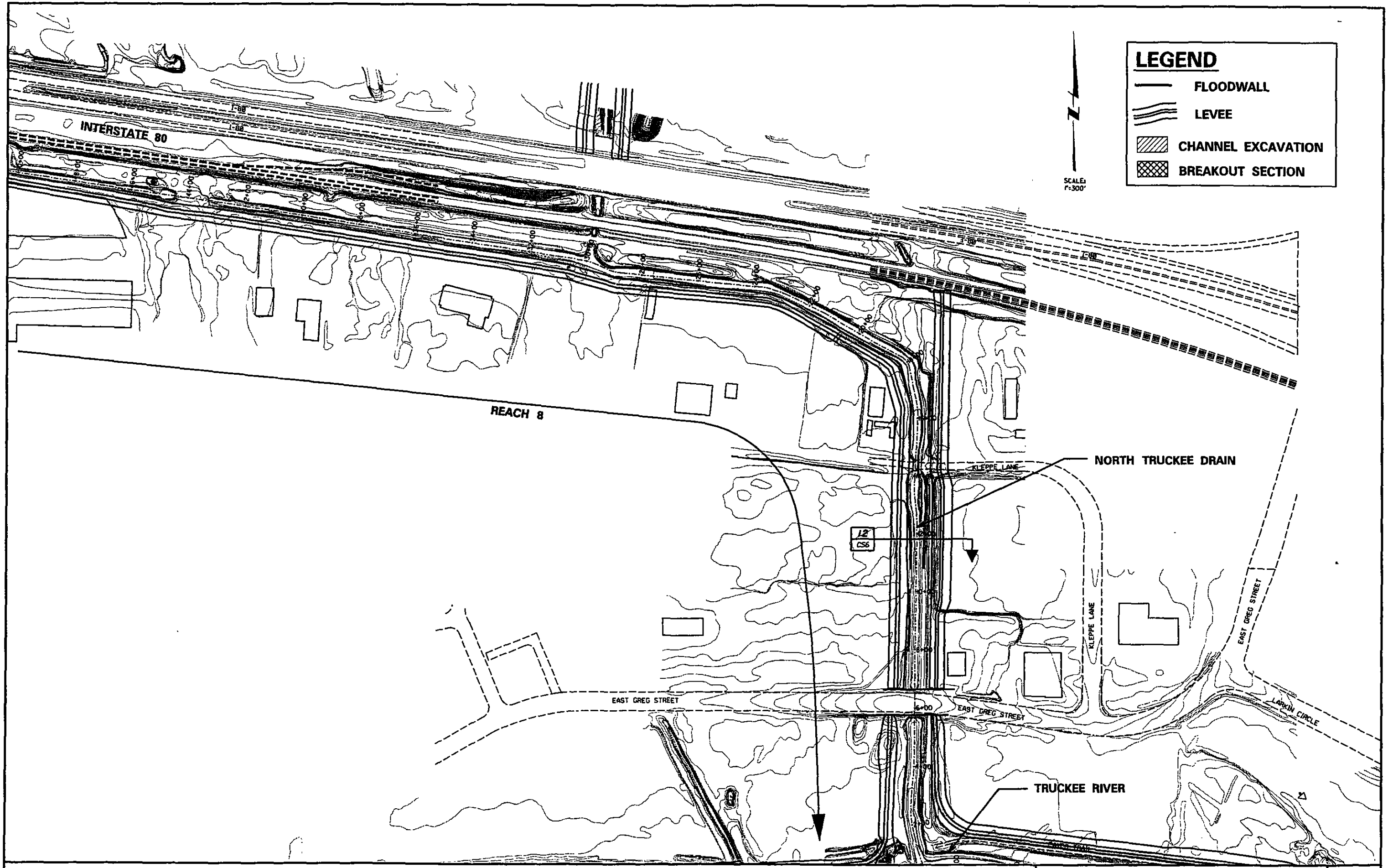



| | |
|---|---|
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 3-12 |
| AUTHORIZED FLOOD CONTROL PLAN | |




U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA
AUTHORIZED FLOOD CONTROL PLAN

FIGURE
3-13




U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA

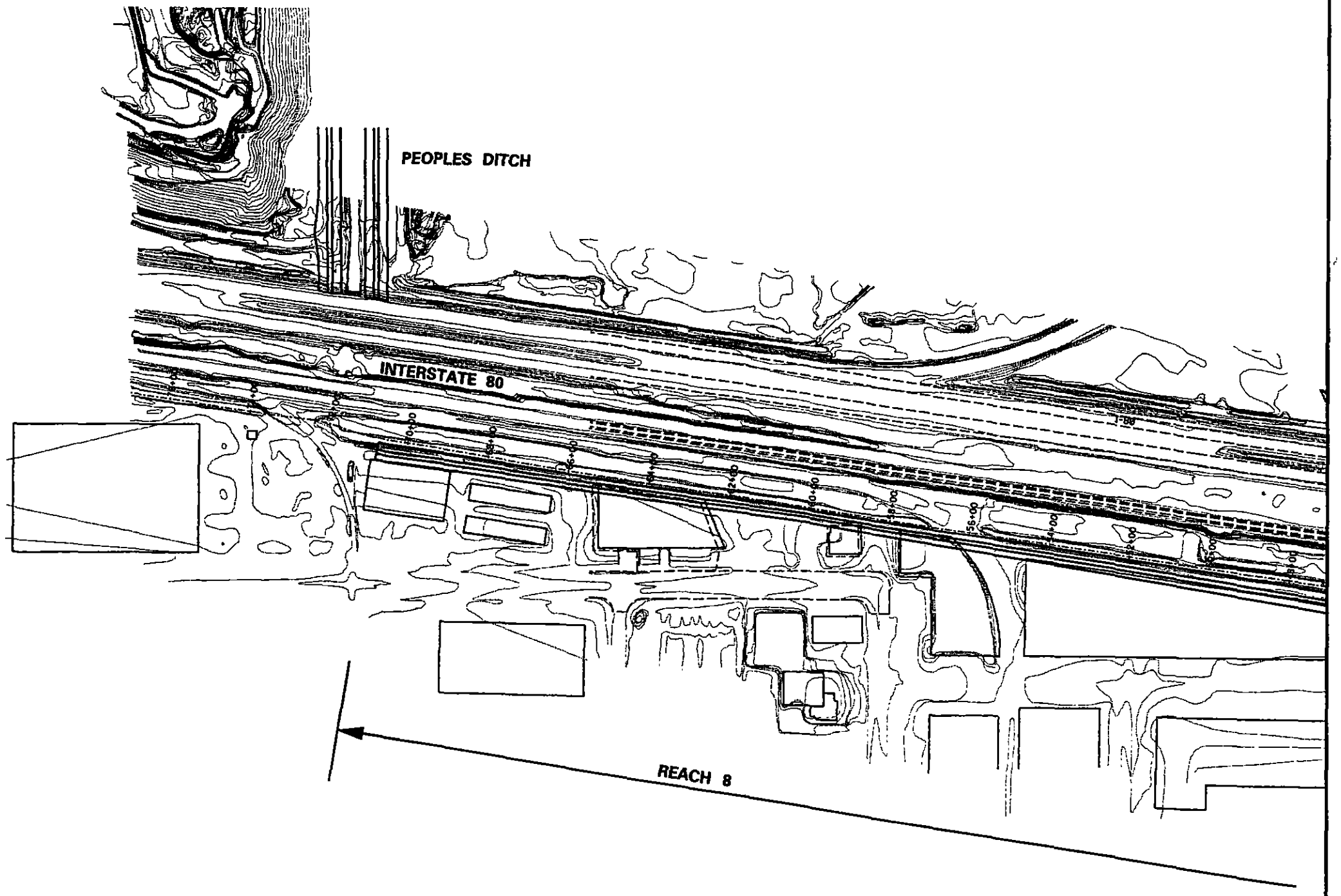
AUTHORIZED FLOOD CONTROL PLAN

FIGURE 3-14

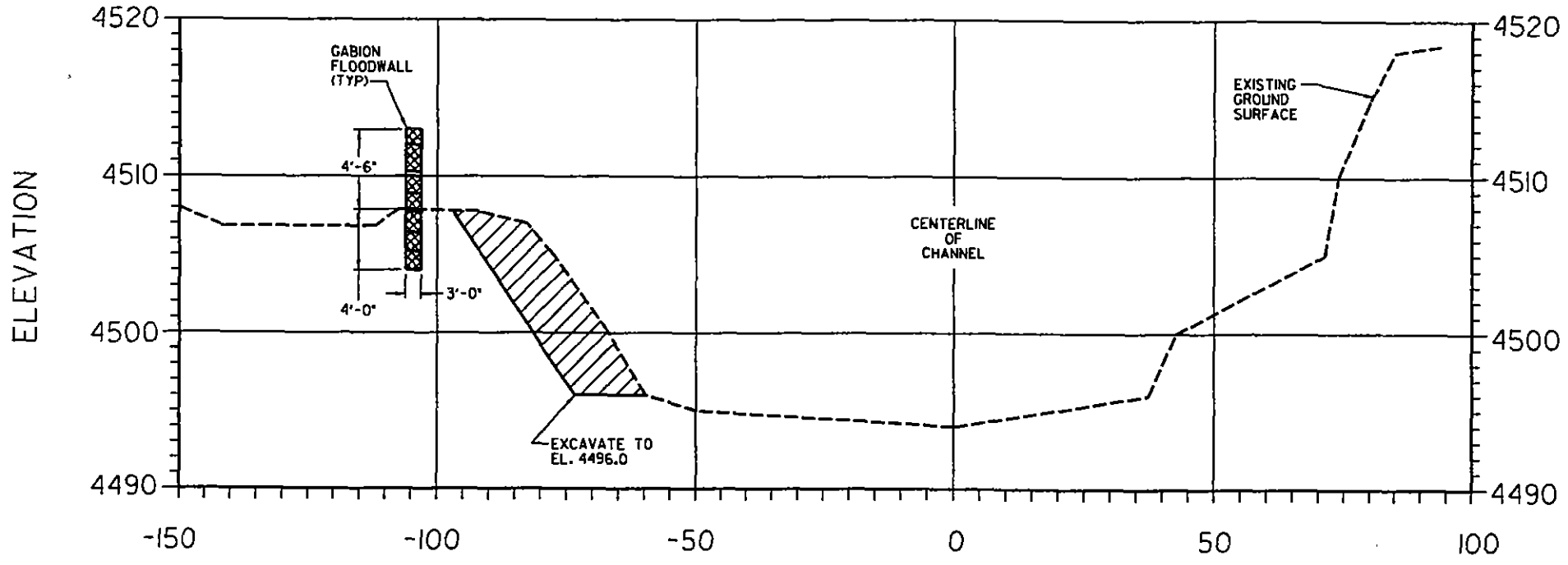
## LEGEND

- FLOODWALL
- LEVEE
- CHANNEL EXCAVATION
- BREAKOUT SECTION

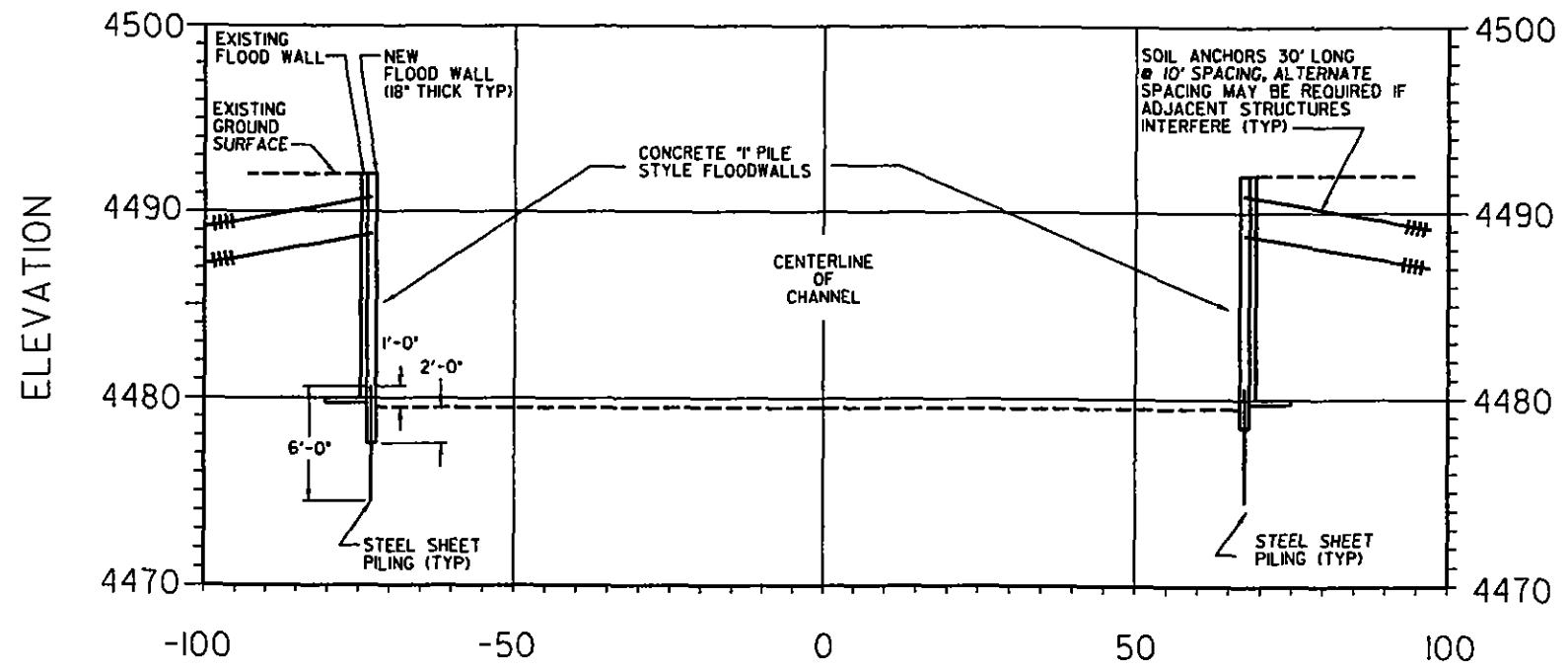
SCALE:
1"=300'




| | |
|---|---|
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 3-15 |
| AUTHORIZED FLOOD CONTROL PLAN | |



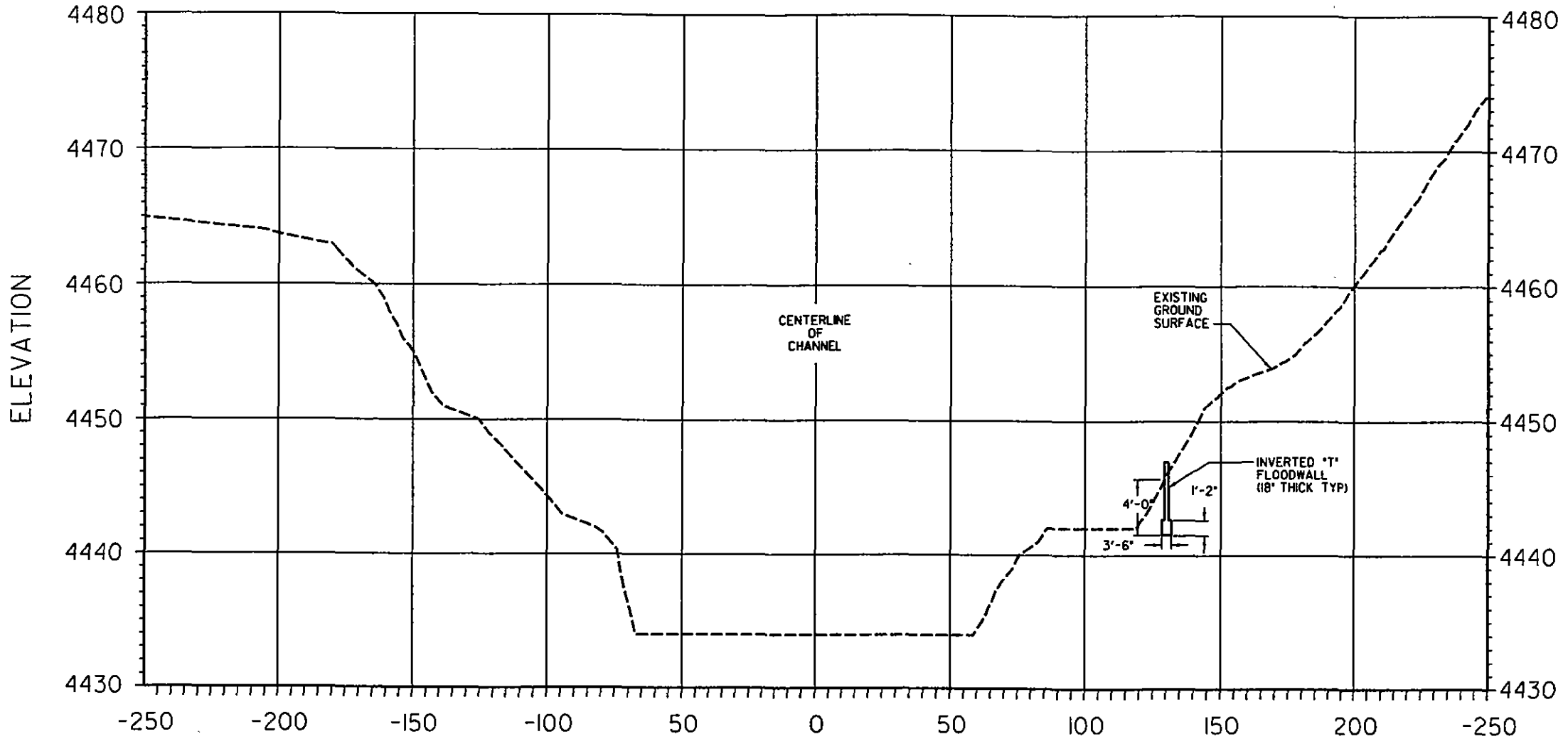

TRUCKEE RIVER - CROSS SECTION 1
STATION 480+00



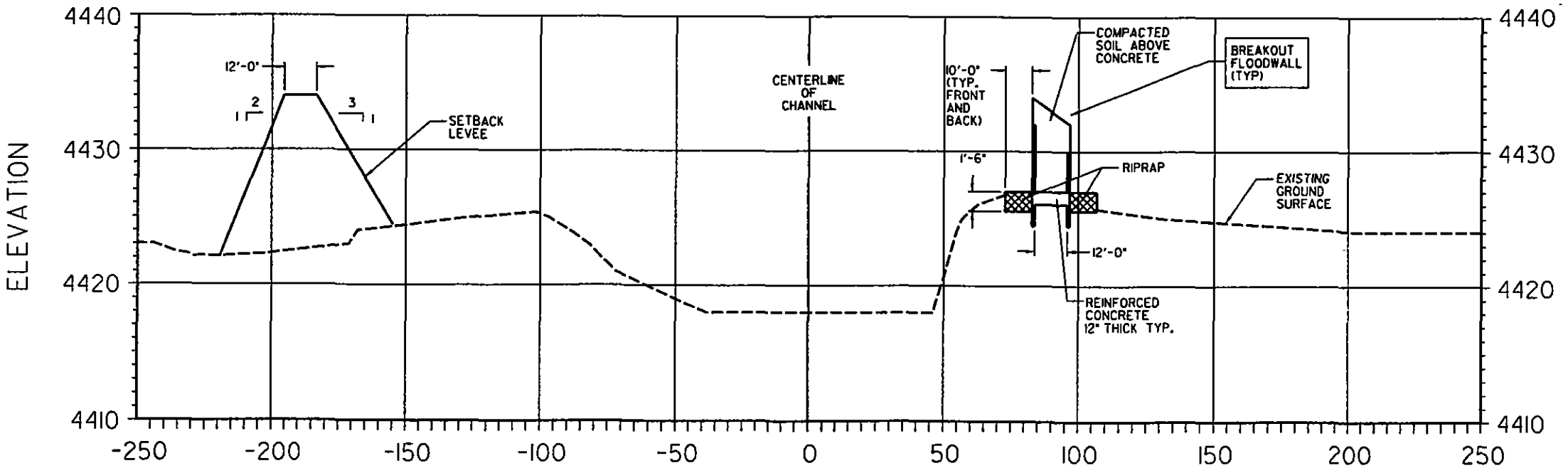

TRUCKEE RIVER - CROSS SECTION 2
STATION 434+00

SCALE:
VERT: 1"=10'
HORIZ: 1"=30'

| | |
|---|---|
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 3-16 |
| SELECTED CROSS SECTIONS | |



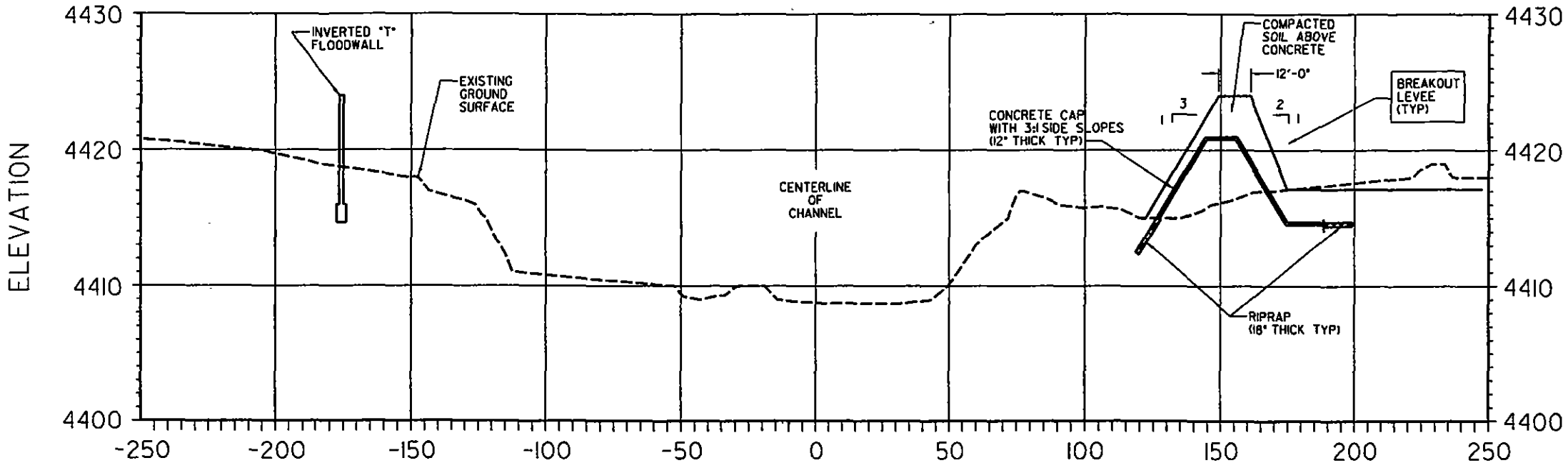

TRUCKEE RIVER
CROSS SECTION 3
STATION 350+00



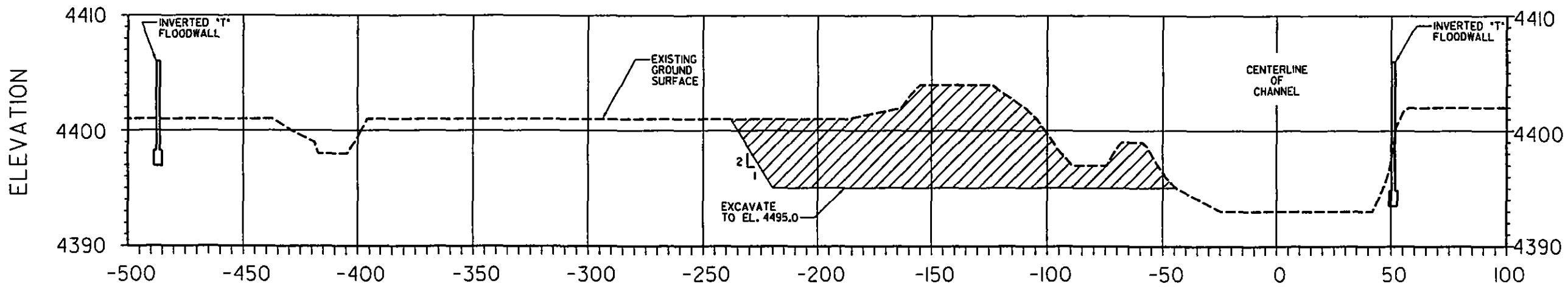

SCALE:
VERT: 1"=10'
HORIZ: 1"=50'

TRUCKEE RIVER
CROSS SECTION 4
STATION 310+00

| | |
|---|---|
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 3-17 |
| SELECTED CROSS SECTIONS | |



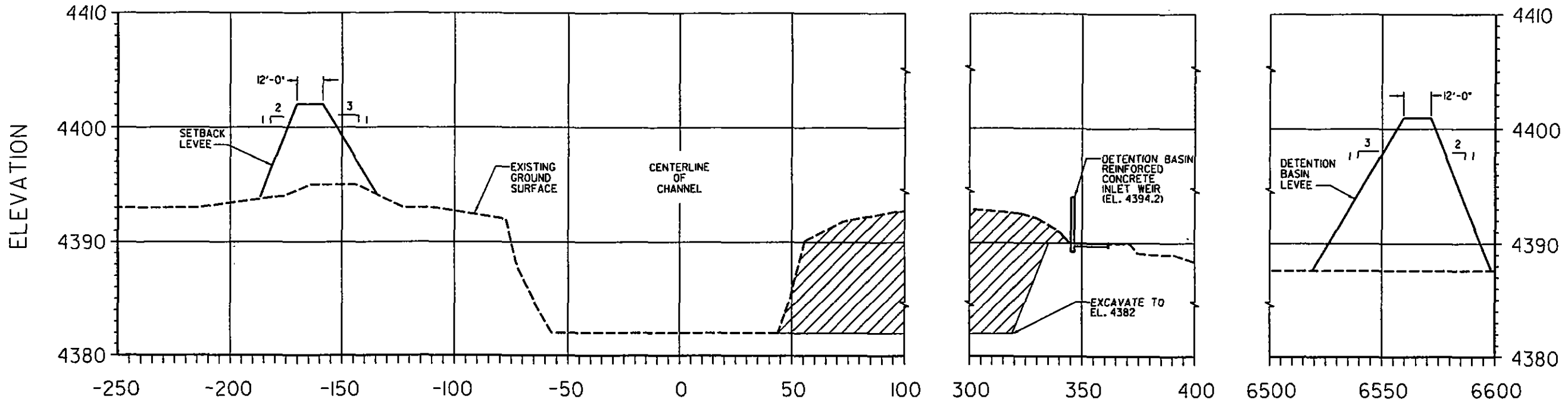

TRUCKEE RIVER - CROSS SECTION 5
STATION 280+00



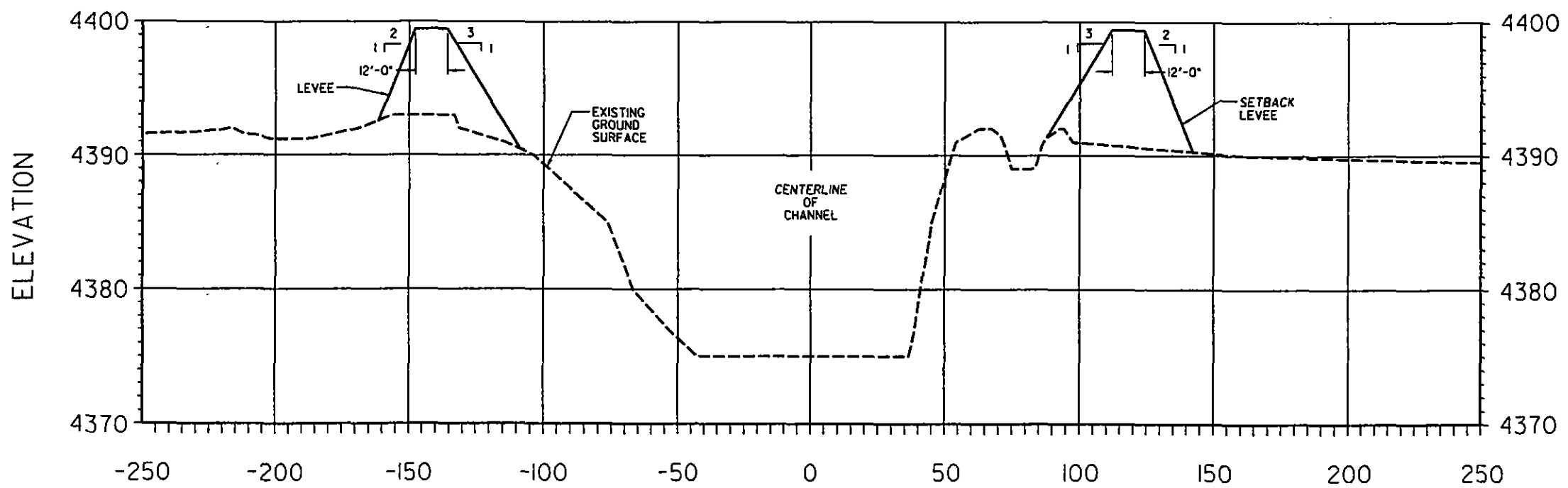

TRUCKEE RIVER - CROSS SECTION 6
STATION 230+00

SCALE:
VERT: 1"=10'
HORIZ: 1"=50'

| | | |
|---|---|---|
| | U.S. ARMY CORPS OF ENGINEERS<br>TRUCKEE MEADOWS, NEVADA<br>SELECTED CROSS SECTIONS | FIGURE<br>3-18 |




TRUCKEE RIVER AND
DETENTIOIN BASIN - CROSS SECTION 7
STATION 180+00

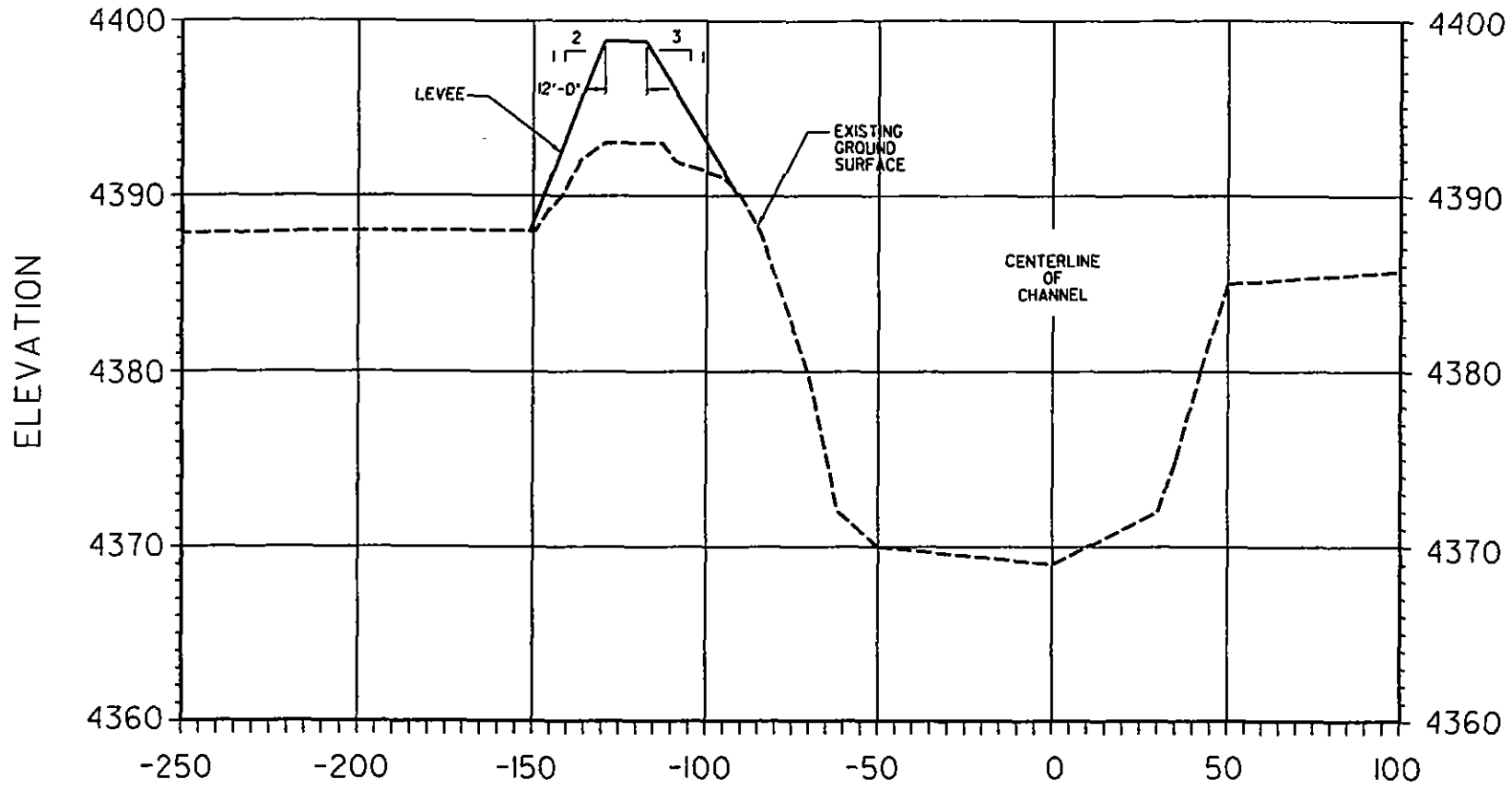



TRUCKEE RIVER - CROSS SECTION 8
STATION 130+00

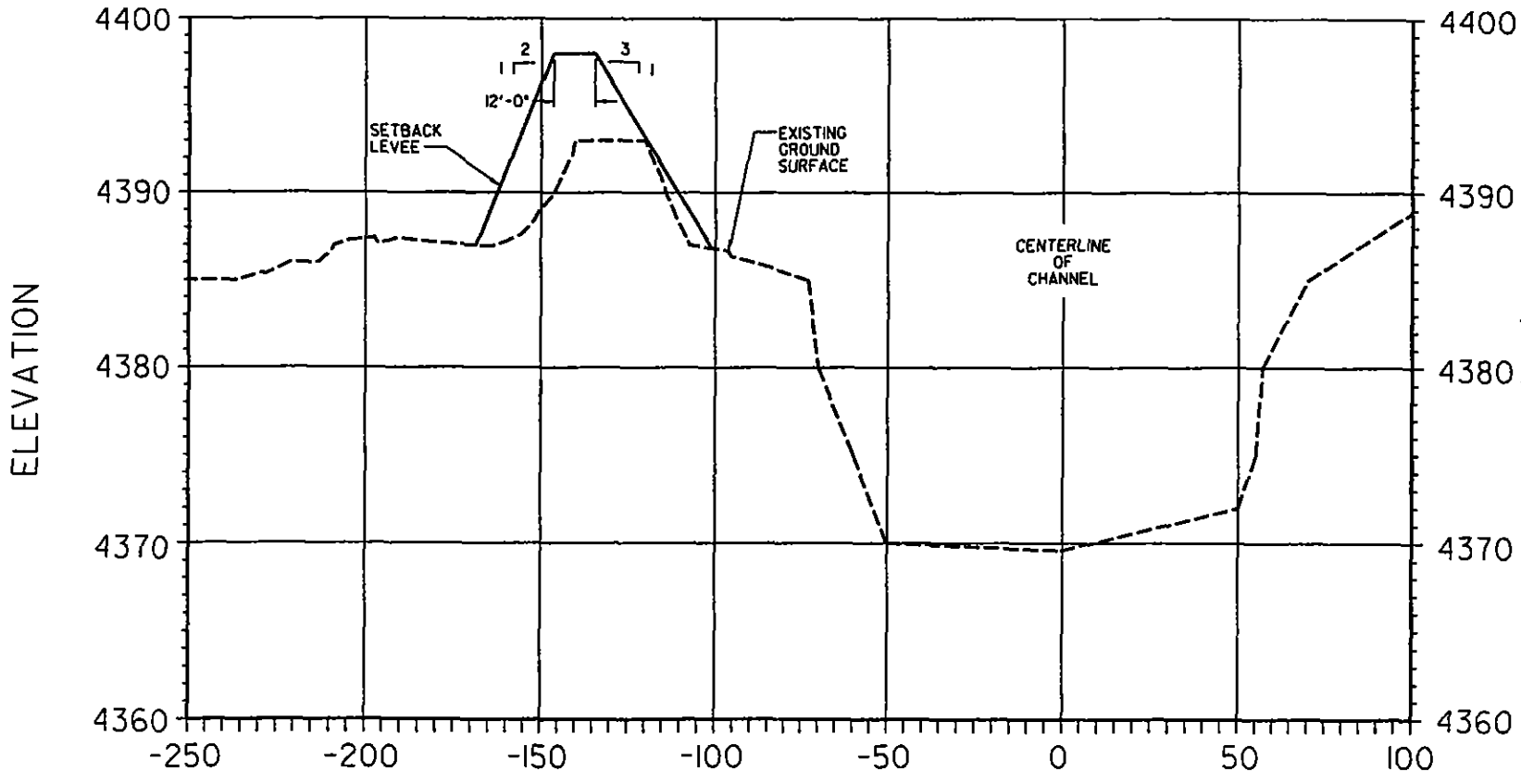
SCALE:

SCALE:
VERT: 1"=10'
HORIZ: 1"=50'

| | | |
|---|---|---|
| | U.S. ARMY CORPS OF ENGINEERS<br>TRUCKEE MEADOWS, NEVADA<br>SELECTED CROSS SECTIONS | FIGURE<br>3-19 |



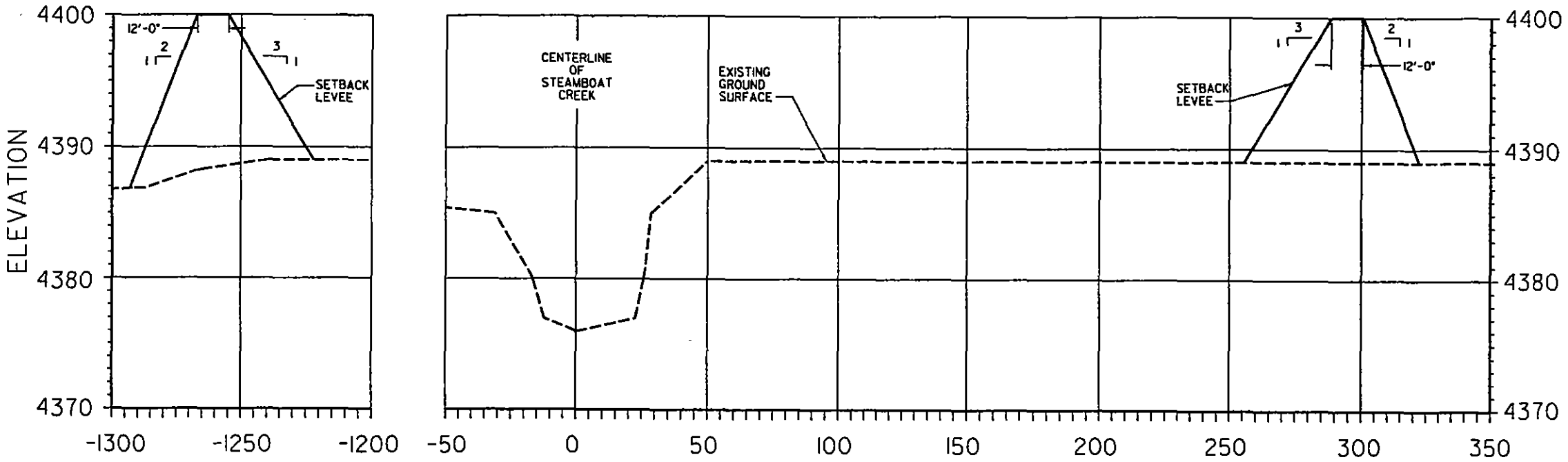

TRUCKEE RIVER
CROSS SECTION 9
STATION 72+00




TRUCKEE RIVER
CROSS SECTION 10
STATION 32+00

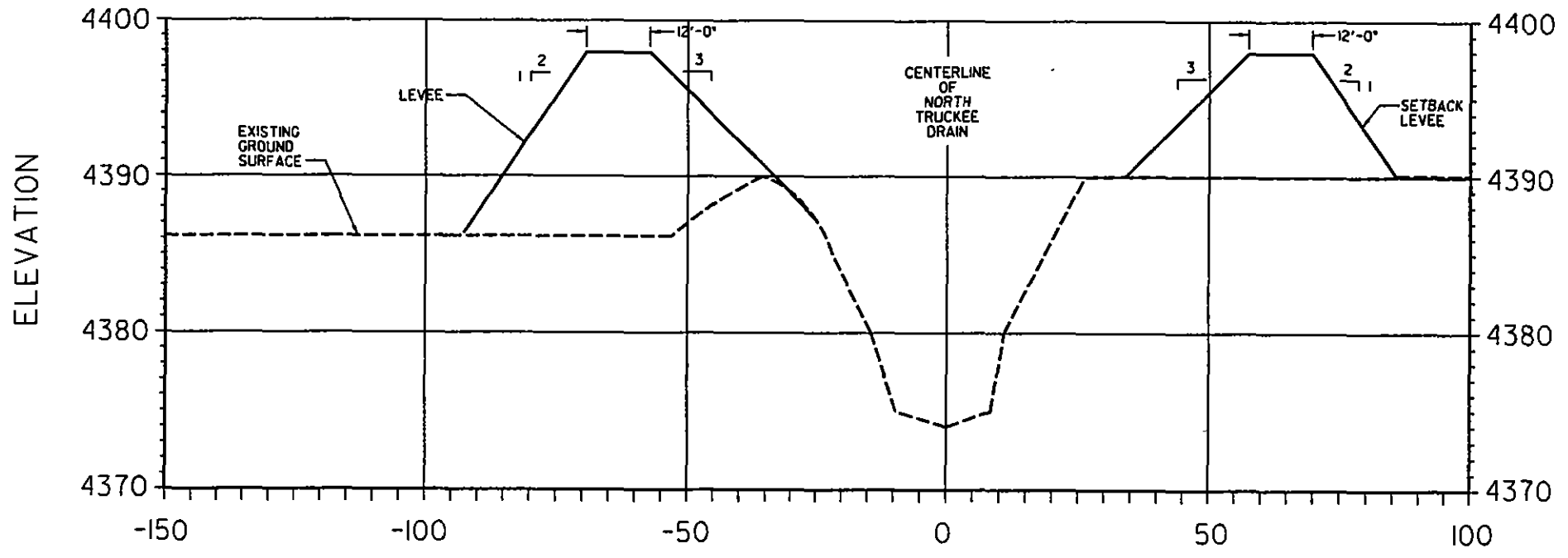
SCALE:
VERT: 1"=10'
HORIZ: 1"=50'

| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
|---|---|
| TRUCKEE MEADOWS, NEVADA | 3-20 |
| SELECTED CROSS SECTIONS | |




STEAMBOAT CREEK
CROSS SECTION II
STATION 108+00

HORIZONTAL SCALE: 1" = 50'




NORTH TRUCKEE DRAIN
CROSS SECTION 12
STATION 12+00

HORIZONTAL SCALE: 1" = 30'

SCALE:
VERT: 1"=10'
HORIZ: AS NOTED

| | | |
|---|---|---|
| | U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| | TRUCKEE MEADOWS, NEVADA | 3-21 |
| | SELECTED CROSS SECTIONS | |

## COSTS

Estimated project costs were developed for the authorized project based on the facilities described above and the unit costs that reflect current (1996) construction costs.

Construction quantities were developed for the facilities described above. The quantities were computed for several types of facilities and activities associated with the construction of the facilities (See backup calculations).

After applying the unit cost to the quantities, a contingency factor was applied to cover miscellaneous unknowns. These costs are summarized in Table 3-1 and are detailed in Tables 3-2 and 3-3.

The costs were estimated with (Table 3-2) and without (Table 3-3) the University Farms detention basin. This step was taken because the detention basin is for hydraulic mitigation and does not directly control the size of levees and floodwalls of the authorized project. As explained in Section 5 of this Reconnaissance Report, there are other, smaller projects available to reduce the volume of flows in the river. These projects could also serve as mitigation in-lieu of the University Farms basin.

**Table 3-1**
**Annualized Cost Estimate for the Authorized project**

| Costs | With Detention Basin | Without Detention Basin |
|---|---|---|
| **First Cost** | $81,759,580 | $73,831,328 |
| **Annualized Capital** | 6,034,671 | 5,449,487 |
| **Annualized O&M** | 1,867,286 | 1,513,458 |
| **Annualized Interest** | 90,000 | 80,000 |
| **Annualized Replacement** | 116,487 | 103,544 |
| **TOTAL ANNUAL COSTS:** | **$8,108,444** | **$7,146,489** |

**Table 3-2**
**Truckee Meadows Reconnaissance Report**
**Annualized Cost Estimate**
**(With Detention Basin)**

**ASSUMPTIONS:**

| | |
|---|---|
| Base (First Cost) | $81,759,580 |
| Months of Construction | 44 |
| Interest Rate -- Annual | 7.375% |
| -- Monthly | 0.615% |
| Amortization Period --Years | 100 |
| Major Replacement Costs | $360,000 |
| Use Escalated Costs for Replacement? | Y |
| Replacement Period -- Years | 50 |
| With Inflation | $1,578,206 |
| Annual Inflation Rate | 3.00% |

**RESULTS:**

| | | |
|---|---|---|
| Annualized Capital Costs | $6,034,671 | Annualized Cost Based on Assumptions Above, Using Payment Function |
| Annualized Interest Costs | $1,867,286 | Annualized Cost Based on Assumptions Above and Calculated Interest, Using Payment Function |
| Annual O&M Costs | $90,000 | Annual O&M Costs |
| Annualized Replacement Costs | $116,487 | Replacement Costs, Annualized Over 100 Year Period |

**TOTAL ANNUAL COSTS:** **$8,108,444**

Major Replacement Costs were estimated as $20,000 per mile of floodwall or levee
Annual O&M Costs were estimated as $5,000 per year per mile of floodwall or levee

**Table 3-3**
**Truckee Meadows Reconnaissance Report**
**Annualized Cost Estimate (in 1996 dollars)**
**(Without Detention Basin)**

**ASSUMPTIONS:**

| | |
|---|---|
| Base (First Cost) | $73,831,328 |
| Months of Construction | 40 |
| Interest Rate -- Annual | 7.375% |
| -- Monthly | 0.615% |
| Amortization Period --Years | 100 |
| Major Replacement Costs | $320,000 |
| Use Escalated Costs for Replacement? | Y |
| Replacement Period -- Years | 50 |
| With Inflation | $1,402,850 |
| Annual Inflation Rate | 3.00% |

**RESULTS:**

| | | |
|---|---|---|
| Annualized Capital Costs | $5,449,487 | Annualized Cost Based on Assumptions Above, Using Payment Function |
| Annualized Interest Costs | $1,513,458 | Annualized Cost Based on Assumptions Above and Calculated Interest, Using Payment Function |
| Annual O&M Costs | $80,000 | Annual O&M Costs |
| Annualized Replacement Costs | $103,544 | Replacement Costs, Annualized Over 100 Year Period |
| **TOTAL ANNUAL COSTS:** | **$7,146,489** | |

Major Replacement Costs were estimated as $20,000 per mile of floodwall or levee
Annual O&M Costs were assumed to be $5,000 per year per mile of floodwall or levee

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## BACKUP CALCULATIONS

# Truckee Meadows Reconnaissance Report
## Annualized Cost Estimate
## (With Detention Basin)

### ASSUMPTIONS:

| | |
|---|---|
| Base (First Cost) --1997 $ | $81,759,580 |
| Months of Construction | 44 |
| Interest Rate -- Annual | 7.375% |
| -- Monthly | 0.615% |
| Amortization Period --Years | 100 |
| Major Replacement Costs --1997 $ | $360,000 |
| Use Escalated Costs for Replacement? | Y |
| Replacement Period -- Years | 50 |
| With Inflation | $1,578,206 |
| Annual Inflation Rate | 3.00% |

### RESULTS:

| | | |
|---|---|---|
| Annualized Capital Costs | $6,034,671 | Annualized Cost Based on Assumptions Above, Using Payment Function |
| Annualized Interest Costs | $1,867,286 | Annualized Cost Based on Assumptions Above and Calculated Interest, Using Payment Function |
| Annual O&M Costs | $90,000 | Annual O&M Costs |
| Annualized Replacement Costs | $116,487 | Replacement Costs, Annualized Over 100 Year Period |
| **TOTAL ANNUAL COSTS:** | **$8,108,444** | |

Major Replacement Costs were estimated as $20,000 per mile of floodwall or levee
Annual O&M Costs were estimated as $5,000 per year per mile of floodwall or levee

# Truckee Meadows Reconnaissance Report
## Annualized Cost Estimate
## (Without Detention Basin)

### ASSUMPTIONS:

| | |
|---|---|
| Base (First Cost) --1997 $ | $73,831,328 |
| Months of Construction | 40 |
| Interest Rate -- Annual | 7.375% |
| -- Monthly | 0.615% |
| Amortization Period --Years | 100 |
| Major Replacement Costs --1997 $ | $320,000 |
| Use Escalated Costs for Replacement? | Y |
| Replacement Period -- Years | 50 |
| With Inflation | $1,402,850 |
| Annual Inflation Rate | 3.00% |

### RESULTS:

| | | |
|---|---|---|
| Annualized Capital Costs | $5,449,487 | Annualized Cost Based on Assumptions Above, Using Payment Function |
| Annualized Interest Costs | $1,513,458 | Annualized Cost Based on Assumptions Above and Calculated Interest, Using Payment Function |
| Annual O&M Costs | $80,000 | Annual O&M Costs |
| Annualized Replacement Costs | $103,544 | Replacement Costs, Annualized Over 100 Year Period |

**TOTAL ANNUAL COSTS: $7,146,489**

Major Replacement Costs were estimated as $20,000 per mile of floodwall or levee

Annual O&M Costs were assumed to be $5,000 per year per mile of floodwall or levee

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 1 - Upstream of Booth Street

Levees: Length = NA Floodwalls: Length = NA
Height = NA Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 06 | Fish and Wildlife Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | | | $ - |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | | | $ - |
| | | | | | | TOTAL PROJECT FIRST COST = | $ - |

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 2 - Booth to Lake Street

Levees: Length = NA Floodwalls: Length = Variable
Height = NA Height = Variable

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 02 | Relocations[1] | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 100,000 | $ 100,000 | $ 25,000 | $ 125,000 |
| | Bridges: Booth Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 1,950,000 | $ 1,950,000 | $ 487,500 | $ 2,437,500 |
| | Relocate Utilities on Bridge | 1 | LS | $ 50,000 | $ 50,000 | $ 12,500 | $ 62,500 |
| | Bridges: N. Arlington Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 3,435,000 | $ 3,435,000 | $ 858,750 | $ 4,293,750 |
| | Relocate Utilities on Bridge | 1 | LS | $ 50,000 | $ 50,000 | $ 12,500 | $ 62,500 |
| | Bridges: S. Arlington Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 1,761,000 | $ 1,761,000 | $ 440,250 | $ 2,201,250 |
| | Relocate Utilities on Bridge | 1 | LS | $ 50,000 | $ 50,000 | $ 12,500 | $ 62,500 |
| | Bridges: Sierra Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 3,009,750 | $ 3,009,750 | $ 752,438 | $ 3,762,188 |
| | Relocate Utilities on Bridge | 1 | LS | $ 100,000 | $ 100,000 | $ 25,000 | $ 125,000 |
| | Bridges: Virginia Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 4,056,000 | $ 4,056,000 | $ 1,014,000 | $ 5,070,000 |
| | Relocate Utilities on Bridge | 1 | LS | $ 100,000 | $ 100,000 | $ 25,000 | $ 125,000 |
| | Bridges: Lake Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 3,313,500 | $ 3,313,500 | $ 828,375 | $ 4,141,875 |
| | Relocate Utilities on Bridge | 1 | LS | $ 50,000 | $ 50,000 | $ 12,500 | $ 62,500 |
| Task Subtotal | | | | | $ 18,925,250 | | $ 23,656,563 |
| 06 | Fish and Wildlife Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 09 | Channels and Canals | | | | | | |
| | Channel Excavation | 13,661 | CY | $ 4.75 | $ 64,890 | $ 16,222 | $ 81,112 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Div of Water-Temp Sheet Piles[2] | 2,880 | SF | $ 16 | $ 46,080 | $ 11,520 | $ 57,600 |
| Task Subtotal | | | | | $ 115,970 | | $ 144,962 |
| 11 | Floodwalls | | | | | | |
| | Excavation | 2,138 | CY | $ 3.00 | $ 6,414 | $ 1,604 | $ 8,018 |
| | Soil Anchors | 34,800 | LF | $ 40 | $ 1,392,000 | $ 348,000 | $ 1,740,000 |
| | Steel Sheet Piles | 34,800 | SF | $ 21 | $ 730,800 | $ 182,700 | $ 913,500 |
| | Gabbions | 2,801 | CY | $ 140 | $ 392,140 | $ 98,035 | $ 490,175 |
| | Formed Concrete Wall | 5,607 | CY | $ 475 | $ 2,663,325 | $ 665,831 | $ 3,329,156 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Cleanup | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Div of Water-Temp Sheet Piles[3] | 109,200 | SF | $ 16 | $ 1,747,200 | $ 436,800 | $ 2,184,000 |
| Task Subtotal | | | | | $ 6,941,879 | | $ 8,677,349 |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 3,117,972 | | $ 3,117,972 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 2,078,648 | | $ 2,078,648 |
| | | | | | TOTAL PROJECT FIRST COST = | | $ 37,675,493 |

[1] All Bridge Costs are Based on $225/sf + $600,000 for potential hydrocarbon contamination
[2] Sheet Piles used to divert water to adjacent channel
[3] Sheet Piles used on North side from Sta. 427+81 and on South side from Sta 427+64

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 3 - Lake Street to Hwy 395

Levees: Length = NA Floodwalls: Length = NA
Height = NA Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 06 | Fish and Wildlife Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | | | $ - |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | | | $ - |

TOTAL PROJECT FIRST COST = $ -

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 4 - Hwy 395 to McCarran Boulevard

Levees: Length = NA Floodwalls: Length = Variable
Height = NA Height = Variable

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 01 | Relocations | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| 06 | Fish and Wildlife Facilities | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 09 | Channels and Canals | | | | | | |
| | Channel Excavation | 89,595 | CY | $ 4.75 | $ 425,576 | $ 106,394 | $ 531,970 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 430,576 | | $ 538,220 |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 19 | AC | $ 2,400 | $ 45,600 | $ 11,400 | $ 57,000 |
| | Embankment | 83,466 | CY | $ 5 | $ 417,330 | $ 104,333 | $ 521,663 |
| | Exc Inspection Trench | 18,700 | CY | $ 2.50 | $ 46,750 | $ 11,688 | $ 58,438 |
| | Excavation | 10,584 | CY | $ 3.00 | $ 31,752 | $ 7,938 | $ 39,690 |
| | Rip Rap | 2,111 | CY | $ 40 | $ 84,440 | $ 21,110 | $ 105,550 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Stab Aggregate Patrol Road | 3,797 | TON | $ 7 | $ 26,579 | $ 6,645 | $ 33,224 |
| | Formed Concrete | 4,222 | CY | $ 475 | $ 2,005,450 | $ 501,363 | $ 2,506,813 |
| | Seeding | 16 | AC | $ 2,000 | $ 32,000 | $ 8,000 | $ 40,000 |
| Task Subtotal | | | | | $ 2,694,901 | | $ 3,368,626 |
| 11 | Floodwalls | | | | | | |
| | Excavation | 50,283 | CY | $ 3.00 | $ 150,849 | $ 37,712 | $ 188,561 |
| | Rip Rap | 2,667 | CY | $ 40 | $ 106,680 | $ 26,670 | $ 133,350 |
| | Embankment Fill | 4,267 | CY | $ 5 | $ 21,335 | $ 5,334 | $ 26,669 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Formed Concrete Wall | 11,564 | CY | $ 475 | $ 5,492,900 | $ 1,373,225 | $ 6,866,125 |
| | Cleanup | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Div of Water-Temp Sheet Piles [1] | 16,800 | SF | $ 16 | $ 268,800 | $ 67,200 | $ 336,000 |
| Task Subtotal | | | | | $ 6,050,564 | | $ 7,563,205 |
| 14 | Recreation Facilities | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 18 | Cultural Resources Pres | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 1,103,525 | | $ 1,103,525 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 735,683 | | $ 735,683 |
| | | | | | TOTAL PROJECT FIRST COST = | | $ 13,334,260 |

[1] Sheet Piles used on South Side from Sta 223-237

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 5 - McCarran to Vista, excludes University Farm Area Levees

Levees: Length = Variable Floodwalls: Length = NA
Height = Variable Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 02 | Relocations | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| 06 | Fish and Wildlife Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 29 | AC | $ 2,400 | $ 69,600 | $ 17,400 | $ 87,000 |
| | Embankment | 279,427 | CY | $ 5 | $ 1,397,135 | $ 349,284 | $ 1,746,419 |
| | Exc Inspection Trench | 36,220 | CY | $ 2.50 | $ 90,550 | $ 22,638 | $ 113,188 |
| | Excavation | 22,372 | CY | $ 3.00 | $ 67,116 | $ 16,779 | $ 83,895 |
| | Stab Aggregate Patrol Road | 5,903 | TON | $ 7 | $ 41,321 | $ 10,330 | $ 51,651 |
| | Seeding | 25 | AC | $ 2,000 | $ 50,000 | $ 12,500 | $ 62,500 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 1,720,722 | | $ 2,150,903 |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 208,887 | | $ 208,887 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 139,258 | | $ 139,258 |

| TOTAL PROJECT FIRST COST = | $ 2,524,047 |
|---|---|

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 6 - Steamboat Creek and Boynton Slough

Levees: Length = Variable, Height = Variable
Floodwalls: Length = NA, Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 02 | Relocations | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| | Bridges: Pembrook Drive | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 64,000 | SF | $ 150 | $ 9,600,000 | $ 2,400,000 | $ 12,000,000 |
| | Relocate Utilities on Bridge | 1 | LS | $ 75,000 | $ 75,000 | $ 18,750 | $ 93,750 |
| Task Subtotal | | | | | $ 9,845,000 | | $ 12,306,250 |
| 06 | Fish and Wildlife Facilities | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 27 | AC | $ 2,400 | $ 64,800 | $ 16,200 | $ 81,000 |
| | Embankment | 270,687 | CY | $ 5 | $ 1,353,435 | $ 338,359 | $ 1,691,794 |
| | Exc Inspection Trench | 33,170 | CY | $ 2.50 | $ 82,925 | $ 20,731 | $ 103,656 |
| | Excavation | 21,383 | CY | $ 3.00 | $ 64,149 | $ 16,037 | $ 80,186 |
| | Rip Rap | 12,750 | CY | $ 40 | $ 510,000 | $ 127,500 | $ 637,500 |
| | Stab Aggregate Patrol Road | 5,406 | TON | $ 7 | $ 37,842 | $ 9,461 | $ 47,303 |
| | Seeding | 23 | AC | $ 2,000 | $ 46,000 | $ 11,500 | $ 57,500 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 2,164,151 | | $ 2,705,189 |
| 14 | Recreation Facilities | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 18 | Cultural Resources Pres | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 1,441,098 | | $ 1,441,098 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 960,732 | | $ 960,732 |

| TOTAL PROJECT FIRST COST = | $ 17,413,269 |
|---|---|

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 7 - University Farm Area, without Detention Basin

Levees: Length = Variable Height = Variable
Floodwalls: Length = NA Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 02 | Relocations | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 20 | AC | $ 2,400 | $ 48,000 | $ 12,000 | $ 60,000 |
| | Embankment | 205,469 | CY | $ 5 | $ 1,027,345 | $ 256,836 | $ 1,284,181 |
| | Exc Inspection Trench | 25,320 | CY | $ 2.50 | $ 63,300 | $ 15,825 | $ 79,125 |
| | Excavation | 12,089 | CY | $ 3.00 | $ 36,267 | $ 9,067 | $ 45,334 |
| | Stab Aggregate Patrol Road | 4,126 | TON | $ 7 | $ 28,882 | $ 7,221 | $ 36,103 |
| | Seeding | 17 | AC | $ 2,000 | $ 34,000 | $ 8,500 | $ 42,500 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 1,242,794 | | $ 1,553,493 |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 151,535 | | $ 151,535 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 101,024 | | $ 101,024 |

| TOTAL PROJECT FIRST COST = | $ 1,831,051 |
|---|---|

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 7A - University Farm Area, with Detention Basin

Levees: Length = Variable Height = Variable
Floodwalls: Length = NA Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 02 | Relocations [1] | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| | Roads: | | | | | | |
| | Construct New Bridge | 12,000 | SF | $ 150 | $ 1,800,000 | $ 450,000 | $ 2,250,000 |
| | Excavation | 1,556 | CY | $ 3.00 | $ 4,668 | $ 1,167 | $ 5,835 |
| | Road Surface | 40,000 | SF | $ 4 | $ 160,000 | $ 40,000 | $ 200,000 |
| Task Subtotal | | | | | $ 1,984,668 | | $ 2,480,835 |
| 03 | Reservoirs - Detention Basin | | | | | | |
| | BLS/Marking | 1 | LS | $ 2,000 | $ 2,000 | $ 500 | $ 2,500 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 7,000 | | $ 8,750 |
| 04 | Inlet Weir | | | | | | |
| | Clearing and Grubbing | 2 | AC | $ 2,400 | $ 4,800 | $ 1,200 | $ 6,000 |
| | Excavation | 1,778 | CY | $ 2.50 | $ 4,445 | $ 1,111 | $ 5,556 |
| | Cleanup | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Bedding Material | 463 | CY | $ 5 | $ 2,315 | $ 579 | $ 2,894 |
| | Formed Concrete | 1,778 | CY | $ 475 | $ 844,550 | $ 211,138 | $ 1,055,688 |
| | Reinforcing Steel | 355,556 | LBS | $ 0.60 | $ 213,334 | $ 53,333 | $ 266,667 |
| | Rip Rap | 1,069 | CY | $ 40 | $ 42,760 | $ 10,690 | $ 53,450 |
| | Miscellaneous Items | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 1,122,204 | | $ 1,402,755 |
| 06 | Fish and Wildlife Facilities | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 09 | Channels and Canals | | | | | | |
| | Excavation | 138,723 | CY | $ 3.00 | $ 416,169 | $ 104,042 | $ 520,211 |
| | Div of Water-Temp Sheet Piles [2] | 21,600 | SF | $ 16 | $ 345,600 | $ 86,400 | $ 432,000 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 766,769 | | $ 958,461 |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 36 | AC | $ 2,400 | $ 86,400 | $ 21,600 | $ 108,000 |
| | Embankment | 352,769 | CY | $ 5 | $ 1,763,845 | $ 440,961 | $ 2,204,806 |
| | Exc Inspection Trench | 45,100 | CY | $ 2.50 | $ 112,750 | $ 28,188 | $ 140,938 |
| | Excavation | 25,836 | CY | $ 3.00 | $ 77,508 | $ 19,377 | $ 96,885 |
| | Rip Rap | 17,274 | CY | $ 40 | $ 690,960 | $ 172,740 | $ 863,700 |
| | Stab Aggregate Patrol Road | 7,350 | TON | $ 7 | $ 51,450 | $ 12,863 | $ 64,313 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Seeding | 31 | AC | $ 2,000 | $ 62,000 | $ 15,500 | $ 77,500 |
| Task Subtotal | | | | | $ 2,849,913 | | $ 3,562,391 |
| 14 | Recreation Facilities | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 18 | Cultural Resources Pres | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 807,666 | | $ 807,666 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 538,444 | | $ 538,444 |
| | | | | | TOTAL PROJECT FIRST COST = | | $ 9,759,303 |

[1] Access to WWTP from Larkin Circle - 300' Long Bridge and 1600' Access Road
[2] Sheet Piles used on South Side from Sta 167-185

DRAFT

Q = 18,500 cfs

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 8 - North Truckee Drain and Peoples Ditch

Levees: Length = Variable Floodwalls: Length = NA
Height = Variable Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 02 | Relocations | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| 06 | Fish and Wildlife Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 33 | AC | $ 2,400 | $ 79,200 | $ 19,800 | $ 99,000 |
| | Embankment | 76,516 | CY | $ 5 | $ 382,580 | $ 95,645 | $ 478,225 |
| | Exc Inspection Trench | 34,192 | CY | $ 2.50 | $ 85,480 | $ 21,370 | $ 106,850 |
| | Excavation | 17,096 | CY | $ 3.00 | $ 51,288 | $ 12,822 | $ 64,110 |
| | Stab Aggregate Patrol Road | 6,686 | TON | $ 7 | $ 46,802 | $ 11,701 | $ 58,503 |
| | Seeding | 28 | AC | $ 2,000 | $ 56,000 | $ 14,000 | $ 70,000 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 706,350 | | $ 882,938 |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 87,162 | | $ 87,162 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 58,108 | | $ 58,108 |

| TOTAL PROJECT FIRST COST = | $ 1,053,208 |
|---|---|

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows - Approved Project Date: 7/18/97

Reach 1: Truckee River, Upstream of Booth Street

| Item | Description | QUANTITIES |
|---|---|---|
| None | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows - Approved Project Date: 7/18/97
Reach 2: Truckee River, Booth Street to Lake Street

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| RELOCATIONS | | Length | Width | Height | Total |
| Bridges: Booth Street | | | | | |
| | Remove Existing Bridge | 120 LF | 37.5 FT | | 4,500 SF |
| | Construct New Bridge | 160 LF | 37.5 FT | | 6,000 SF |
| | Relocate Utilities on Bridge | 1-Gas-4 inch | | | |
| | | 6-Telephone-3.5 inch | | | |
| Bridges: N. Arlington Street | | | | | |
| | Remove Existing Bridge | 128 LF | 75 FT | | 9,600 SF |
| | Construct New Bridge | 168 LF | 75 FT | | 12,600 SF |
| | Relocate Utilities on Bridge | Street Lighting-Power Line | | | |
| | | 9-Telephone -3.5 inch | | | |
| Bridges: S. Arlington Street | | | | | |
| | Remove Existing Bridge | 46 LF | 60 FT | | 2,760 SF |
| | Construct New Bridge | 86 LF | 60 FT | | 5,160 SF |
| | Relocate Utilities on Bridge | Street Lighting-Power Line | | | |
| | | 9-Telephone -3.5 inch | | | |
| Bridges: Sierra Street | | | | | |
| | Remove Existing Bridge | 130 LF | 63 FT | | 8,190 SF |
| | Construct New Bridge | 170 LF | 63 FT | | 10,710 SF |
| | Relocate Utilities on Bridge | 1-Water-12 inch | | | |
| | | 4-Gas-3.5 inch | | | |
| | | 1-Power-Transmission Line | | | |
| Bridges: Virginia Street | | | | | |
| | Remove Existing Bridge | 152 LF | 80 FT | | 12,160 SF |
| | Construct New Bridge | 192 LF | 80 FT | | 15,360 SF |
| | Relocate Utilities on Bridge | 1-Water-8 inch CIP | | | |
| | | 3-Telephone-2 inch | | | |
| | | 9-Telephone -6 inch PVC | | | |
| | | 1-Unknown-1 inch | | | |
| | | 1-Unknown-3 inch | | | |
| Bridges: Lake Street | | | | | |
| | Remove Existing Bridge | 161 LF | 60 FT | | 9,660 SF |
| | Construct New Bridge | 201 LF | 60 FT | | 12,060 SF |
| | Relocate Utilities on Bridge | 6-Telephone-3.5 inch | | | |
| CHANNELS AND CANALS - Near Booth Street, North Arlington, and South Arlington | | | | | |
| | Channel Excavation | | | | 13,661 CY |
| FLOODWALLS | | | | | |
| | Excavation | | | | 2,138 CY |
| | Soil Anchors | 34,800 LF | | | 34,800 LF |
| | Steel Sheet Piles | 5,800 LF | | 6 FT | 34,800 SF |
| | Gabions | 3,361 LF | 3 FT | 7.5 FT | 2,801 CY |
| | Formed Reinf Concrete Wall | | | | 5,607 CY |
| | Cleanup | | | | |
| | Care and Diversion of Water | | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows - Approved Project Date: 7/18/97
Reach 3: Truckee River, Lake Street to Hwy 395

| Item | Description | QUANTITIES |
|---|---|---|
| None | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows - Approved Project Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran Boulevard

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| CHANNELS AND CANALS - Glendale Park | | Length | Width | Height | Total |
| | Channel Excavation | | | | 89,595 CY |
| LEVEES | | | | | |
| | Clear and Grub | 11,650 LF | 70 FT | | 19 AC |
| | Embankment fill | | | | 83,466 CY |
| | Exc inspection trench | | | | 21,267 CY |
| | Excavation | | | | 10,584 CY |
| | Riprap | 3,800 LF | 10 FT | 1.5 FT | 4,644 TON |
| | Aggregate patrol road | 11,650 LF | 12 FT | 4 IN | 3,797 TON |
| | Formed Reinforced Concrete | 1,900 LF | 40 FT | 1.5 FT | 4,222 CY |
| | Fencing | | | | 0 LF |
| | Seeding | 11,650 LF | 60 FT | | 16 AC |
| FLOODWALLS | | | | | |
| | Excavation | | | | 42,023 CY |
| | Formed Reinf Concrete Wall | | | | 11,565 CY |
| | Rip Rap | 4,800 LF | 10 FT | 1.5 FT | 2,667 CY |
| | Fill | 2,400 LF | 12 FT | 4 FT | 4,267 CY |
| | Cleanup | | | | |
| | Care and Diversion of Water | | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows - Approved Project Date: 7/18/97

Reach 5: Truckee River, McCarran Boulevard to Vista (Excludes University Farms Flood Control Facilities on Truckee River's Right Bank)

| Item | Description | QUANTITIES | | | | |
|---|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | Total | |
| | Clear and Grub | 18,110 | LF 70 | FT | 29 | AC |
| | Embankment fill | | | | 279,427 | CY |
| | Exc inspection trench | 18,110 | LF 9 | FT 6.0 | FT 36,220 | CY |
| | Excavation | | | | 22,372 | CY |
| | Riprap | | | | | TON |
| | Aggregate patrol road | 18,110 | LF 12 | FT 4 | IN 5,903 | TON |
| | Fencing | | | | | LF |
| | Seeding | 18,110 | LF 60 | FT | 25 | AC |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows - Approved Project  Date: 7/18/97
Reach 6: Steamboat Creek and Boynton Slough

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| BRIDGE-Pembrook Drive | | Length | Width | Height | Total |
| | Remove Existing Bridge | 800 LF | 40 LF | | 32,000 SF |
| | Construct New Bridge | 800 LF | 80 LF | | 64,000 SF |
| | Relocate Utilities on Bridge | 1-Gas-6 inch<br>1-Water-14 inch | | | |
| LEVEES | | | | | |
| | Clear and Grub | 16,586 LF | 70 FT | | 27 AC |
| | Embankment fill | | | | 270,687 CY |
| | Exc inspection trench | 16,585 LF | 9 FT | 6.0 FT | 33,170 CY |
| | Excavation | | | | 21,383 CY |
| | Riprap | 8,606 LF | 40 FT | 1 FT | 28,049 TON |
| | Aggregate patrol road | 16,586 LF | 12 FT | 4 IN | 5,406 TON |
| | Fencing | | | | LF |
| | Seeding | 16,586 LF | 60 FT | | 23 AC |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows - Approved Project Date: 7/18/97

Reach 7: University Farms Area (Without a Detention Basin, Includes Truckee River Levee)

| Item | Description | QUANTITIES | | | | |
|---|---|---|---|---|---|---|
| LEVEES | | | | | | |
| | Clear and Grub | 12,660 | LF | 70 FT | 20 | AC |
| | Embankment fill | | | | 205,469 | CY |
| | Exc inspection trench | 12,660 | LF | 9 FT 6.0 FT | 25,320 | CY |
| | Excavation | | | | 12,089 | CY |
| | Riprap | | | | | TON |
| | Aggregate patrol road | 12,660 | LF | 12 FT 4 IN | 4,126 | TON |
| | Fencing | | | | | LF |
| | Seeding | 12,660 | LF | 60 FT | 17 | AC |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows - Approved Project Date: 7/18/97

Reach 7A: University Farms Area (Includes Detention Basin and Truckee River Levee)

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| WEIR CONSTRUCTION - Inlet weir, outlet weir, low level outlet | | Length | Width | Height | Total |
| | Clear and Grub | 1,350 LF | 70 FT | | 2 AC |
| | Excavation | | | | 1,778 CY |
| | Bedding Material | 1,250 LF | 20 FT | 6 IN | 1,019 TON |
| | Formed Concrete | | | | 1,778 CY |
| | Reinforcing Steel | | | | 355,556 LBS |
| | Rip Rap | 1,650 LF | 35 FT | 0.5 FT | 2,353 TON |
| | 48" RCP | | | | 100 LF |
| | 48" Control gates | | | | 2 EA |
| | 48" Flap gates | | | | 2 EA |
| CHANNELS AND CANALS - In front of 1000' inlet weir | | | | | |
| | Excavation | | | | 138,723 CY |
| LEVEES | | | | | |
| | Clear and Grub | 22,550 LF | 70 FT | | 36 AC |
| | Embankment fill | | | | 352,769 CY |
| | Exc inspection trench | | | | 45,100 CY |
| | Excavation | | | | 25,836 CY |
| | Riprap | 11,660 LF | 40 FT | 1 FT | 38,003 TON |
| | Aggregate patrol road | 22,550 LF | 12 FT | 4 IN | 7,350 TON |
| | Fencing | | | | LF |
| | Seeding | 22,550 LF | 60 FT | | 31 AC |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows - Approved Project  Date: 7/18/97

Reach 8: North Truckee Drain and Peoples Ditch

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | Total |
| | Clear and Grub | 20,515 LF | 70 FT | | 33 AC |
| | Embankment fill | | | | 76,516 CY |
| | Exc inspection trench | 20,515 LF | 9 FT | 5.0 FT | 34,192 CY |
| | Excavation | 20,515 LF | 45 FT | 0.5 FT | 17,096 CY |
| | Riprap | | | | TON |
| | Aggregate patrol road | 20,515 LF | 12 FT | 4 IN | 6,686 TON |
| | Fencing | | | | LF |
| | Seeding | 20,515 LF | 60 FT | | 28 AC |

# CONSTRUCTION ESTIMATES

CHANNEL EXCAVATION VOLUME CALCULATIONS

Reach 2: Truckee River, Booth Street to Lake Street

| Location | Length | Width | Height | Volume |
|---|---|---|---|---|
| Booth Street | 400 FT | 15 FT | 12 FT | 2,667 CY |
| North Arlington | 700 FT | 97 FT | 1.5 FT | 3,772 CY |
| South Arlington | 400 FT | 50 FT | 1.5 FT | 1,111 CY |
| South Arlington | 300 FT | 100 FT | 1.5 FT | 1,667 CY |
| Sierra Street | 400 FT | 200 FT | 1.5 FT | 4,444 CY |
| | | | | 13,661 CY |

FLOODWALL CONCRETE VOLUME CALCULATIONS

Reach 2: Truckee River, Booth Street to Lake Street

| Location | Length | Width | Height | Volume |
|---|---|---|---|---|
| Booth to Arlington | 300 LF | 1.5 FT | 22 FT | 367 CY |
| | 525 LF | 1.5 FT | 15 FT | 438 CY |
| | 1,075 LF | 1.5 FT | 14 FT | 836 CY |
| Arlington to Sierra | 500 LF | 1.5 FT | 20 FT | 556 CY |
| | 250 LF | 1.5 FT | 19 FT | 264 CY |
| | 500 LF | 1.5 FT | 15 FT | 417 CY |
| | 175 LF | 1.5 FT | 17 FT | 165 CY |
| | 75 LF | 1.5 FT | 18 FT | 75 CY |
| Sierra to Virginia | 275 LF | 1.5 FT | 21 FT | 321 CY |
| | 75 LF | 1.5 FT | 17 FT | 71 CY |
| | 300 LF | 1.5 FT | 18 FT | 300 CY |
| | 50 LF | 1.5 FT | 22 FT | 61 CY |
| Virginia to Center | 400 LF | 1.5 FT | 18.5 FT | 411 CY |
| | 50 LF | 1.5 FT | 22 FT | 61 CY |
| | 300 LF | 1.5 FT | 20 FT | 333 CY |
| | 50 LF | 1.5 FT | 18 FT | 50 CY |
| Center to Lake | 350 LF | 1.5 FT | 19 FT | 369 CY |
| | 100 LF | 1.5 FT | 18 FT | 100 CY |
| | 50 LF | 1.5 FT | 17.5 FT | 49 CY |
| | 300 LF | 1.5 FT | 16.5 FT | 275 CY |
| | 100 LF | 1.5 FT | 16 FT | 89 CY |
| | | | **Total Volume** | **5,607 CY** |

FLOODWALL EXCAVATION VOLUME CALCULATIONS

Reach 2: Truckee River, Booth to Lake

| Location | Length | Width | Height | Volume |
|---|---|---|---|---|
| Gabion | 3,361 LF | 3 FT | 4 FT | 1,494 CY |
| I Pile | 5,800 LF | 1.5 FT | 2 FT | 644 CY |
| | | | **Total Volume** | **2,138 CY** |

# CONSTRUCTION ESTIMATES

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK

Reach 4: Truckee River, Hwy 395 to McCarran

Station 221+00 to 223+00

Channel Invert Elevation: 4390 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 200 LF | 4400 FT | 10 FT | 2,200 SFT | 16,296 CY | 40 FT |
| Add 2:1 Slope | 2.5 LF | 4400 FT | 10 FT | 2,200 SFT | 204 CY | 40 FT |
| | | | | **Total Cummulative Volume** | **16,500 CY** | |

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK

Station 223+00 to 228+00

Channel Invert Elevation: 4392 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 500 LF | 4400 FT | 8 FT | 400 SFT | 7,407 CY | 50 FT |
| | 500 LF | 4405 FT | 13 FT | 390 SFT | 7,222 CY | 30 FT |
| | 500 LF | 4400 FT | 8 FT | 560 SFT | 10,370 CY | 70 FT |
| Add 2:1 Slope | 2 LF | 4400 FT | 8 FT | 560 SFT | 41 CY | 70 FT |
| | | | | **Total Cummulative Volume** | **41,541 CY** | |

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK

Station 228+00 to 232+00

Channel Invert Elevation: 4395 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 400 LF | 4400 FT | 5 FT | 200 SFT | 2,963 CY | 40 FT |
| | 400 LF | 4405 FT | 10 FT | 400 SFT | 5,926 CY | 40 FT |
| | 400 LF | 4401 FT | 6 FT | 600 SFT | 8,889 CY | 100 FT |
| Add 2:1 Slope | 1.5 LF | 4401 FT | 6 FT | 600 SFT | 33 CY | 100 FT |
| | | | | **Total Cummulative Volume** | **59,353 CY** | |

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK

Station 232+00 to 236+00

Channel Invert Elevation: 4395 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 400 LF | 4400 FT | 5 FT | 200 SFT | 2,963 CY | 40 FT |
| | 400 LF | 4403 FT | 8 FT | 800 SFT | 11,852 CY | 100 FT |
| Add 2:1 Slope | 2 LF | 4403 FT | 8 FT | 800 SFT | 59 CY | 100 FT |
| | | | | **Total Cummulative Volume** | **74,227 CY** | |

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK

Station 236+00 to 240+00

Channel Invert Elevation: 4395 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 400 LF | 4400 FT | 5 FT | 100 SFT | 1,481 CY | 20 FT |
| | 400 LF | 4405 FT | 10 FT | 750 SFT | 11,111 CY | 75 FT |
| Add 2:1 Slope | 2.5 LF | 4405 FT | 10 FT | 750 SFT | 69 CY | 75 FT |
| | | | | **Total Cummulative Volume** | **86,889 CY** | |

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK

Station 240+00 to 242+00

Channel Invert Elevation: 4393 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 200 LF | 4405 FT | 12 FT | 360 SFT | 2,667 CY | 30 FT |
| Add 2:1 Slope | 3 LF | 4405 FT | 12 FT | 360 SFT | 40 CY | 30 FT |
| | | | | **Total Cummulative Volume** | **89,595 CY** | |

## CONSTRUCTION ESTIMATES

Project: Truckee Meadows — Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Glendale Ave to Greg Street Bridge

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 1,700 | LF | 70 | FT | | | 2.7 | AC |
| | Embankment fill | | | | | | | 23,941 | CY |
| | Exc inspection trench | 1,700 | LF | 9 | FT | 6.0 | FT | 3,400 | CY |
| | Excavation | 1,700 | LF | 70 | FT | 0.5 | FT | 2,204 | CY |
| | Riprap | 200 | LF | 10 | FT | 1.5 | FT | 244 | TON |
| | Aggregate patrol road | 1,700 | LF | 12 | FT | 4 | IN | 554 | TON |
| | Formed Reinforced Concrete | 100 | LF | 40 | FT | 1.5 | FT | 222 | CY |
| | Fencing | | | | | | | | LF |
| | Seeding | 1,700 | LF | 60 | FT | | | 2.3 | AC |

Project: Truckee Meadows — Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Greg Street Bridge to Rock Boulevard

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 3,850 | LF | 70 | FT | | | 6.2 | AC |
| | Embankment fill | | | | | | | 30,894 | CY |
| | Exc inspection trench | 3,850 | LF | 9 | FT | 6.0 | FT | 7,700 | CY |
| | Excavation | 3,850 | LF | 70 | FT | 0.5 | FT | 4,991 | CY |
| | Riprap | 3,600 | LF | 10 | FT | 18 | IN | 4,400 | TON |
| | Formed Reinforced Concrete | 1,800 | LF | 40 | FT | 1.5 | FT | 4,000 | CY |
| | Aggregate patrol road | 3,850 | LF | 12 | FT | 4 | IN | 1,255 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 3,850 | LF | 60 | FT | | | 5.3 | AC |

Project: Truckee Meadows Date: 7/18/97

Reach 4: Truckee River, Hwy 395 to McCarran

Location: Truckee River, Rock Boulevard to McCarren Boulevard

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | TOTAL |
| | Clear and Grub | 6,100 LF | 70 FT | | 9.8 AC |
| | Embankment fill | | | | 28,631 CY |
| | Exc inspection trench | 6,100 LF | 9 FT | 5.0 FT | 10,167 CY |
| | Excavation | 6,100 LF | 30 FT | 0.5 FT | 3,389 CY |
| | Riprap | 0 LF | 0 FT | 0 IN | 0 TON |
| | Aggregate patrol road | 6,100 LF | 12 FT | 4 IN | 1,988 TON |
| | Fencing | | | | 0 LF |
| | Seeding | 6,100 LF | 60 FT | | 8.4 AC |

Notes:

1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.
4. Assume 12" riprap on northern and eastern basin levees, per 1983 report.
5. Assume 200 lb rebar per cubic-yard formed concrete, per 1991 report.
6. Assume 6" bedding/drain material beneath detentino basin weirs.
7. Assume levee breakout sections have a 10ft width and 1.5ft height of rip rap
8. Assume levee breakout sections have 40ft width and 1.5 ft height of concrete

LEVEE FILL VOLUME CALCULATIONS

Truckee River, Glendale Ave to Greg Street Bridge (left bank)

Finished Height of Levee: 4435 to 4431 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| 312+00 to 302+00 | 1,000 LF | 4424 FT | 10 FT | 370 SFT | 13,704 CY |
| 100ft breakout | 100 LF | 4424 FT | 8 FT | 256 SFT | 948 CY |
| 301+00 to 300+70 | 30 LF | 4424 FT | 7 FT | 207 SFT | 229 CY |
| 300+70 to 299+50 | 120 LF | 4422 FT | 9 FT | 311 SFT | 1,380 CY |
| 299+50 to 296+60 | 290 LF | 4425 FT | 8 FT | 256 SFT | 2,750 CY |
| 296+00 to 295+00 | 160 LF | 4417 FT | 16 FT | 832 SFT | 4,930 CY |
| | **1,700 LF** | **Total Length** | | **Total Volume** | **23,941 CY** |
| | **10.0 FT** | **Avg Height** | | | |

LEVEE FILL VOLUME CALCULATIONS

Truckee River, Greg Street Bridge to Rock Boulevard

Finished Height of Levee: 4432 to 4417 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| Left Bank | 800 LF | 4420 FT | 12 FT | 504 SFT | 14,933 CY |
| Right Bank | 200 LF | 4425 FT | 7 FT | 207 SFT | 1,530 CY |
| 292+00 to 288+00 | 400 LF | 4424 FT | 2 FT | 34 SFT | 504 CY |
| 1000 ft breakout | 1,000 LF | 4416 FT | 8 FT | 256 SFT | 9,481 CY |
| 278+00 to 277+00 | 100 LF | 4417 FT | 6 FT | 162 SFT | 600 CY |
| 277+00 to 274+00 | 300 LF | 4416 FT | 4 FT | 88 SFT | 978 CY |
| 800ft Breakout | 800 LF | 4415 FT | 3 FT | 59 SFT | 1,733 CY |
| 266+00 to 263+50 | 250 LF | 4412 FT | 5 FT | 123 SFT | 1,134 CY |
| | **3,850 LF** | **Total Length** | | **Total Volume** | **30,894 CY** |
| | **6.6 FT** | **Avg Height** | | | |

LEVEE FILL VOLUME CALCULATIONS

Truckee River, Rock Boulevard to McCarren Boulevard

Finished Height of Levee: 4410 to 4405 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| Right Bank | 200 LF | 4408 FT | 2 FT | 34 SFT | 252 CY |
| 254+00 to 252+00 | 200 LF | 4407 FT | 3 FT | 59 SFT | 433 CY |
| 252+00 to 246+00 | 600 LF | 4405 FT | 4 FT | 88 SFT | 1,956 CY |
| 246+00 to 240+00 | 600 LF | 4401 FT | 7 FT | 207 SFT | 4,589 CY |
| 240+00 to 238+00 | 300 LF | 4402 FT | 6 FT | 162 SFT | 1,800 CY |
| 222+00 to 214+00 | 800 LF | 4404 FT | 1 FT | 15 SFT | 430 CY |
| 214+00 to 200+00 | 1,400 LF | 4400 FT | 4 FT | 88 SFT | 4,563 CY |
| 200+00 to 199+00 | 100 LF | 4397 FT | 5 FT | 123 SFT | 454 CY |
| Left Bank | 1,200 LF | 4400 FT | 5 FT | 123 SFT | 5,444 CY |
| 206+00 to 202+00 | 400 LF | 4395 FT | 9 FT | 311 SFT | 4,600 CY |
| 202+00 to 199+00 | 300 LF | 4392 FT | 10 FT | 370 SFT | 4,111 CY |
| | **6,100 LF** | **Total Length** | | **Total Volume** | **28,631 CY** |
| | **4.5 FT** | **Avg Height** | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows — Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Hwy 395 to Glendale

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | 2,950 | LF | 9 | FT | 6 | FT | 5,900 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 2,502 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Project: Truckee Meadows — Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Glendale Ave to Greg Street Bridge

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | | | | | | | 17,111 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 3,539 | CY |
| | Rip Rap | 2,800 | LF | 10 | FT | 1.5 | FT | 1,556 | CY |
| | Fill | 1,400 | LF | 12 | FT | 4.0 | FT | 2,489 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Project: Truckee Meadows — Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Greg Street Bridge to Rock Boulevard

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | 770 | LF | 9 | FT | 6 | FT | 1,540 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 765 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Project: Truckee Meadows Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Rock Boulevard to McCarren Boulevard

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | | | | | | | 17,472 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 4,759 | CY |
| | Fill | 1,000 | LF | 12 | FT | 4 | FT | 1,778 | CY |
| | Rip Rap | 2,000 | LF | 10 | FT | 2 | FT | 1,111 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Notes:
1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.
4. Assume 12" riprap on northern and eastern basin levees, per 1983 report.
5. Assume 200 lb rebar per cubic-yard formed concrete, per 1991 report.
6. Assume 6" bedding/drain material beneath detentino basin weirs.
7. Assume 10ft width and 1.5ft high rip rap for breakout floodwalls.
8. Assume concrete dimensions are close to the breakout cross section in 1985 report.
9. Assume breakout fill height is 1 ft above the floodwall height and the width is 12ft, per 1985 report.

FLOODWALL VOLUME CALCULATIONS

Truckee River, Hwy 395 to Glendale

| | | Length | Width | Height | Volume |
|---|---|---|---|---|---|
| Above Ground | Right Bank | 850 LF | 1.5 FT | 5 FT | 236 CY |
| | | 700 LF | 1.5 FT | 7 FT | 272 CY |
| | | 1,400 LF | 1.5 FT | 4 FT | 311 CY |
| Below Ground | Right Bank | 2,950 LF | 3.5 FT | 1.2 FT | 459 CY |
| | | 2,950 LF | 4 FT | 2.8 FT | 1,224 CY |
| | | | | | **2,502** CY |

FLOODWALL VOLUME CALCULATIONS

Truckee River, Glendale Ave to Greg Street Bridge

| | | Length | Width | Height | Volume |
|---|---|---|---|---|---|
| Above Ground | Left Bank | 450 LF | 1.5 FT | 5 FT | 125 CY |
| | 800ft Breakout | 800 LF | 12 FT | 1 FT | 356 CY |
| | 800ft Breakout | 800 LF | 1 FT | 9 FT | 267 CY |
| | Right Bank | 1,900 LF | 1.5 FT | 5 FT | 528 CY |
| | 600ft Breakout | 600 LF | 12 FT | 1 FT | 267 CY |
| | 600ft Breakout | 600 LF | 1 FT | 9 FT | 200 CY |
| | | 450 LF | 1.5 FT | 8 FT | 200 CY |
| Below Ground | Left & Right Bank | 2,800 LF | 3.5 FT | 1.2 FT | 436 CY |
| | | 2,800 LF | 4 FT | 2.8 FT | 1,161 CY |
| | | | | | **3,539** CY |

FLOODWALL EXCAVATION VOLUME CALCULATIONS

Truckee River, Glendale Ave to Greg Street Bridge

| | Length | Width | Height | Volume |
|---|---|---|---|---|
| | 2,800 LF | 9 FT | 6 FT | 5,600 CY |
| | 1,400 LF | 37 FT | 6 FT | 11,511 CY |
| | | | | **17,111** CY |

FLOODWALL VOLUME CALCULATIONS

Truckee River, Greg Street to South Rock

| | | Length | Width | Height | Volume |
|---|---|---|---|---|---|
| Above Ground | Left Bank | 100 LF | 1.5 FT | 5 FT | 28 CY |
| | | 670 LF | 1.5 FT | 8 FT | 298 CY |
| Below Ground | Left Bank | 770 LF | 3.5 FT | 1.2 FT | 120 CY |
| | | 770 LF | 4 FT | 2.8 FT | 319 CY |
| | | | | | **765** CY |

FLOODWALL VOLUME CALCULATIONS

Truckee River, South Rock to South McCarran

| | | Length | Width | Height | Volume |
|---|---|---|---|---|---|
| Above Ground | Left Bank | 150 LF | 1.5 FT | 5 FT | 42 CY |
| | Breakout 1000ft | 1,000 LF | 12 FT | 1 FT | 444 CY |
| | | 1,000 LF | 1 FT | 9 FT | 333 CY |
| | | 2,275 LF | 1.5 FT | 5 FT | 632 CY |
| | | 1,050 LF | 1.5 FT | 6 FT | 350 CY |
| | Right Bank | 1,150 LF | 1.5 FT | 5 FT | 319 CY |
| Below Ground | Left & Right Bank | 4,625 LF | 3.5 FT | 1.2 FT | 719 CY |
| | | 4,625 LF | 4 FT | 2.8 FT | 1,919 CY |
| | | | | | **4,759** CY |

FLOODWALL EXCAVATION VOLUME CALCULATIONS

Truckee River, South Rock to South McCarran

| | Length | Width | Height | Volume |
|---|---|---|---|---|
| | 4,625 LF | 9 FT | 6 FT | 9,250 CY |
| | 1,000 LF | 37 FT | 6 FT | 8,222 CY |
| | | | | 17,472 CY |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows — Date: 7/18/97
Reach 5: Truckee River, McCarran to Vista
Location: Truckee River east of North Truckee Drain

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 4,050 | LF | 70 | FT | | | 6.5 | AC |
| | Embankment fill | | | | | | | 111,764 | CY |
| | Exc inspection trench | 4,050 | LF | 9 | FT | 6.0 | FT | 8,100 | CY |
| | Excavation | 4,050 | LF | 90 | FT | 0.5 | FT | 6,750 | CY |
| | Riprap | 0 | LF | 0 | FT | 0 | FT | 0 | TON |
| | Aggregate patrol road | 4,050 | LF | 12 | FT | 4 | IN | 1,320 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 4,050 | LF | 60 | FT | | | 5.6 | AC |

Project: Truckee Meadows — Date: 7/18/97
Reach 5: Truckee River, McCarran to Vista
Location: Left Bank: McCarran Blvd to N.T. Drain; Rt Bank: McCarran to inlet weir

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 14,060 | LF | 70 | FT | | | 22.6 | AC |
| | Embankment fill | | | | | | | 167,663 | CY |
| | Exc inspection trench | 14,060 | LF | 9 | FT | 6.0 | FT | 28,120 | CY |
| | Excavation | 14,060 | LF | 60 | FT | 0.5 | FT | 15,622 | CY |
| | Riprap | 0 | LF | 40 | FT | 12 | IN | 0 | TON |
| | Aggregate patrol road | 14,060 | LF | 12 | FT | 4 | IN | 4,583 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 14,060 | LF | 60 | FT | | | 19.4 | AC |

Notes:

1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.

LEVEE FILL VOLUME CALCULATIONS
Truckee River east of North Truckee Drain
Finished Height of Levee: 4401 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| E/o NTDrain | 1,200 LF | 4386 FT | 15 FT | 743 SFT | 33,000 CY |
| midsection | 1,650 LF | 4387 FT | 14 FT | 658 SFT | 40,211 CY |
| Larkin Circle area | 450 LF | 4384 FT | 17 FT | 927 SFT | 15,442 CY |
| east end | 750 LF | 4385 FT | 16 FT | 832 SFT | 23,111 CY |
| | **4,050 LF** | **Total Length** | | **Total Volume** | **111,764 CY** |
| | **15.0 FT** | **Avg Height** | | | |

LEVEE FILL VOLUME CALCULATIONS
Left Bank: McCarran Blvd to N.T. Drain; Rt Bank: McCarran to inlet weir
Finished Height of Levee: 4401 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| Upstrm of NTDrain | 1,200 LF | 4390 FT | 11 FT | 435 SFT | 19,311 CY |
| 86+00 to 100+00 | 1,400 LF | 4389 FT | 12 FT | 504 SFT | 26,133 CY |
| | 650 LF | 4389 FT | 12 FT | 504 SFT | 12,133 CY |
| 106+00 to 116+00 | 1,000 LF | 4391 FT | 10 FT | 370 SFT | 13,704 CY |
| | 400 LF | 4390 FT | 11 FT | 435 SFT | 6,437 CY |
| 120+00 to 136+00 | 1,600 LF | 4391 FT | 10 FT | 370 SFT | 21,926 CY |
| 136+00 to 146+00 | 1,000 LF | 4393 FT | 8 FT | 256 SFT | 9,481 CY |
| 146+00 to 158+00 | 1,200 LF | 4393 FT | 8 FT | 256 SFT | 11,378 CY |
| 158+00 to 160+00 | 860 LF | 4394 FT | 7 FT | 207 SFT | 6,577 CY |
| | 750 LF | 4395 FT | 6 FT | 162 SFT | 4,500 CY |
| Dwnstrm of McCarran | 1,400 LF | 4396 FT | 5 FT | 123 SFT | 6,352 CY |
| Dwnstrm of McCarran | 1,200 LF | 4395 FT | 6 FT | 162 SFT | 7,200 CY |
| Rt Bank McC to weir | 1,400 LF | 4390 FT | 11 FT | 435 SFT | 22,530 CY |
| | **14,060 LF** | **Total Length** | | **Total Volume** | **167,663 CY** |
| | **9.0 FT** | **Avg Height** | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows  Date: 7/18/97
Reach 6: Steamboat Creek and Boynton Slough
Location: Boynton Slough from McCarran to Pembrook to Steamboat Cr.

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 7,980 | LF | 70 | FT | | | 12.8 | AC |
| | Embankment fill | | | | | | | 159,212 | CY |
| | Exc inspection trench | 7,980 | LF | 9 | FT | 6.0 | FT | 15,960 | CY |
| | Excavation | 7,980 | LF | 80 | FT | 0.5 | FT | 11,822 | CY |
| | Riprap | 0 | LF | 0 | FT | 0 | FT | 0 | TON |
| | Aggregate patrol road | 7,980 | LF | 12 | FT | 4 | IN | 2,601 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 7,980 | LF | 60 | FT | | | 11.0 | AC |

Project: Truckee Meadows  Date: 7/18/97
Reach 6: Steamboat Creek and Boynton Slough
Location: East of Steamboat Creek

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 8,605 | LF | 70 | FT | | | 13.8 | AC |
| | Embankment fill | 8,605 | LF | | | | | 111,475 | CY |
| | Exc inspection trench | 8,605 | LF | 9 | FT | 6.0 | FT | 17,210 | CY |
| | Excavation | 8,605 | LF | 60 | FT | 0.5 | FT | 9,561 | CY |
| | Riprap | 8,605 | LF | 40 | FT | 12 | IN | 28,046 | TON |
| | Aggregate patrol road | 8,605 | LF | 12 | FT | 4 | IN | 2,805 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 8,605 | LF | 60 | FT | | | 11.9 | AC |

Project: Truckee Meadows
Reach 6: Steamboat Creek and Boynton Slough
Location: South of Boynton Slough
Date: 7/18/97

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | TOTAL |
| | Clear and Grub | 1 LF | 70 FT | | 0.0 AC |
| | Embankment fill | 1 LF | | | 0 CY |
| | Exc inspection trench | 1 LF | 9 FT | 0.0 FT | 0 CY |
| | Excavation | 1 LF | 20 FT | 0.5 FT | 0 CY |
| | Riprap | 1 LF | 30 FT | 12 IN | 2 TON |
| | Aggregate patrol road | 1 LF | 12 FT | 4 IN | 0 TON |
| | Fencing | | | | 0 LF |
| | Seeding | 1 LF | 60 FT | | 0.0 AC |

Project: Truckee Meadows
Reach 6: Steamboat Creek and Boynton Slough
Location: Bridge Replacements: Pembrook and McCarran
Date: 7/18/97

| Item | Description | QUANTITIES | |
|---|---|---|---|
| REPLACEMENT | | | Total |
| | Demo existing bridges | Pembrook | LS |
| | | McCarran | LS |
| | Construct new bridges | Pembrook | LS |
| | | McCarran | LS |

Notes:
1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.

LEVEE FILL VOLUME CALCULATIONS
Boynton Slough from McCarran to Pembrook to Steamboat Cr.
Finished Height of Levee: 4401 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| N/o Boynton | 3,720 LF | 4387 FT | 14 FT | 658 SFT | 90,658 CY |
| N/o Boynton | 2,160 LF | 4390 FT | 11 FT | 435 SFT | 34,760 CY |
| Pembrook to Steam. | 2,100 LF | 4390 FT | 11 FT | 435 SFT | 33,794 CY |
| | 0 LF | 4401 FT | 0 FT | 0 SFT | 0 CY |
| | **7,980 LF** | **Total Length** | | **Total Volume** | **159,212 CY** |
| | **12.4 FT** | **Avg Height** | | | |

LEVEE FILL VOLUME CALCULATIONS
East of Steamboat Creek
Finished Height of Levee: 4398 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| N/o Pembrook | 1,500 LF | 4388 FT | 10 FT | 370 SFT | 20,556 CY |
| N/o Pembrook | 1,200 LF | 4387 FT | 11 FT | 435 SFT | 19,311 CY |
| N/o Pembrook | 1,320 LF | 4389 FT | 9 FT | 311 SFT | 15,180 CY |
| S/o Pembrook | 600 LF | 4389 FT | 9 FT | 311 SFT | 6,900 CY |
| S/o Pembrook | 1,080 LF | 4385 FT | 13 FT | 579 SFT | 23,140 CY |
| S/o Pembrook | 1,085 LF | 4394 FT | 4 FT | 88 SFT | 3,536 CY |
| S/o Pembrook | 1,620 LF | 4388 FT | 10 FT | 370 SFT | 22,200 CY |
| tie into hills | 200 LF | 4394 FT | 4 FT | 88 SFT | 652 CY |
| | 0 LF | 4398 FT | 0 FT | 0 SFT | 0 CY |
| | **8,605 LF** | **Total Length** | | **Total Volume** | **111,475 CY** |
| | **9.4 FT** | **Avg Height** | | | |

LEVEE FILL VOLUME CALCULATIONS
South of Boynton Slough
Finished Height of Levee: 4402 FT

| Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|
| 0 LF | 4402 FT | 0 FT | 0 SFT | 0 CY |
| 0 LF | 4402 FT | 0 FT | 0 SFT | 0 CY |
| 0 LF | 4402 FT | 0 FT | 0 SFT | 0 CY |
| 0 LF | 4402 FT | 0 FT | 0 SFT | 0 CY |
| 1 LF | 4402 FT | 0 FT | 0 SFT | 0 CY |
| **1 LF** | **Total Length** | | **Total Volume** | **0 CY** |
| **0.0 FT** | **Avg Height** | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows
Reach 7: University Farms Area, Without Detention Basin
Location: Eastern Levees: West of Steamboat overflow area
Date: 7/18/97

| Item | Description | QUANTITIES | | | | | | |
|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | TOTAL | |
| | Clear and Grub | 6,660 | LF | 70 | FT | | 10.7 | AC |
| | Embankment fill | | | | | | 129,482 | CY |
| | Exc inspection trench | 6,660 | LF | 9 | FT | 6.0 FT | 13,320 | CY |
| | Excavation | 6,660 | LF | 80 | FT | 0.5 FT | 9,867 | CY |
| | Riprap | | | | | | | TON |
| | Aggregate patrol road | 6,660 | LF | 12 | FT | 4 IN | 2,171 | TON |
| | Fencing | | | | | | 0 | LF |
| | Seeding | 6,660 | LF | 60 | FT | | 9.2 | AC |

Project: Truckee Meadows
Reach 7 University Farms Area, Without Detention Basin
Location: North Bank: Truckee River Levee
Date: 7/18/97

| Item | Description | QUANTITIES | | | | | | |
|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | TOTAL | |
| | Clear and Grub | 6,000 | LF | 70 | FT | | 9.6 | AC |
| | Embankment fill | | | | | | 75,987 | CY |
| | Exc inspection trench | 6,000 | LF | 9 | FT | 6.0 FT | 12,000 | CY |
| | Excavation | 6,000 | LF | 20 | FT | 0.5 FT | 2,222 | CY |
| | Riprap | | | | | | | TON |
| | Aggregate patrol road | 6,000 | LF | 12 | FT | 4 IN | 1,956 | TON |
| | Fencing | | | | | | | LF |
| | Seeding | 6,000 | LF | 60 | FT | | 8.3 | AC |

1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.
4. Assume 12" riprap on northern and eastern basin levees, per 1983 report.
5. Assume 200 lb rebar per cubic-yard formed concrete, per 1991 report.
6. Assume 6" bedding/drain material beneath detentino basin weirs.

LEVEE FILL VOLUME CALCULATIONS
Eastern Levees: West of Steamboat overflow area
Finished Height of Levee: 4400 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| Pembrook | 2,400 LF | 4388.5 FT | 11.5 FT | 469 SFT | 41,656 CY |
| north to knoll | 2,280 LF | 4388.5 FT | 11.5 FT | 469 SFT | 39,573 CY |
| tie into knoll | 1,980 LF | 4386 FT | 14 FT | 658 SFT | 48,253 CY |
| | **6,660 LF** | **Total Length** | | **Total Volume** | **129,482 CY** |
| | **12.2 FT** | **Avg Height** | | | |

LEVEE FILL VOLUME CALCULATIONS
North Bank: Truckee River Levee
Finished Height of Levee: 4401 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| 182+00 to 172+00 | 1,000 LF | 4393 FT | 8 FT | 256 SFT | 9,481 CY |
| 172+00 to 169+00 | 300 LF | 4392 FT | 9 FT | 311 SFT | 3,450 CY |
| 169+00 to 168+00 | 100 LF | 4395 FT | 6 FT | 162 SFT | 600 CY |
| 168+00 to 162+00 | 600 LF | 4392 FT | 9 FT | 311 SFT | 6,900 CY |
| 162+00 to 158+00 | 400 LF | 4395 FT | 6 FT | 162 SFT | 2,400 CY |
| 158+00 to 138+00 | 2,000 LF | 4391 FT | 10 FT | 370 SFT | 27,407 CY |
| 138+00 to 122+00 | 1,600 LF | 4390 FT | 11 FT | 435 SFT | 25,748 CY |
| | **6,000 LF** | **Total Length** | | **Total Volume** | **75,987 CY** |
| | **9.5 FT** | **Avg Height** | | | |

**Reach 7A: University Farms Area, Includes Detention Basin**

EXCAVATION VOLUME CALCULATIONS - 1000FT WEIR

Station 184+75 to 184+00

Channel Invert Elevation: 4381 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 75 LF | 4390 FT | 9 FT | 1,980 SFT | 5,500 CY | 40 FT |
| | 75 LF | 4394 FT | 13 FT | 2,860 SFT | 7,944 CY | 50 FT |
| Subtract 2:1 Slope | 3 LF | 4394 FT | 13 FT | 2,860 SFT | 344 CY | 50 FT |
| | | | **Total Cummulative Volume** | | **13,100** CY | |

Station 184+00 to 180+00

Channel Invert Elevation: 4380 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 400 LF | 4390 FT | 10 FT | 100 SFT | 1,481 CY | 10 FT |
| | 400 LF | 4393 FT | 13 FT | 2,600 SFT | 38,519 CY | 200 FT |
| Subtract 2:1 Slope | 3 LF | 4393 FT | 13 FT | 2,600 SFT | 313 CY | 200 FT |
| | | | **Total Cummulative Volume** | | **52,787** CY | |

Station 180+00 to 174+00

Channel Invert Elevation: 4382 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 600 LF | 4390 FT | 8 FT | 80 SFT | 1,778 CY | 10 FT |
| | 600 LF | 4393 FT | 11 FT | 2,090 SFT | 46,444 CY | 190 FT |
| | 400 LF | 4393 FT | 11 FT | 550 SFT | 8,148 CY | 50 FT |
| | 200 LF | 4395 FT | 13 FT | 650 SFT | 4,815 CY | 50 FT |
| Subtract 2:1 Slope | 3 LF | 4395 FT | 13 FT | 650 SFT | 78 CY | 50 FT |
| | | | **Total Cummulative Volume** | | **113,894** CY | |

Station 174+00 to 168+00

Channel Invert Elevation: 4385 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 600 LF | 4390 FT | 5 FT | 200 SFT | 4,444 CY | 40 FT |
| | 200 LF | 4395 FT | 10 FT | 600 SFT | 4,444 CY | 60 FT |
| | 400 LF | 4391 FT | 6 FT | 1,080 SFT | 16,000 CY | 180 FT |
| Subtract 2:1 Slope | 2 LF | 4391 FT | 6 FT | 1,080 SFT | 60 CY | 180 FT |
| | | | **Total Cummulative Volume** | | **138,723** CY | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows — Date: 7/18/97
Reach 7A: University Farms Area, Includes Detention Basin
Location: Western & Southern Levees: East side McCarran, North side Pembrook

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 10,890 | LF | 70 | FT | | | 17.5 | AC |
| | Embankment fill | | | | | | | 156,781 | CY |
| | Exc inspection trench | 10,890 | LF | 9 | FT | 6.0 | FT | 21,780 | CY |
| | Excavation | 10,890 | LF | 70 | FT | 0.5 | FT | 14,117 | CY |
| | Riprap | 0 | LF | 0 | FT | 0 | FT | 0 | TON |
| | Aggregate patrol road | 10,890 | LF | 12 | FT | 4 | IN | 3,549 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 10,890 | LF | 60 | FT | | | 15.0 | AC |

Project: Truckee Meadows — Date: 7/18/97
Reach 7A: University Farms Area, Includes Detention Basin
Location: Eastern Levees: West of Steamboat overflow area

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 6,660 | LF | 70 | FT | | | 10.7 | AC |
| | Embankment fill | | | | | | | 129,482 | CY |
| | Exc inspection trench | 6,660 | LF | 9 | FT | 6.0 | FT | 13,320 | CY |
| | Excavation | 6,660 | LF | 80 | FT | 0.5 | FT | 9,867 | CY |
| | Riprap | 6,660 | LF | 40 | FT | 12 | IN | 21,707 | TON |
| | Aggregate patrol road | 6,660 | LF | 12 | FT | 4 | IN | 2,171 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 6,660 | LF | 60 | FT | | | 9.2 | AC |

Project: Truckee Meadows Date: 7/18/97
Reach 7A: University Farms Area, Includes Detention Basin
Location: Northern Levees: Truckee River

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 5,000 | LF | 70 | FT | | | 8.0 | AC |
| | Embankment fill | | | | | | | 66,506 | CY |
| | Exc inspection trench | 5,000 | LF | 9 | FT | 6.0 | FT | 10,000 | CY |
| | Excavation | 5,000 | LF | 20 | FT | 0.5 | FT | 1,852 | CY |
| | Riprap | 5,000 | LF | 40 | FT | 12 | IN | 16,296 | TON |
| | Aggregate patrol road | 5,000 | LF | 12 | FT | 4 | IN | 1,630 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 5,000 | LF | 60 | FT | | | 6.9 | AC |

Project: Truckee Meadows Date: 7/18/97
Reach 7A: University Farms Area, Includes Detention Basin
Location: Detention basin facilities: inlet weir, outlet weir, low level outlet

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FACILITIES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 1,350 | LF | 70 | FT | | | 2.2 | AC |
| | Excavation | 1,350 | LF | | | | | 1,778 | CY |
| | Bedding material | 1,250 | LF | 20 | FT | 6 | IN | 1,019 | TON |
| | Formed concrete | | | | | | | 1,778 | CY |
| | Reinforcing steel | | | | | | | 355,556 | LBS |
| | Riprap | 1,650 | LF | 35 | LF | 6 | IN | 2,353 | TON |
| | 48" RCP | | | | | | | 100 | LF |
| | 48" Control gates | | | | | | | 2 | EA |
| | 48" Flap gates | | | | | | | 2 | EA |

Notes:
1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.
4. Assume 12" riprap on northern and eastern basin levees, per 1983 report.
5. Assume 200 lb rebar per cubic-yard formed concrete, per 1991 report.
6. Assume 6" bedding/drain material beneath detentino basin weirs.

LEVEE FILL VOLUME CALCULATIONS

Western and Southern Levees: East side McCarran, North side Pembrook

Finished Height of Levee: 4401 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| river to Kimlick | 780 LF | 4392 FT | 9 FT | 311 SFT | 8,970 CY |
| Kimlick to McCarran | 780 LF | 4394 FT | 7 FT | 207 SFT | 5,966 CY |
| S/o McCarran | 1,800 LF | 4393 FT | 8 FT | 256 SFT | 17,067 CY |
| S/o McCarran | 1,200 LF | 4392 FT | 9 FT | 311 SFT | 13,800 CY |
| to Pembrook | 2,790 LF | 4390 FT | 11 FT | 435 SFT | 44,898 CY |
| Pembrook | 3,540 LF | 4389 FT | 12 FT | 504 SFT | 66,080 CY |
| | **10,890 LF** | **Total Length** | | **Total Volume** | **156,781 CY** |
| | **10.2 FT** | **Avg Height** | | | |

LEVEE FILL VOLUME CALCULATIONS

Eastern Levees: West of Steamboat overflow area

Finished Height of Levee: 4400 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| Pembrook | 2,400 LF | 4388.5 FT | 11.5 FT | 469 SFT | 41,656 CY |
| north to knoll | 2,280 LF | 4388.5 FT | 11.5 FT | 469 SFT | 39,573 CY |
| tie into knoll | 1,980 LF | 4386 FT | 14 FT | 658 SFT | 48,253 CY |
| | **6,660 LF** | **Total Length** | | **Total Volume** | **129,482 CY** |
| | **12.2 FT** | **Avg Height** | | | |

LEVEE FILL VOLUME CALCULATIONS

Northern Levees: Truckee River Right Bank

Finished Height of Levee: 4401 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| 172+00 to 169+00 | 300 LF | 4392 FT | 9 FT | 311 SFT | 3,450 CY |
| 169+00 to 168+00 | 100 LF | 4395 FT | 6 FT | 162 SFT | 600 CY |
| 168+00 to 162+00 | 600 LF | 4392 FT | 9 FT | 311 SFT | 6,900 CY |
| 162+00 to 158+00 | 400 LF | 4395 FT | 6 FT | 162 SFT | 2,400 CY |
| 158+00 to 138+00 | 2,000 LF | 4391 FT | 10 FT | 370 SFT | 27,407 CY |
| 138+00 to 122+00 | 1,600 LF | 4390 FT | 11 FT | 435 SFT | 25,748 CY |
| | **5,000 LF** | **Total Length** | | **Total Volume** | **66,506 CY** |
| | **9.7 FT** | **Avg Height** | | | |

CONCRETE VOLUME CALCULATIONS

Detention basin facilities: inlet weir, outlet weir, low level outlet

| | Length | X-Sect | Volume |
|---|---|---|---|
| inlet weir | 1,000 LF | 38 SFT | 1,407 CY |
| outlet weir | 250 LF | 40 SFT | 370 CY |
| low level outlet | 100 LF | 0 SFT | CY |
| | **1,350 LF** | | **1,778 CY** |

## CONSTRUCTION ESTIMATES

Project: Truckee Meadows
Reach 8: N. Truckee Drain, Peoples Ditch
Location: N. Truckee Drain, Peoples Ditch
Date: 7/18/97

| Item | Description | QUANTITIES | | | | | |
|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | Height | TOTAL | |
| | Clear and Grub | 20,515 | LF | 70 FT | | 33.0 | AC |
| | Embankment fill | 20,515 | LF | | | 76,516 | CY |
| | Exc inspection trench | 20,515 | LF | 9 FT | 5 FT | 34,192 | CY |
| | Excavation | 20,515 | LF | 45 FT | 0.5 FT | 17,096 | CY |
| | Riprap | 0 | LF | 0 FT | 0 FT | 0 | TON |
| | Aggregate patrol road | 20,515 | LF | 12 FT | 4 IN | 6,686 | TON |
| | Fencing | 0 | LF | | | 0 | LF |
| | Seeding | 20,515 | LF | 60 FT | | 28.3 | AC |

Notes:

1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee.
2. Clearing and grubbing was estimated at 70' wide along the length of the levee in the 1991 report (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.

LEVEE FILL VOLUME CALCULATIONS
North Truckee Drain Area
Finished Height of Levee: 4394 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| NTDR | 430 LF | 4388 FT | 6 FT | 162 SFT | 2,580 CY |
| NTDR | 430 LF | 4388 FT | 6 FT | 162 SFT | 2,580 CY |
| NTDR | 780 LF | 4389 FT | 5 FT | 123 SFT | 3,539 CY |
| NTDR | 600 LF | 4392 FT | 2 FT | 34 SFT | 756 CY |
| NTDR | 1,200 LF | 4386 FT | 8 FT | 256 SFT | 11,378 CY |
| S/o 80 | 4,875 LF | 4388 FT | 6 FT | 162 SFT | 29,250 CY |
| N/o 80 | 4,200 LF | 4391 FT | 3 FT | 59 SFT | 9,100 CY |
| N/o 80 | 4,200 LF | 4391 FT | 3 FT | 59 SFT | 9,100 CY |
| N/o 80 | 900 LF | 4391 FT | 3 FT | 59 SFT | 1,950 CY |
| N/o 80 | 900 LF | 4391 FT | 3 FT | 59 SFT | 1,950 CY |
| N/o 80 | 1,000 LF | 4391 FT | 3 FT | 59 SFT | 2,167 CY |
| N/o 80 | 1,000 LF | 4391 FT | 3 FT | 59 SFT | 2,167 CY |
| | **20,515 LF** | **Total Length** | | **Total Volume** | **76,516 CY** |
| | **4.2 FT** | **Avg Height** | | | |

# Section 4
# Other Projects

# Section 4
# Other Proj cts

## 26,000 cfs FACILITIES

This section of the Reconnaissance Report estimates the increase in the size and extent of the approved project features that would be needed to pass 26,000 cfs. This analysis was performed to provide a cost for facilities only, and does not reflect a new alternative flood control project. The costs developed from this analysis will be used by the COE to determine a federal interest in this project.

## RESULTS

The 26,000 cfs analysis uses flood control measures similar to those used by the approved project for most of the Booth Street to Vista reach (Figure 4-1). The flood control measures include floodwalls, levees, channel excavation, and replacement of bridges.

The differences between facilities needed to convey 26,000 cfs compared to those for 18,500 cfs include the height of floodwalls and new features required in areas not subject to flooding under 18,500 cfs. To allow for easier comparison, the nine reaches in the approved project are used in the 26,000 cfs analysis. Height of floodwalls and levees, unless otherwise stated, were determined using water surface elevations from the HEC-RAS program with an additional 3 feet of freeboard and subtracting the ground surface elevation.

Descriptions of the assumed project features, design assumptions, and construction concerns for this update follow. Figures showing a plan view of the facilities in each reach and typical cross sections were developed. These figures appear together at the end of the facilities description.

### Reach 1: Truckee River Upstream of Booth Street

Assumed Features: In this reach the flood control features are shown on Figures 4-2 and 4-3. The following features are illustrated:

- Floodwall on right bank beginning on 508+00 and extending downstream to Booth Street.

- Floodwall on right bank beginning on 486+00 and extending downstream to Booth Street.

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Assumptions/Construction Concerns: Assumptions and concerns for Reach 1 include:

- The floodwall on the right and left bank upstream of Booth Street will be a reinforced-concrete inverted "T" style wall constructed as illustrated in cross sections 3, 5, and 6 on Figures 4-18 and 4-19. The floodwall is assumed to tie into the 4th Street embankment shown on the Figure.

### Reach 2: Truckee River from Booth Street to Lake Street

Assumed Project Features: In this reach the flood control plan is shown on Figures 4-3 and 4-4. The following features are illustrated:

- Floodwall on left bank for entire reach.
- Floodwall on right bank beginning at Station 478+00 and extending downstream to Keystone Avenue.
- Floodwall on right bank beginning at Station 464+00 and extending downstream to Lake Street.
- Channel excavation just downstream of the Booth Street Bridge, approximate length as indicated on Figure 4-3.
- Channel excavation beginning upstream of both Arlington Street bridges and extending to the Sierra Street Bridge.
- Bridge structures on Booth Street, Arlington Street-North, Arlington Street-South, Sierra Street, Virginia Street, and Lake Street are to be replaced with larger flow capacities.
- Bridge flood gates on Arlington Street-North, Arlington Street-South, Sierra Street, Virginia Street, Center Street, Lake Street and the left bank of Booth Street.

Assumptions/Construction Concerns: Assumptions and concerns for Reach 2 include:

- The floodwall on the left bank between Booth Street and Arlington will be a gabion wall, as illustrated in cross section 1 on Figure 4-18. Dimensions shown were assumed constant for the entire length.

- The floodwall on the left bank from station 478+00 and extending downstream to Keystone Avenue will be a reinforced-concrete inverted "T" style wall constructed as illustrated in cross sections 3, 5, and 6 on Figures 4-19 and 4-20.

- The floodwall on the remainder of the left bank and the right bank Station 464+00 and Lake Street will be a reinforced-concrete I-pile wall constructed adjacent to the existing floodwall, as illustrated in cross section 2 on Figure 4-18. The height of the floodwall was determined using the water surface elevations from the HEC-RAS program with an additional 3 feet of freeboard and subtracting channel invert elevations.

- The channel excavation downstream of Booth Street was assumed to have the cross section indicated in cross section 1 on Figure 4-18 for its entire length.

- The channel excavation at the Arlington Street bridges was assumed to be 1.5 feet deep for the entire channel area, as shown.

- Flood gates were assumed at the bridges; these would consist of two steel plates that attach to the floodwall and join at the centerline of the road when closed.

- The replaced bridges were assumed to be raised and designed with a larger opening, with the bottom chord of the bridge at the elevations specified in the Feasibility Report. A 20-foot extension was assumed for each end of each replaced bridge to provide a ramped transition to the elevated bridge. The Center Street Bridge is currently being reconstructed and was not included in the estimates. The detailed design of the bridges and the transitions would be developed in the next phase of the project.

- Utilities on each bridge were assumed to be relocated on the new bridge. The utilities involved are listed in the attached construction estimates for Reach 2.

### Reach 3: Truckee River from Lake Street to Highway 395

Assumed Project Features: The Reach 3 flood control plan is shown on Figures 4-4 and 4-5. The following features are illustrated for the right bank:

- Floodwall from Lake Street tying into higher ground at approximately Station 418+15.

- Floodwall from Station 413+00 tying into Wells Avenue at approximately Station 403+24.

- Floodwall from Wells to Highway 395

The following features are illustrated for the left bank:

- Floodwall from Lake Street tying into higher ground at approximately Station 418+15.
- Floodwall from approximately Station 399+22 tying into higher ground at approximately Station 369+97.

- Floodwall from approximately Station 364+11 tying into higher ground at approximately Station 358+41.

Assumptions/Construction Concerns: Assumptions and concerns for Reach 3 include:

- All floodwalls in this reach will be reinforced-concrete inverted "T" style walls constructed as illustrated in cross sections 3, 5, and 6 on Figures 4-19 and 4-20.

**Reach 4: Truckee River from Highway 395 to McCarran Boulevard.**

Assumed Project Features: The reach flood control plan is shown on Figures 4-5 through 4-8. The following features are illustrated for the right bank:

- Floodwall from Highway 395 to Greg Street. This floodwall contains a 600-foot breakout section starting at approximately Station 303+20 to 309+20.

- Levee from Greg Street to Station 238+00. This levee contains two breakout sections of 1000 feet and 800 feet, starting at Stations 288+00 to 278+00 and 274+00 respectively.

- Floodwall from Station 238+00 to approximately Station 223+20

- Levee from Station 223+20 to McCarran Boulevard.

The following features are illustrated for the Left bank:

- Floodwall from Glendale Avenue to approximately Station 312+00. This floodwall contains an 800-foot breakout section starting at approximately Station 321+50 to 313+50.

- Levee from Station 312+00 to Station 286+00. This levee contains a 100-foot breakout section starting at Station 302+00 to 301+00.

- Floodwall from Station 286+00, tying into Rock Boulevard. at approximately Station 277+50.

- Levee from Station 277+50 to 264+00.

- Floodwall from Rock Boulevard Bridge to Station 218+00. This floodwall contains a 1000-foot breakout section starting at Station 262+00 to 252+00.

- Excavation in the Truckee River channel and extending into Glendale Park from Station 242+00 to approximately Station 222+00.

- Levee from Station 218+00 to McCarran Boulevard.

Assumptions/Construction Concerns: Assumptions and concerns for Reach 4 include:

- All floodwalls in this reach will be reinforced-concrete inverted "T" style walls constructed as illustrated in cross sections 3, 5, and 6 on Figures 4-19 and 4-20. The floodwalls were assumed to extend 4 feet below ground, with footing dimensions 1 foot 2 inches high by 3 feet 6 inches wide. Assume excavation required for concrete placement at 9 feet wide by 6 feet deep.

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross section 4 on Figure 4-19.

- The levee inspection trench is assumed to be 9 feet wide and feet deep for levees greater than 6 feet in total height. For levees less than 6 feet in height, the depth of the trench will equal the height of the levee. Assume clearing and grubbing 70 feet wide along the length of the levee.

- Breakout floodwalls in this reach will be constructed as illustrated in cross section 4 on Figure 4-19. (Also see the attached construction estimates for Reach 4, and typical cross section in Feasibility Report).

- Breakout levees in this reach will be constructed as illustrated in cross section 5 on Figure 4-20. (Also see the attached construction estimates for Reach 4, and typical cross section in Feasibility Report).

- Severe bank erosion and undermining of buildings took place in the vicinity of Station 238+00 to Station 226+00. The cross section of the Truckee River needs to be updated and the floodwall may need to be relocated. The

location of the floodwall will depend on the future plans for the remaining structures.

- Excavation in the vicinity of Glendale Park (Stations 242+00 to 222+00) was assumed have an area as indicated on Sheet 6. The land was assumed to be excavated to an elevation of 4395 and that the excavation would daylight on a 2:1 slope, as illustrated in cross section 6 on Figure 4-20.

### Reach 5: Truckee River from McCarran Boulevard to Vista (Excludes University Farms Area levee along right bank of Truckee River from Station 183+50 to 122+00)

Assumed Project Features: The reach flood control plan is shown on Figures 4-9 through 4-11. The following feature is illustrated for the right bank:

Levee from McCarran Boulevard. to approximately Station 183+50.

The following feature is illustrated for the left bank:

Levee from McCarran Boulevard. to approximately Station 31+50, excluding the entrance of the North Truckee Drain at approximately Station 73+00.

Assumptions/Construction Concerns: Assumptions and concerns for the Reach 5 include:

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross sections 7, 8, 9, and 10 on Figures 4-21 and 4-22. The approved project assumed a constant 4401 levee elevation throughout this reach, which resulted in 5 feet of freeboard. As stated previously, the heights of the levees were determined using the water surface elevations from the HEC-RAS program with an additional 3 feet of freeboard. This assumption resulted in a lower levee elevation than assumed in the approved project.

- The levee inspection trench is assumed to be 9 feet wide and 6 feet deep for levees greater than 6 feet in total height. For levees less than 6 feet in height, the depth of the trench will equal the height of the levee. Assume clearing and grubbing 70 feet wide along the length of the levee.

### Reach 6: Steamboat Creek and Boynton Slough

Assumed Project Features: The reach flood control plan is shown on Figures 4-12 through 4-14. The following features are illustrated for Boynton Slough:

- Levee along left bank from Longley Lane to southeast corner of the detention basin levee.

- Floodwall from southeast corner of detention basin levee to 1800 feet southeast of McCarran Boulevard.

- Levee from southeast corner of detention basin levee to approximately 7,500 feet south of Boynton Slough.

- McCarran Boulevard and Mira Loma Road raised.

The following features are illustrated for Steamboat Creek:

- Levee along right bank ties into hillside to the East, as shown.

- Pembrook Bridge raised and widened.

Assumptions/Construction Concerns: Assumptions and concerns for Reach 6 include:

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross section 11 on Figure 4-23. The approved project assumed a constant 4401 levee elevation on Boynton Slough to determine the levee height, this resulted in 8 feet of freeboard. As stated above, which cost estimate assumes 3 feet of freeboard above the modeled water surface elevation. This assumption results in a lower levee height than considered in the flood project.

- The levee inspection trench is assumed to be 9 feet wide and 6 feet deep for levees greater than 6 feet in total height. For levees less than 6 feet in height, the depth of the trench will equal the height of the levee. Assume clearing and grubbing 35 feet on both sides of the centerline along the length of the levee.

- Pembrook Bridge and Mira Loma Road assumed to be raised to pass Steamboat Creek water during floods.

- South McCarran Boulevard assumed to be raised to pass Boynton Slough water during floods.

Reaches 7 and 7A delineate between two project options. Reach 7 describes features required for a project to control Truckee River flooding without a

detention basin and reach 7A describes features required for a project with a detention basin.

### Reach 7: University Farms Area (excludes South and West detention basin levees and inlet and outlet weirs)

Assumed Project Features: The reach flood control plan is shown on Figures 4-9, 4-10, 4-12, and 4-13. The following features are illustrated:

- Levee on right bank of Truckee River from Station 183+50 to Station 122+00.
- East detention basin levee from the Truckee River to the Boynton Slough levee.

Assumptions/Construction Concerns: Assumptions and concerns for Reach 7 include:

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross section 8 on Figure 4-21 and cross section 11 on Figure 4-23. The height of the levee was determined using the HEC-RAS output hydraulic profiles and subtracting indicated improvement elevations from ground surface elevations obtained from the preliminary design topographic maps. The detention basin levees were assumed at elevation 4402 based on the estimated water surface elevation at the basin inlet weir plus 3 feet of freeboard.
- The levee inspection trench is assumed to be 9 feet wide and 6 feet deep for levees greater than 6 feet in total height. For levees less than 6' in height, the depth of the trench will equal the height of the levee. Assume clearing and grubbing 70 feet wide along the length of the levee.
- Reach 7 features include levees along Steamboat Creek and Boynton Slough designed to control backwater flooding from the Truckee River.
- The water surface elevation at the Steamboat Creek/Truckee River confluence for 26,000 cfs was estimated at 4394. With 3 feet of freeboard, the levee height would be 4397. To develop loss for levees in this reach the levees proposed under the approved project had to be extended up Boynton Slough from McCarran Boulevard. to Longley Avenue and upstream to near Huffacher Hills. Extending the levees was required to account for the Truckee River backwater.

Interior drainage will have to be accommodated at Boynton Slough, Whites Creek, Evans Creek, and the other tributary areas.

### Reach 7A: University Farms Area (includes South and West detention basin levees and inlet and outlet weirs)

Assumed Project Features: The reach flood control plan is shown on Figures 4-9, 4-10, 4-12, 4-13, and 4-15. The following features are illustrated:

- Levee on right bank of Truckee River from Station 183+50 to Station 122+00.
- Downstream detention basin levee from the Truckee River to the Boynton Slough levee.
- Excavation in the Truckee River channel and extending to the detention basin inlet weir area from roughly Station 186+00 to Station 168+00.
- Detention basin inlet and outlet weirs.
- Levee along McCarran Boulevard.

Assumptions/Construction Concerns: Assumptions and concerns for Reach 7A include:

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross section 8 on Figure 4-21 and cross section 11 on Figure 4-23.
- The levee inspection trench is assumed to be 9 feet wide and 6 feet deep for levees greater than 6 feet in total height. For levees less than 6 feet in height, the depth of the trench will equal the height of the levee. Assume clearing and grubbing 70 feet wide along the length of the levee.
- The detention basin inlet weir will be reinforced-concrete, as illustrated in cross section 7 on Figure 4-21. Weir crest elevation will be 4394.2 as per the Feasibility Report. There will be 200 feet of riprap upstream and downstream of the inlet weir at a thickness of 6 inches. (Also see the attached construction estimates for Reach 7A, and typical cross section in Feasibility Report).
- Excavation in front of the detention basin inlet weir (Stations 186+00 to 168+00) was assumed have an area as indicated on Sheet 7. The land was assumed to be excavated to an elevation of 4382.0 and that the excavation would daylight on a 2:1 slope, as illustrated in cross section 7 on Figure 4-21.

## Reach 8: North Truckee Drain and Peoples Ditch

Assumed Project Features: The reach flood control plan is shown on Figures 4-16 and 4-17. The following features are illustrated for the North Truckee Drain:

- Levee on right and left bank of the North Truckee Drain from Truckee River to Interstate 80. Left bank levee will tie into Interstate 80's embankment.

- Levee on right bank will continue along Interstate 80 to approximately North Truckee Drain Station 70+60.

- Levees east of Interstate 80 on both banks of the North Truckee Drain. These levees must extend far enough upstream to account for the Truckee River backwater and to accommodate interior drainage.

The following feature are illustrated for Peoples Ditch:

- North-south oriented levees on right and left bank of two portions of the Peoples Ditch north of Interstate 80 starting in the vicinity of North Truckee Drain Stations 28+00 to 30+00 and 71+00 to 73+00. These levees will tie into higher ground approximately 900 feet north of Interstate 80.

Assumptions/Construction Concerns: Assumptions and concerns for Reach 8 include:

- All levees in this reach will be compacted earth topped with a 12-foot wide, 4-inch thick layer of aggregate and constructed as illustrated in cross section 12 on Figure 4-23.

- The levee inspection trench is assumed to be 9 feet wide and 6 feet deep for levees greater than 6 feet in total height. For levees less than 6 feet in height, the depth of the trench will equal the height of the levee. Assume clearing and grubbing 70 feet wide along the length of the levee.

- The levees on both Peoples Ditch and the North Truckee Drain north of Interstate 80 are assumed to be at an elevation of 4397.

- North Truckee Drain and Peoples Ditch levees protect the Sparks industrial area from significant flooding caused by Truckee River backwater runoff tributary to the North Truckee River Drain to Sparks and Spanish Springs Valley.

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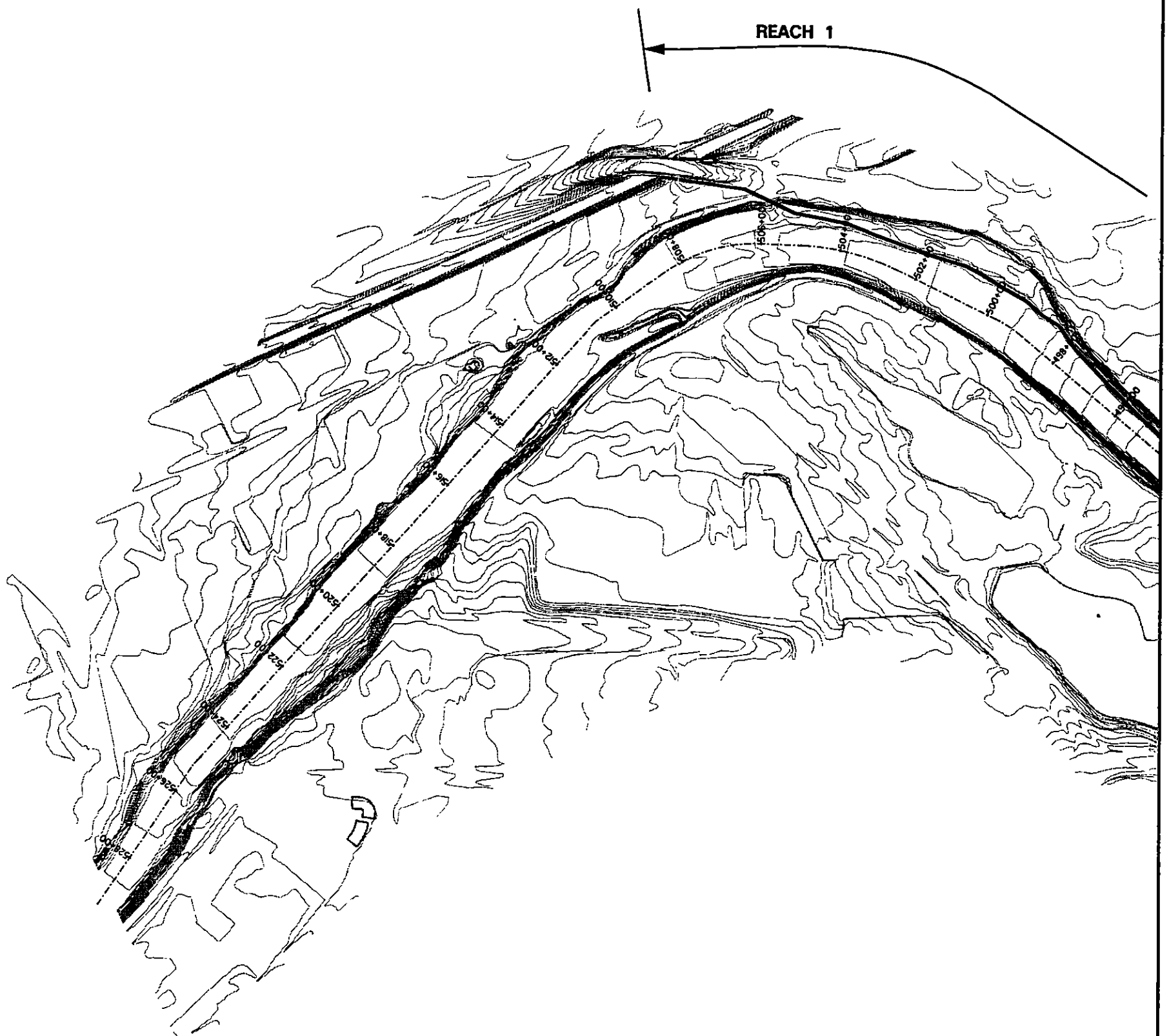
## LEGEND

- FLOODWALL
- LEVEE
- CHANNEL EXCAVATION
- BREAKOUT SECTION

N

SCALE:
1"=300'

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| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-2 |
| 26,000 CFS FLOOD CONTROL PLAN | |

## LEGEND

- FLOODWALL
- LEVEE
- CHANNEL EXCAVATION
- BREAKOUT SECTION

N

SCALE: 1"=300'

REACH 1

REACH 2

BOOTH STREET BRIDGE

CHANNEL EXCAVATION

KEYSTONE AVENUE BRIDGE

ARLINGTON AVENUE BRIDGES

CHANNEL EXCAVATION

WEST 1ST STREET

RALSTON STREET

NEVADA STREET

NORTH ARLINGTON AVENUE

SIERRA STREET

| | | |
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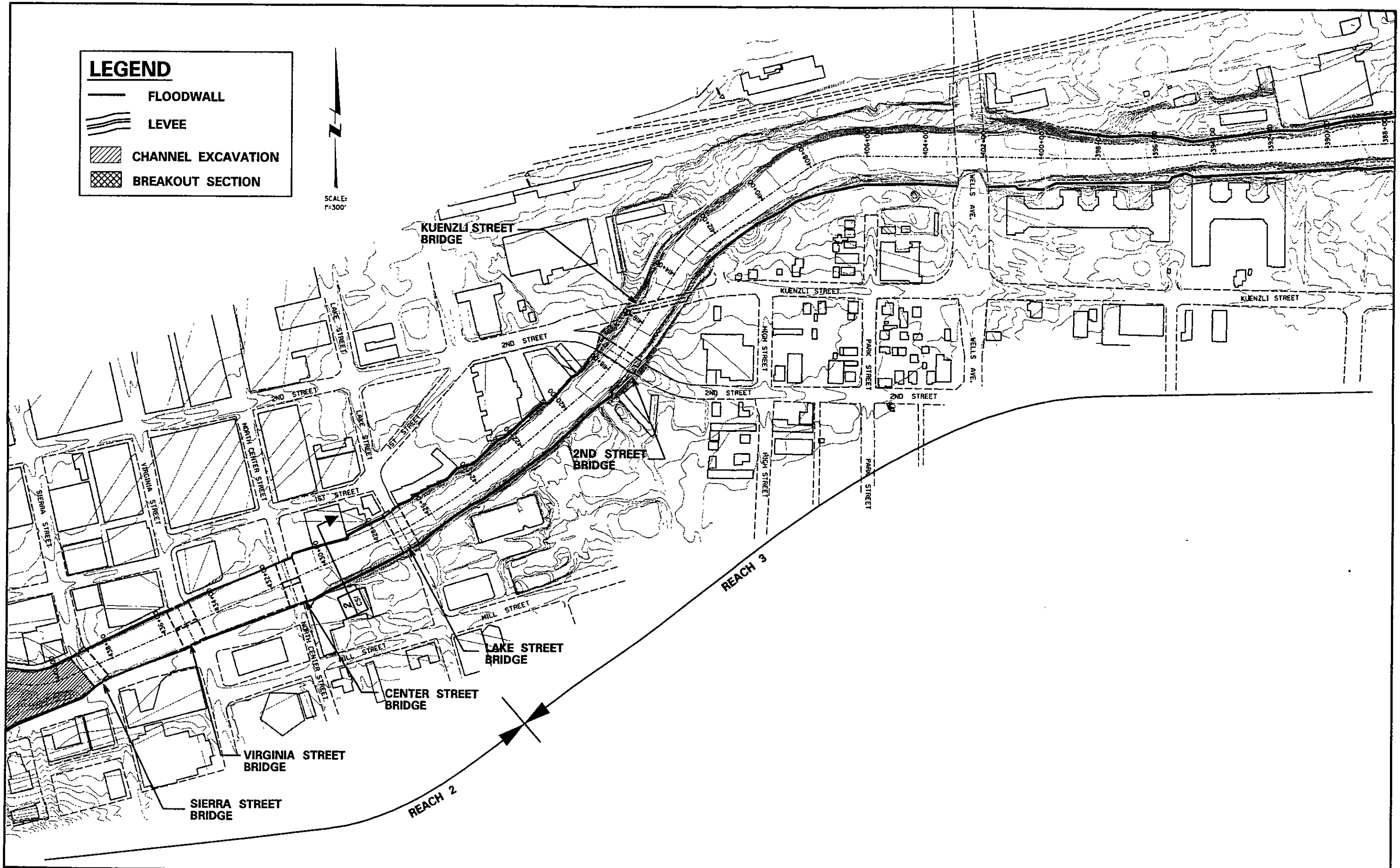
| | U.S. ARMY CORPS OF ENGINEERS<br>TRUCKEE MEADOWS, NEVADA<br>26,000 CFS FLOOD CONTROL PLAN | FIGURE<br>4-3 |

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| | U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| | TRUCKEE MEADOWS, NEVADA | |
| | 26,000 CFS FLOOD CONTROL PLAN | 4-4 |

## LEGEND

- FLOODWALL
- LEVEE
- CHANNEL EXCAVATION
- BREAKOUT SECTION

N

SCALE: 1"=300'

REACH 3

REACH 4

HIGHWAY 395

KIETZKE LN

KIETZKE LANE BRIDGE

KIETZKE LN

SUNSHINE LN

Highway 395

KUENZLI STREET

KUENZLI STREET

KUENZLI STREET

GIROUX STREET

MANUEL STREET

KIETZKE LN

| | |
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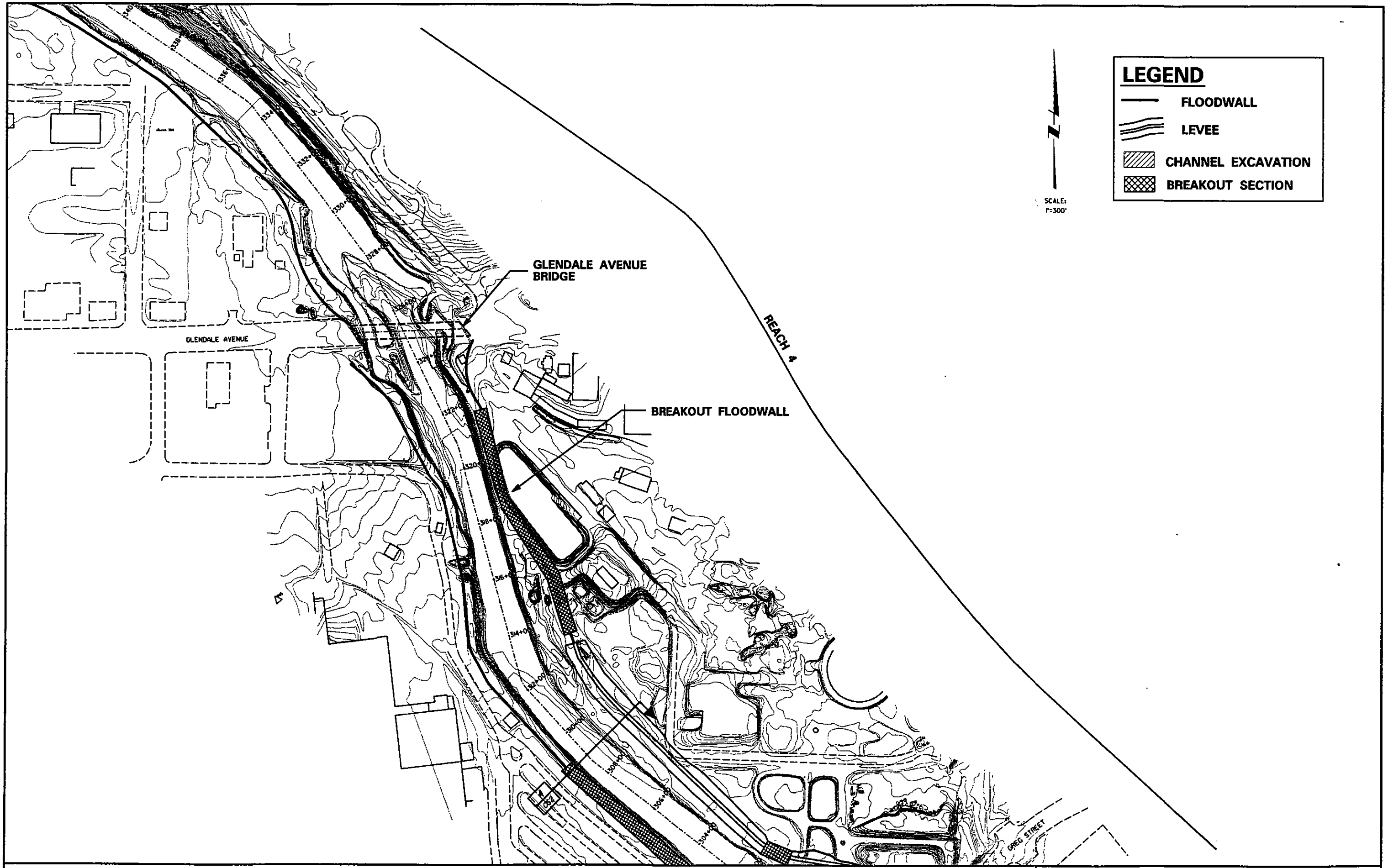
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-5 |
| 26,000 CFS FLOOD CONTROL PLAN | |

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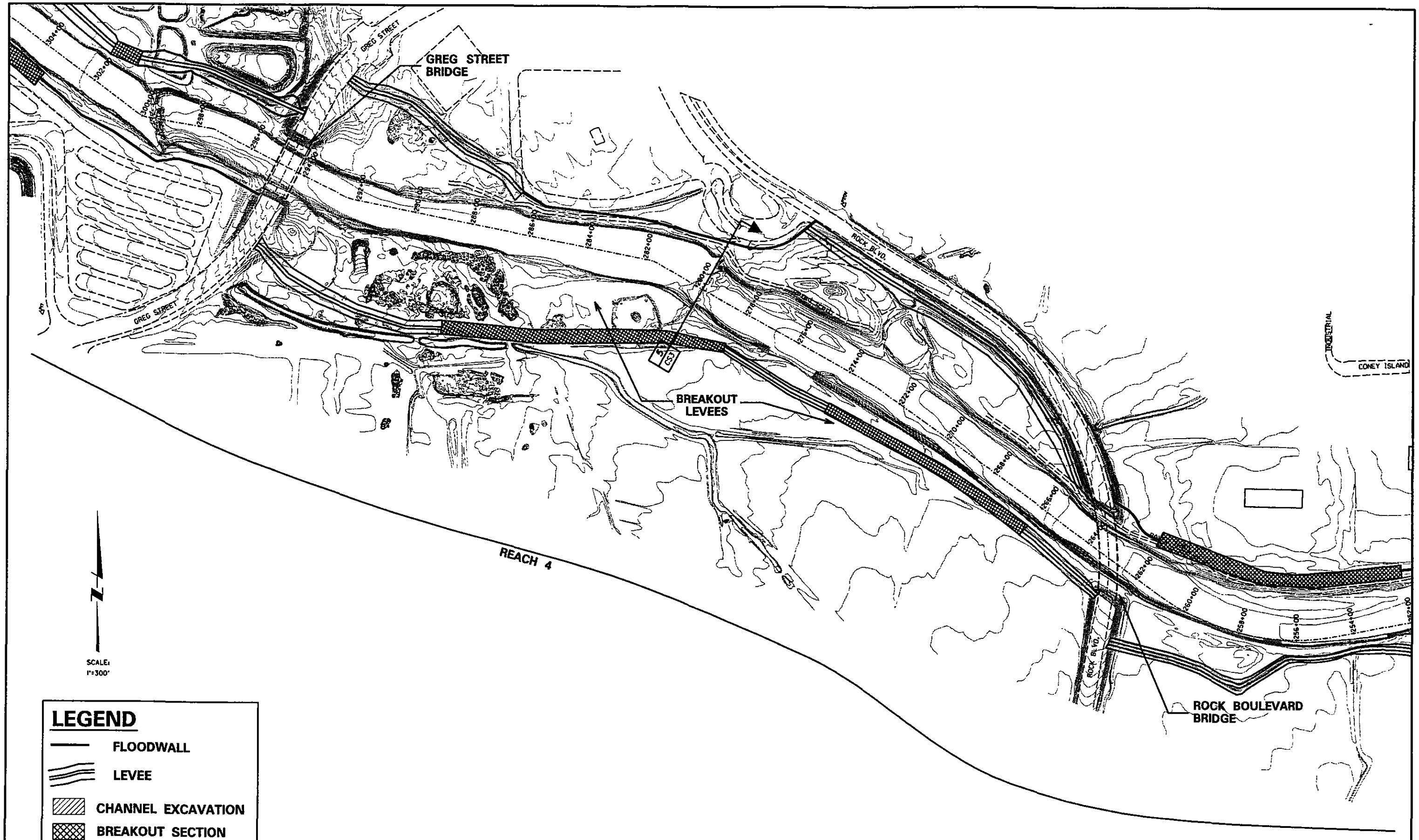
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-6 |
| 26,000 CFS FLOOD CONTROL PLAN | |

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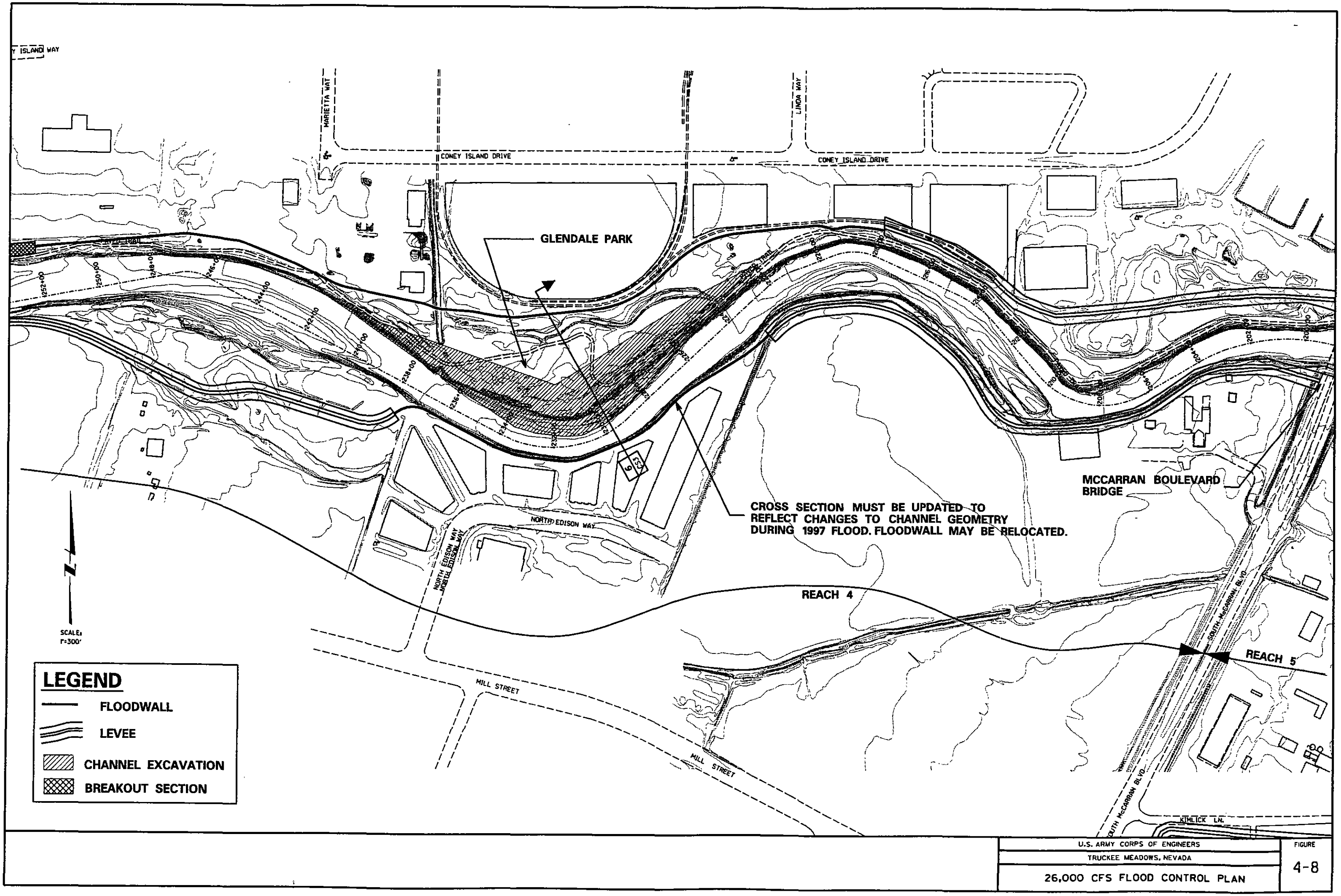
| U.S. ARMY CORPS OF ENGINEERS<br>TRUCKEE MEADOWS, NEVADA<br>26,000 CFS FLOOD CONTROL PLAN | | FIGURE<br>4-7 |

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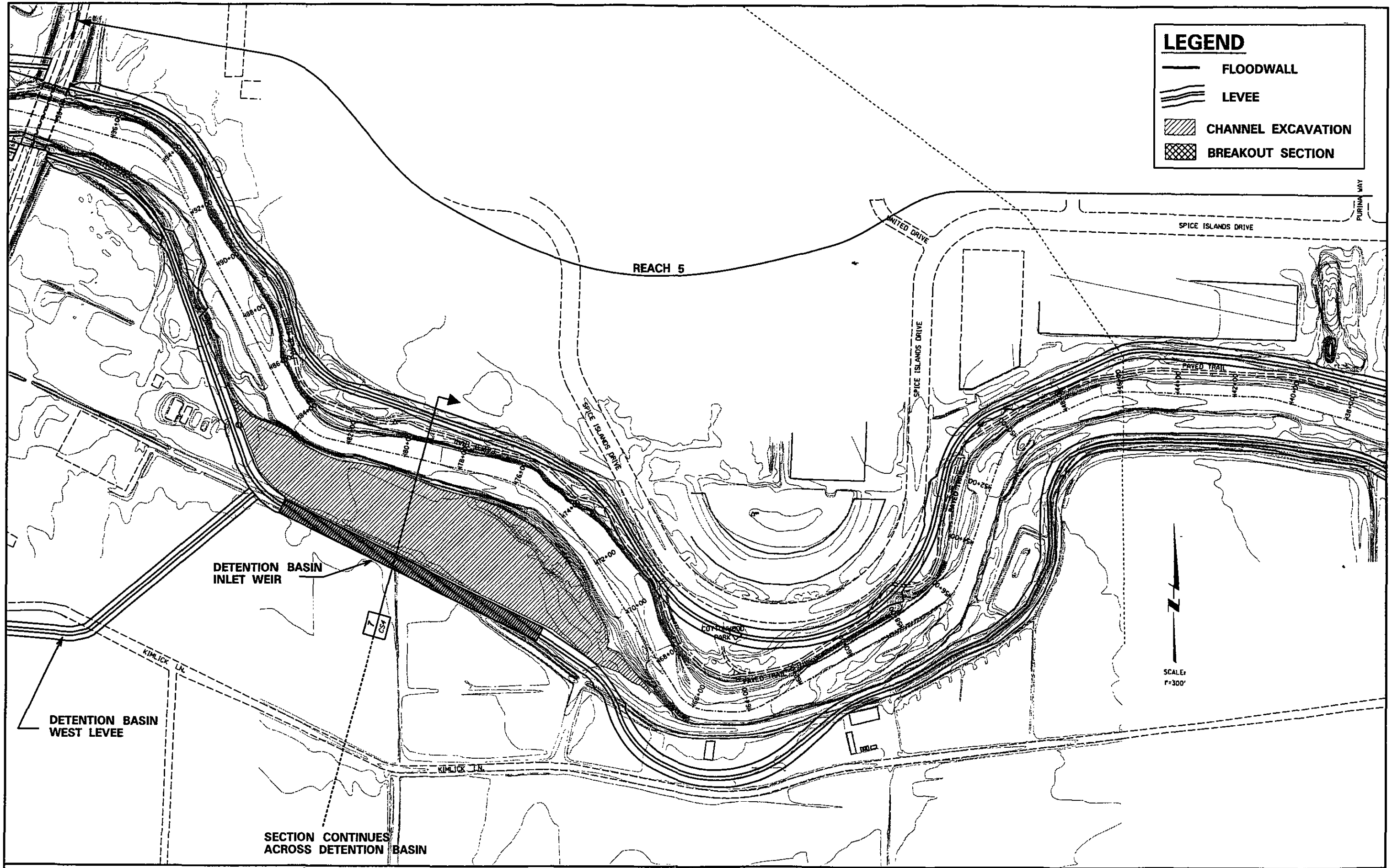
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-8 |
| 26,000 CFS FLOOD CONTROL PLAN | |

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| | U.S. ARMY CORPS OF ENGINEERS<br>TRUCKEE MEADOWS, NEVADA<br>26,000 CFS FLOOD CONTROL PLAN | FIGURE<br>4-9 |

## LEGEND

- FLOODWALL
- LEVEE
- CHANNEL EXCAVATION
- BREAKOUT SECTION

N

SCALE: 1"=300'

REACH 5

PAVED TRAIL

DEMING WAY

SPICE ISLANDS DRIVE

CONDOMINIUM COMMON AREA

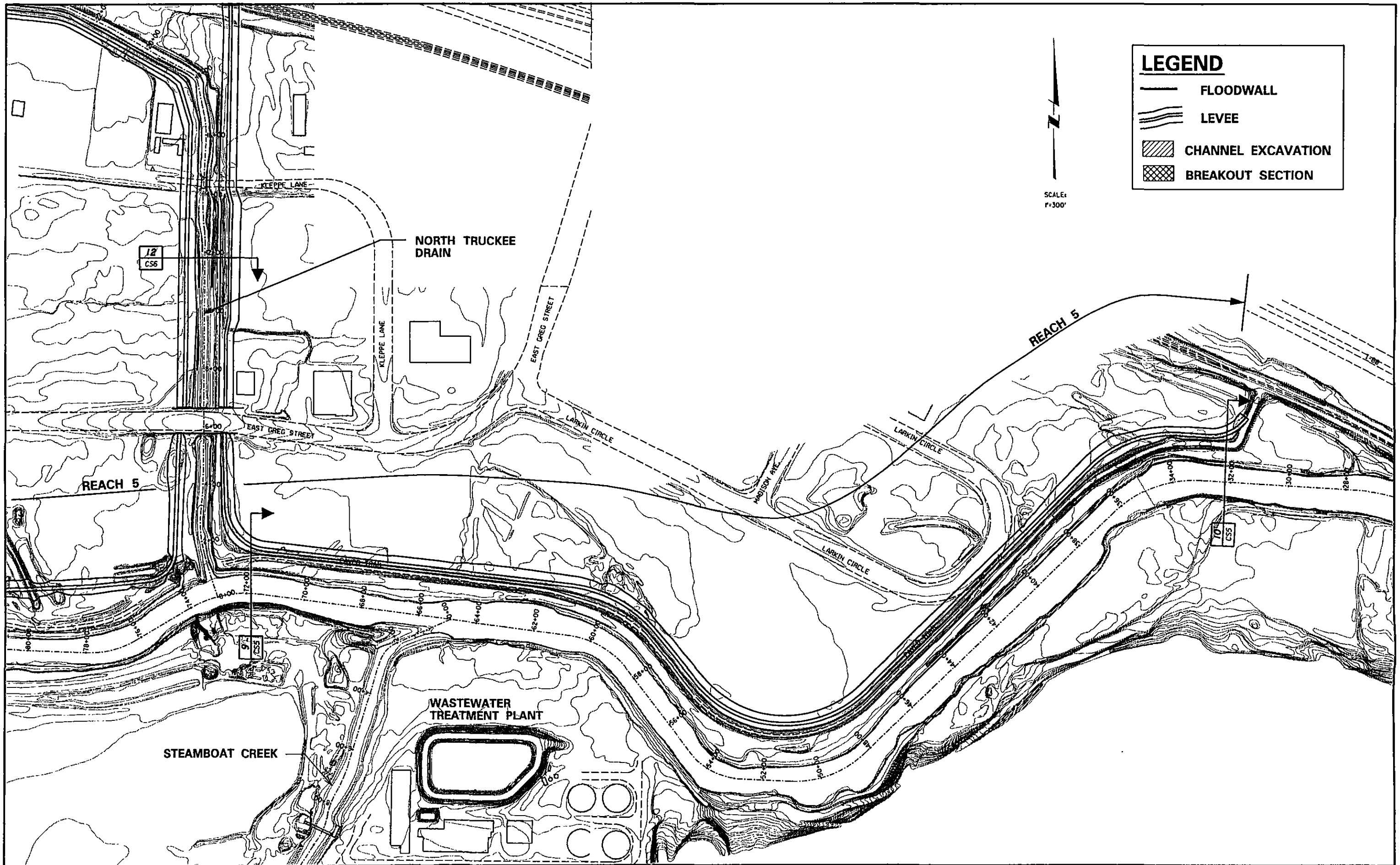
MINGO TRAIL

DETENTION BASIN EAST LEVEE

STEAMBOAT CREEK

DETENTION BASIN

| | |
|---|---|
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-10 |
| 26,000 CFS FLOOD CONTROL PLAN | |

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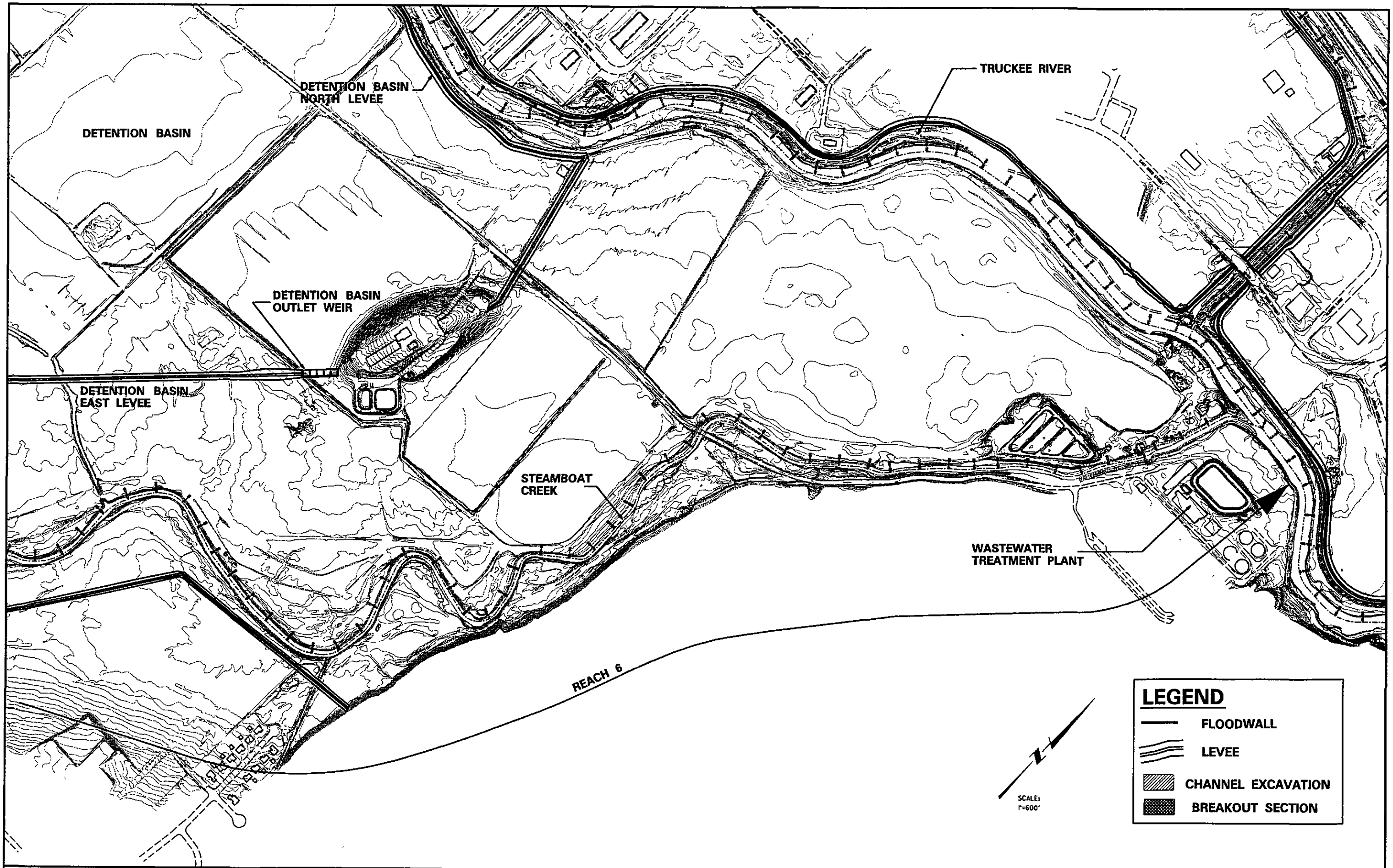
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-11 |
| 26,000 CFS FLOOD CONTROL PLAN | |

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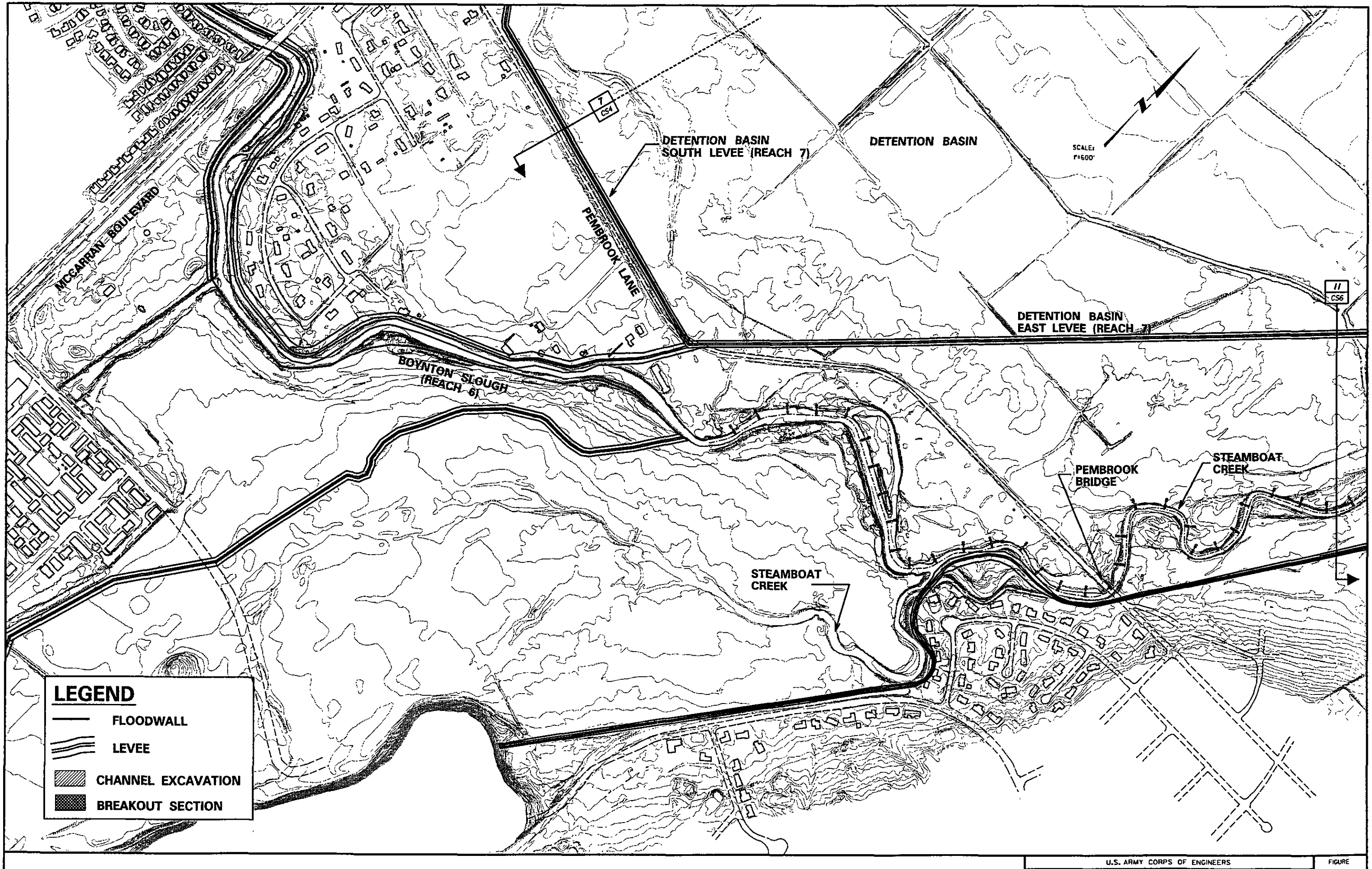
| | U.S. ARMY CORPS OF ENGINEERS<br>TRUCKEE MEADOWS, NEVADA<br>26,000 CFS FLOOD CONTROL PLAN | FIGURE<br>4-12 |

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| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-13 |
| 26,000 CFS FLOOD CONTROL PLAN | |

## LEGEND

- FLOODWALL
- LEVEE
- CHANNEL EXCAVATION
- BREAKOUT SECTION

SCALE: 1"=600'

MCCARRAN BOULEVARD

LONGLEY LANE

DETENTION BASIN SOUTH LEVEE (REACH 7)

7 CFS

REACH 6

BOYNTON SLOUGH (REACH 6)

GOLF COURSE

MIRA LOMA

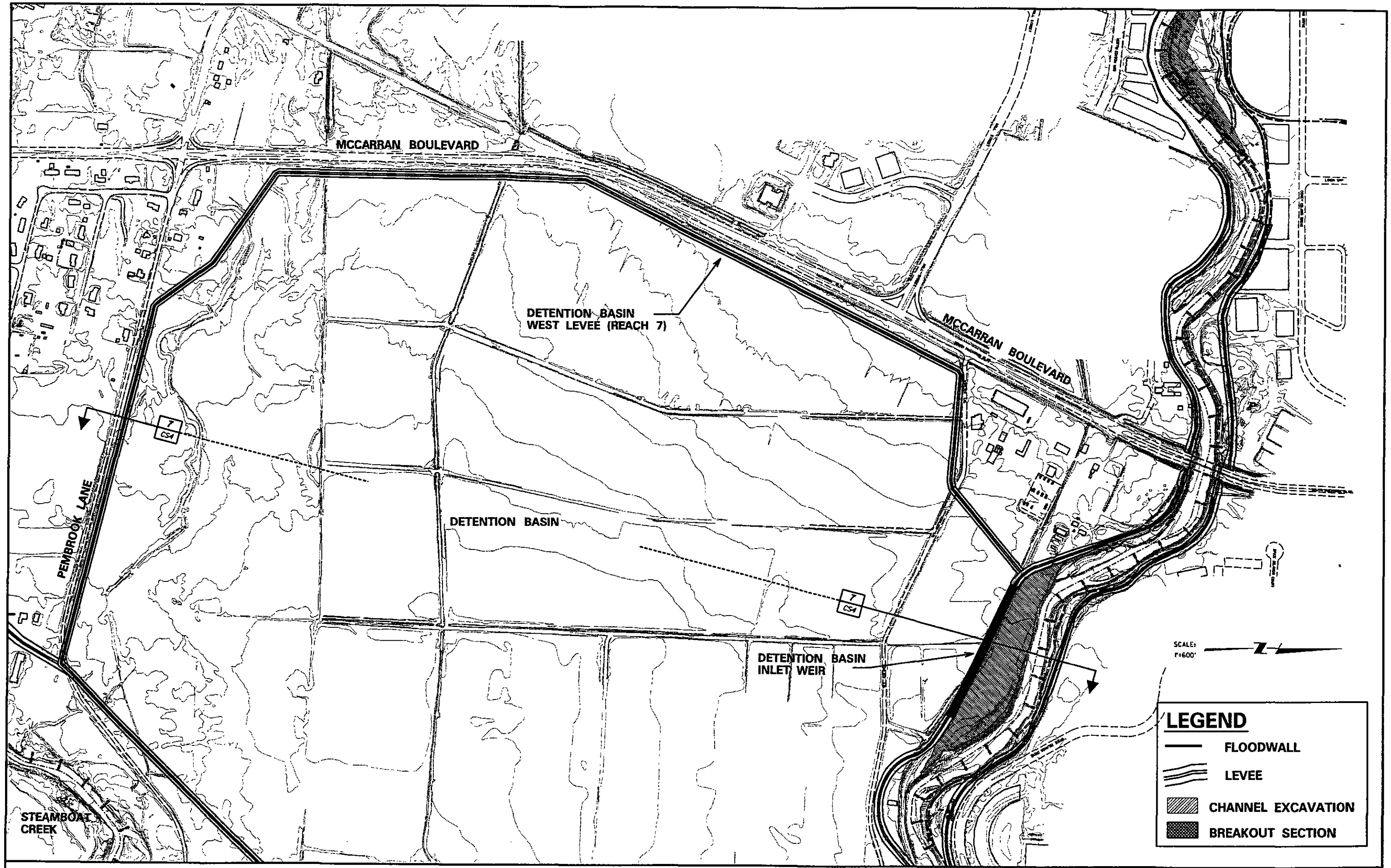
PEMBROOK LANE

DETENTION BASIN

U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA

26,000 CFS FLOOD CONTROL PLAN

FIGURE 4-14

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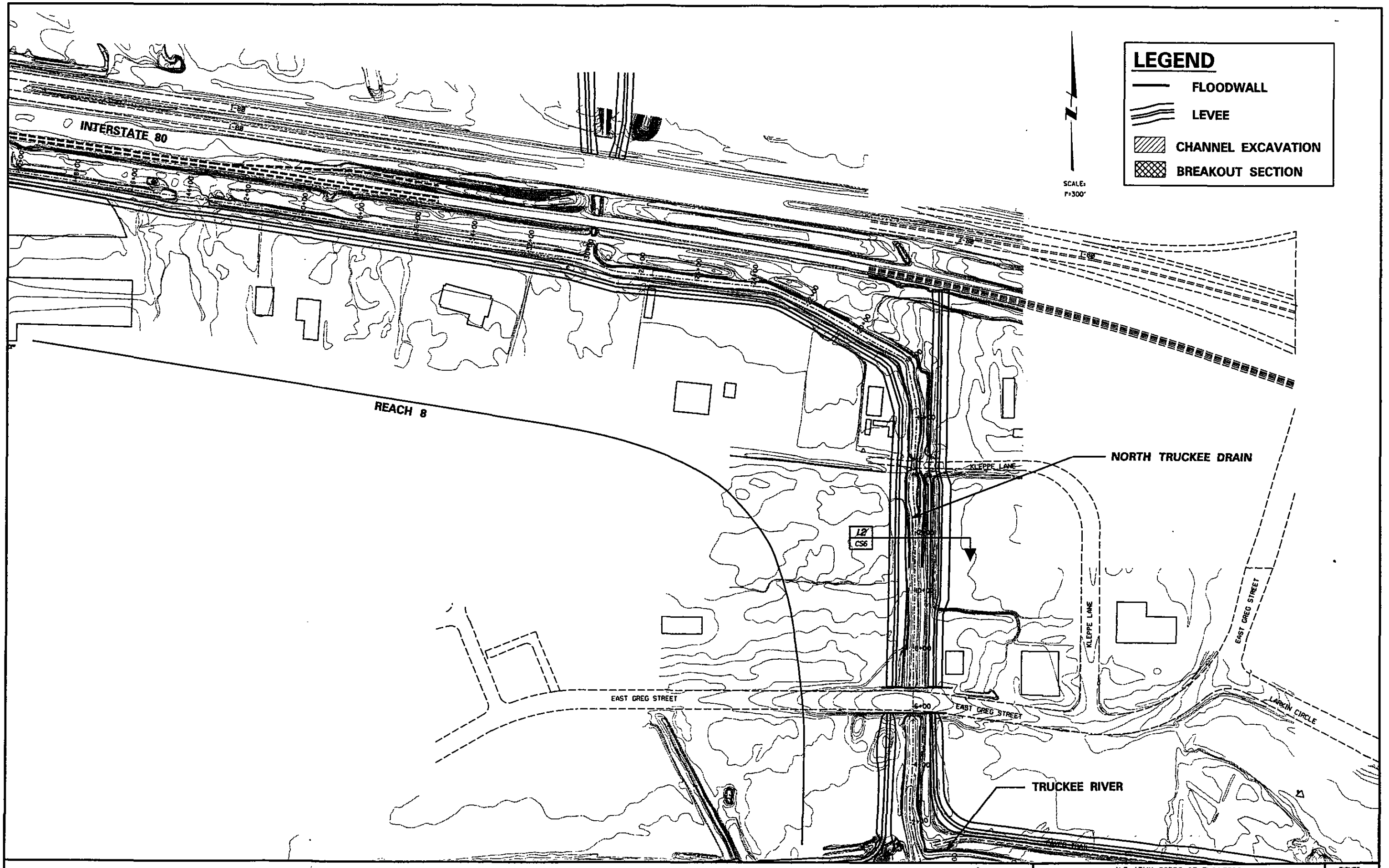
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-15 |
| 26,000 CFS FLOOD CONTROL PLAN | |

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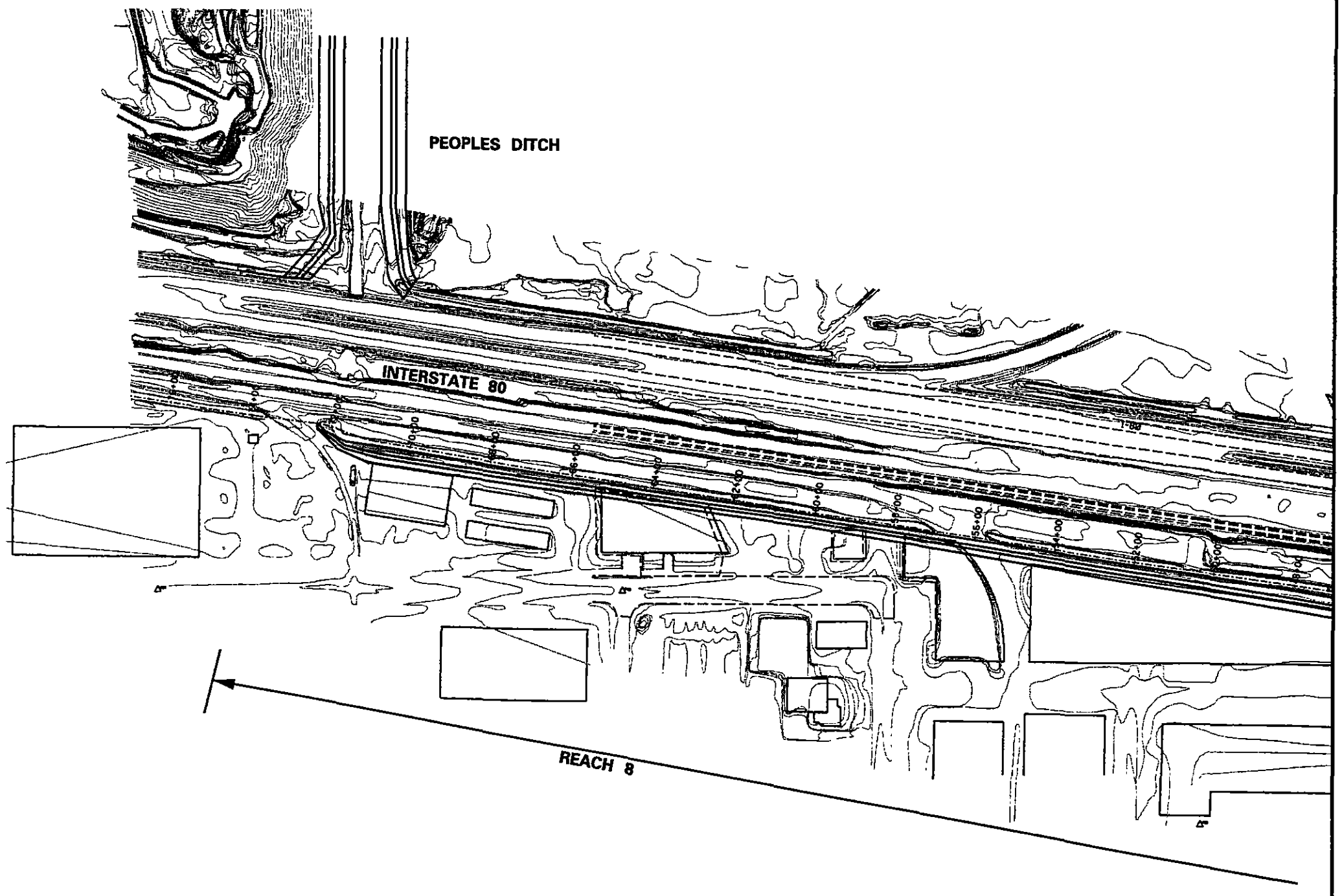
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-16 |
| 26,000 CFS FLOOD CONTROL PLAN | |

## LEGEND

- FLOODWALL
- LEVEE
- CHANNEL EXCAVATION
- BREAKOUT SECTION

N

SCALE:
1"=300'

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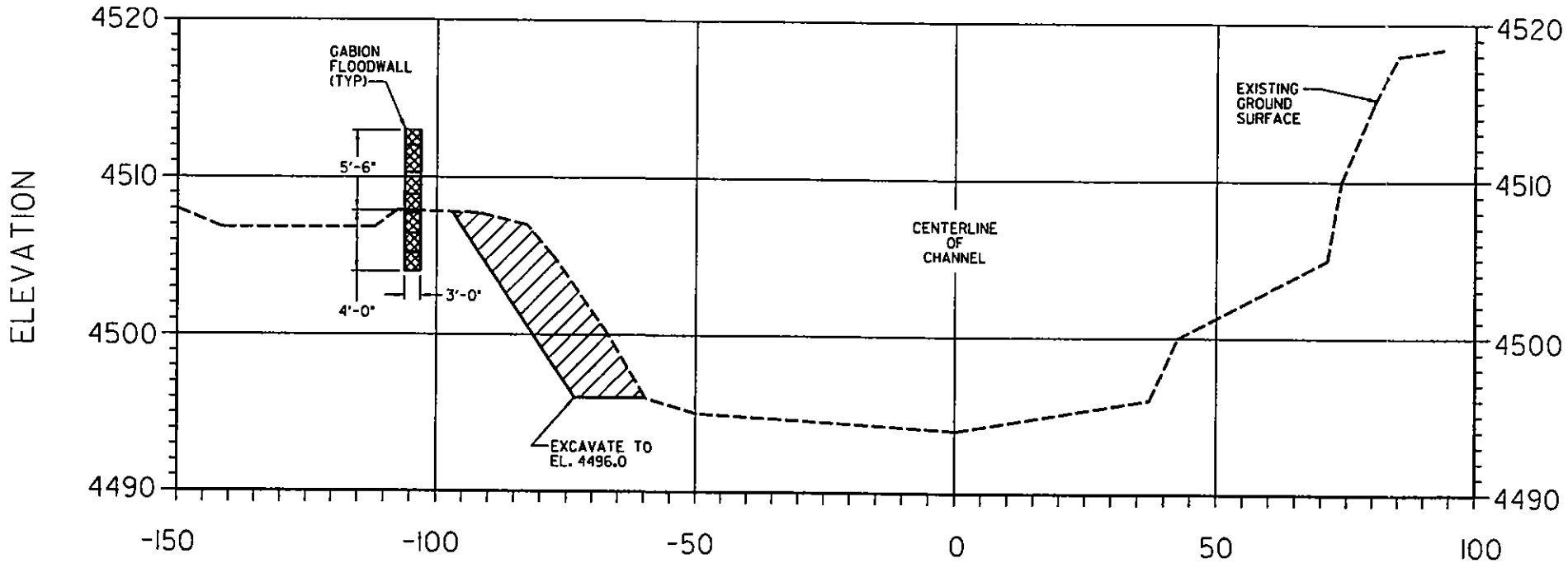
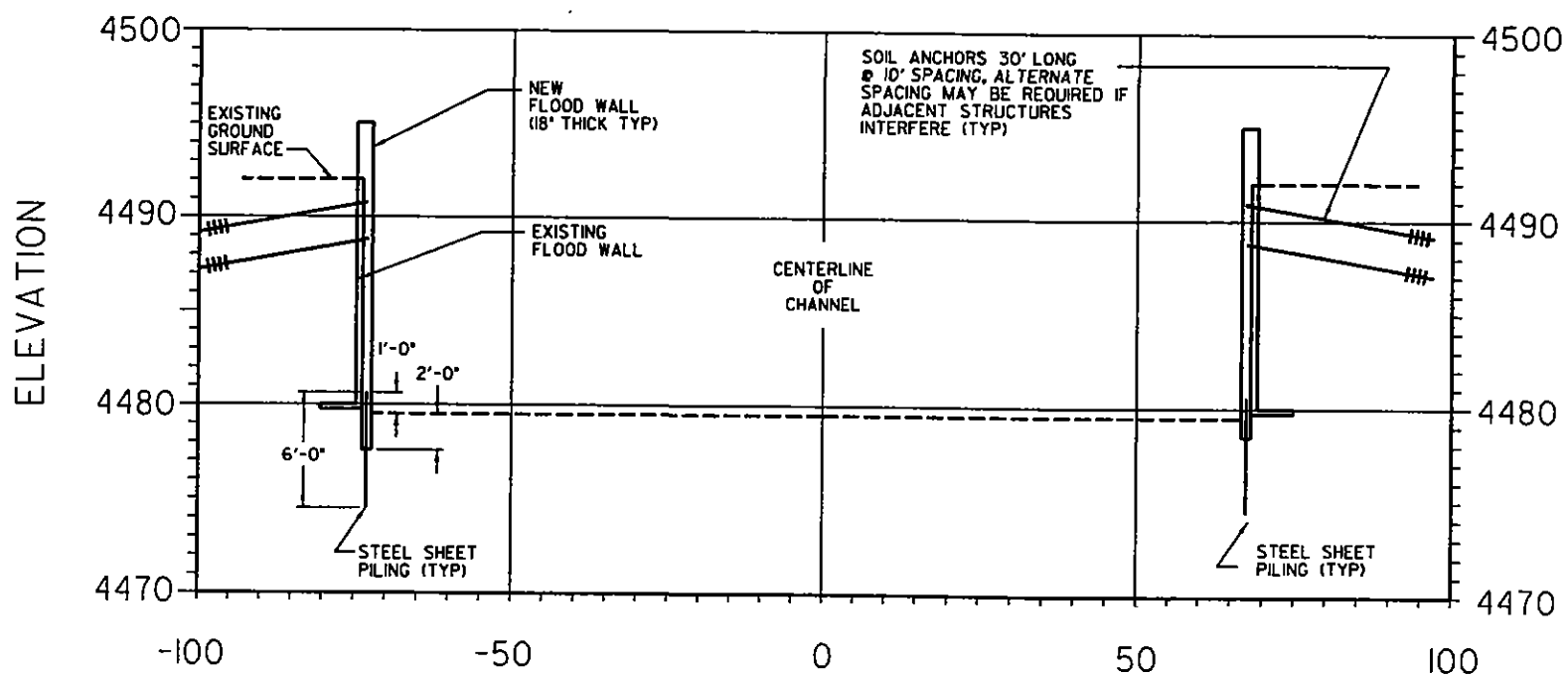
| U.S. ARMY CORPS OF ENGINEERS | | FIGURE |
| TRUCKEE MEADOWS, NEVADA | | 4-17 |
| 26,000 CFS FLOOD CONTROL PLAN | | |




TRUCKEE RIVER - CROSS SECTION 1
STATION 480+00




TRUCKEE RIVER - CROSS SECTION 2
STATION 434+00

SCALE:
VERT: 1"=10'
HORIZ: 1"=30'

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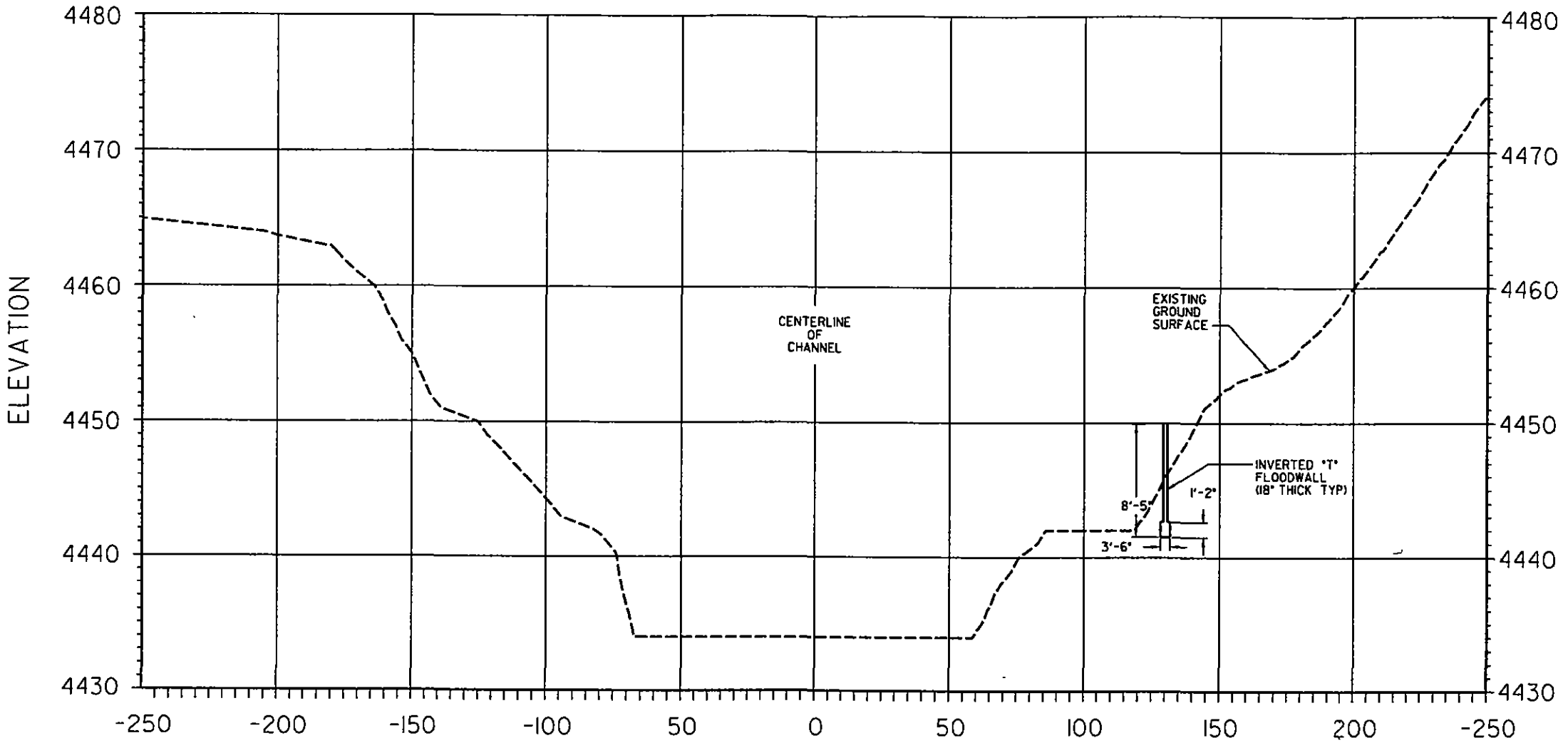
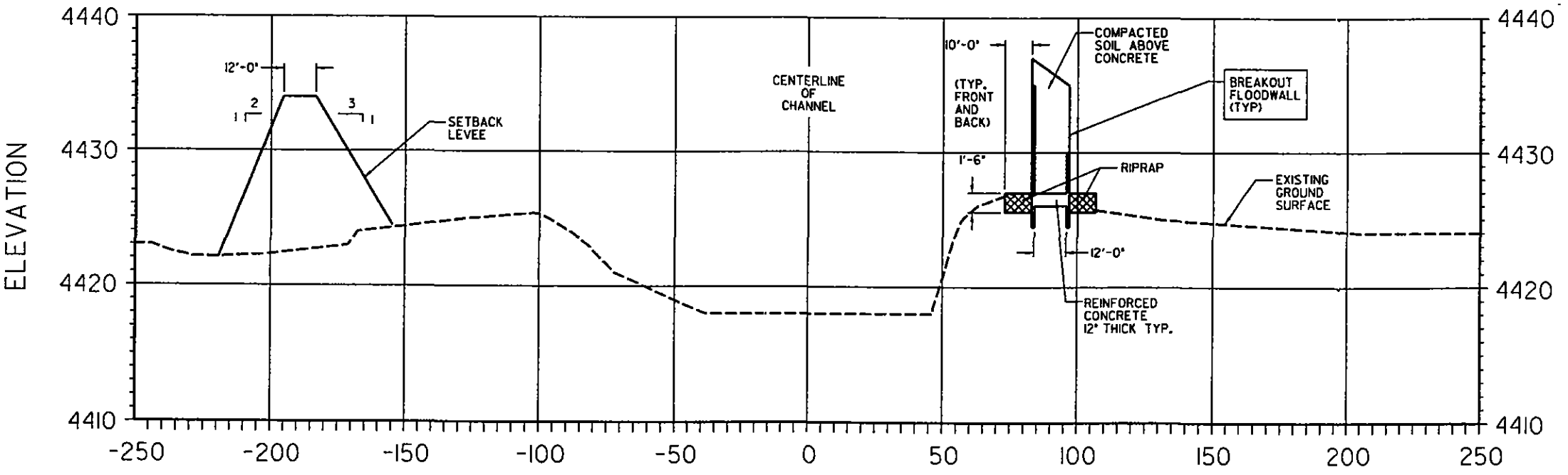
|---|---|
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-18 |
| SELECTED CROSS SECTIONS | |



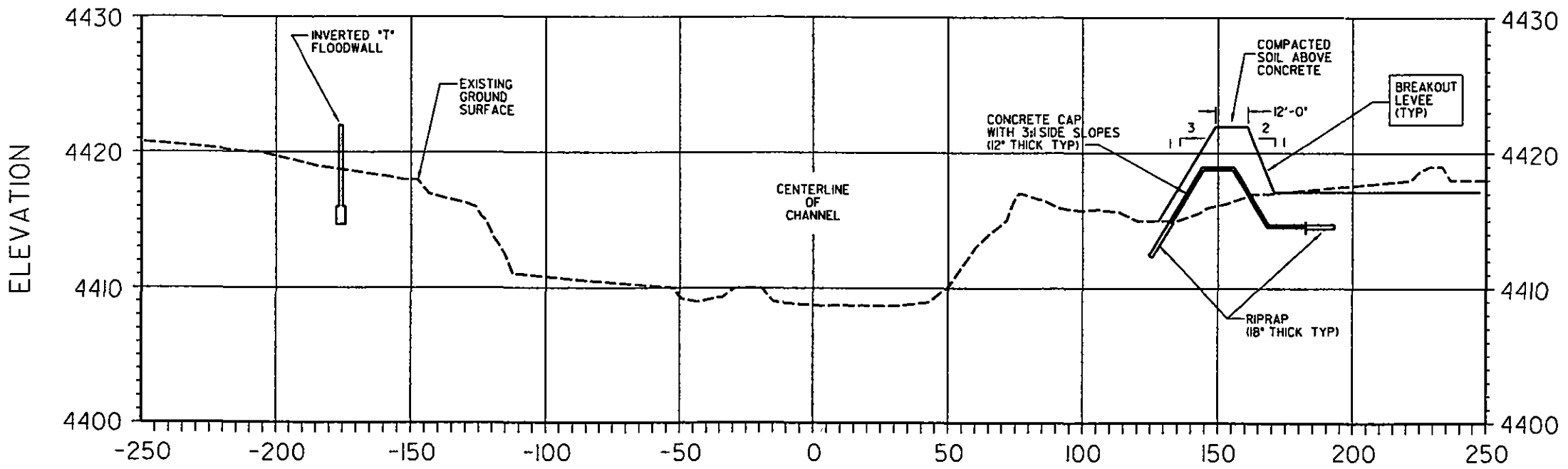

TRUCKEE RIVER
CROSS SECTION 3
STATION 350+00



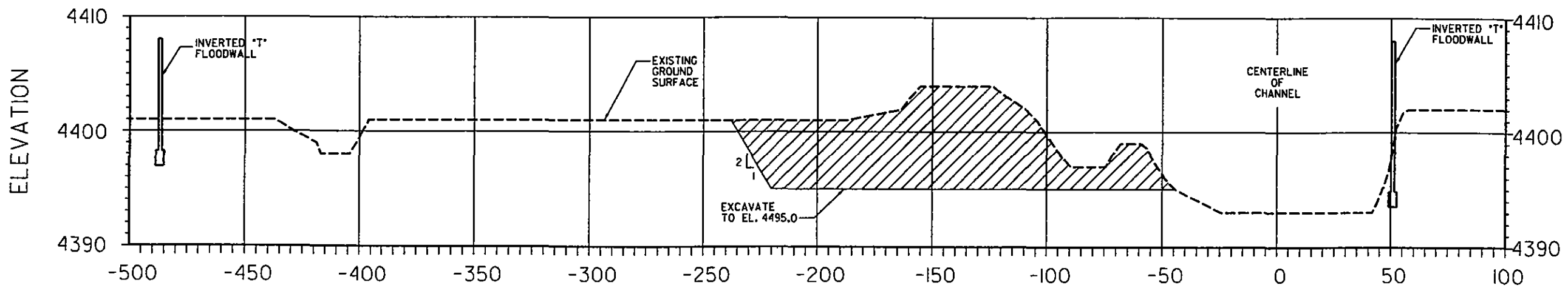

SCALE:
VERT: 1"=10'
HORIZ: 1"=50'

TRUCKEE RIVER
CROSS SECTION 4
STATION 310+00

| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
|---|---|
| TRUCKEE MEADOWS, NEVADA | 4-19 |
| SELECTED CROSS SECTIONS | |



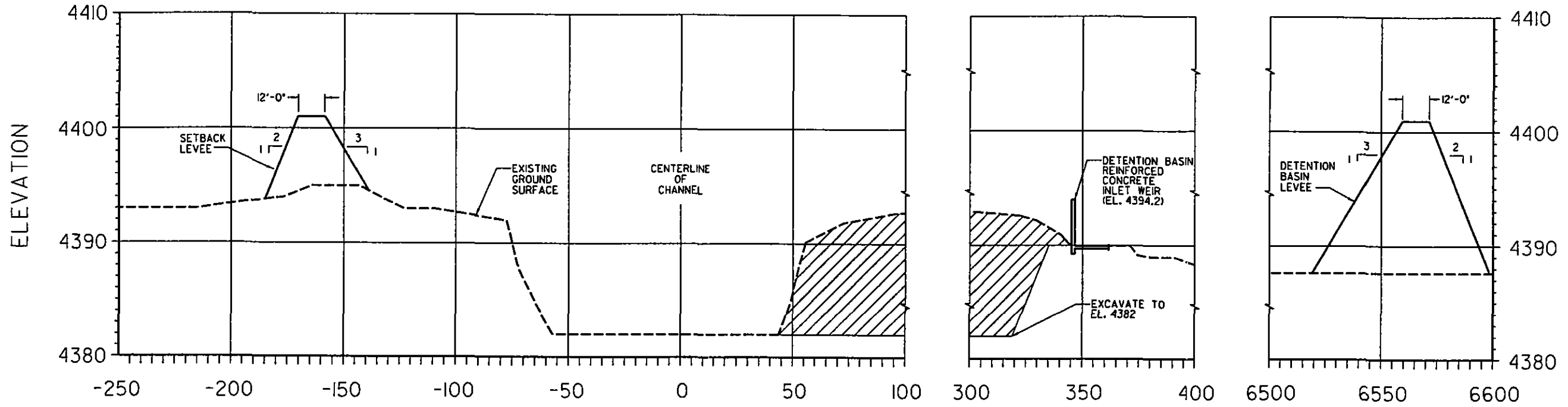

TRUCKEE RIVER - CROSS SECTION 5
STATION 280+00



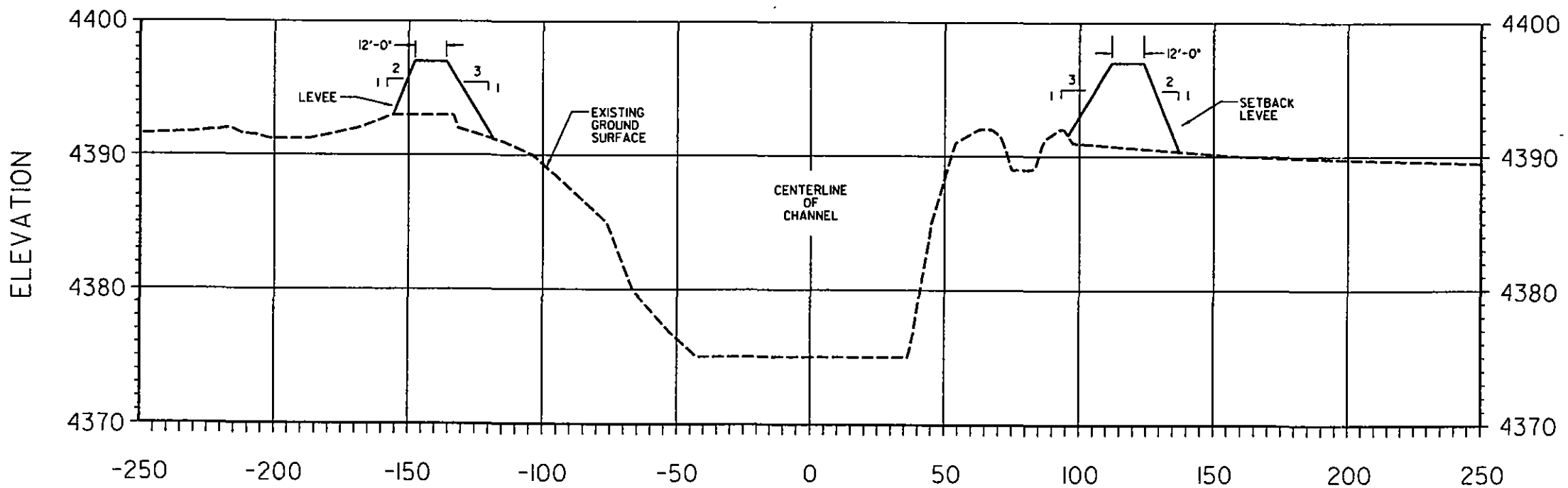

TRUCKEE RIVER - CROSS SECTION 6
STATION 230+00

SCALE:
VERT: 1"=10'
HORIZ: 1"=50'

| | |
|---|---|
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-20 |
| SELECTED CROSS SECTIONS | |




TRUCKEE RIVER AND
DETENTIOIN BASIN - CROSS SECTION 7
STATION 180+00




TRUCKEE RIVER - CROSS SECTION 8
STATION 130+00

SCALE:
VERT: 1"=10'
HORIZ: 1"=50'

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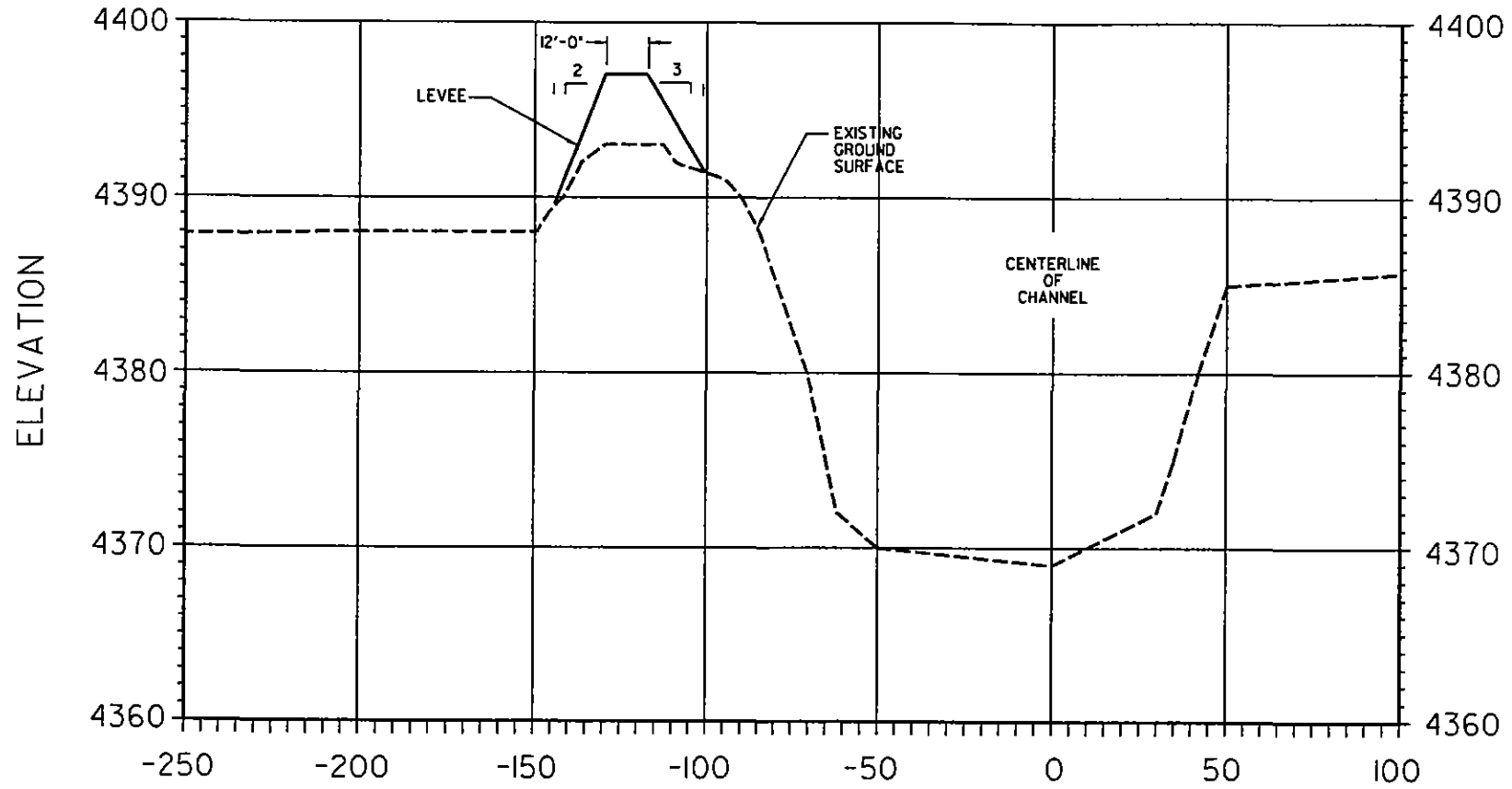
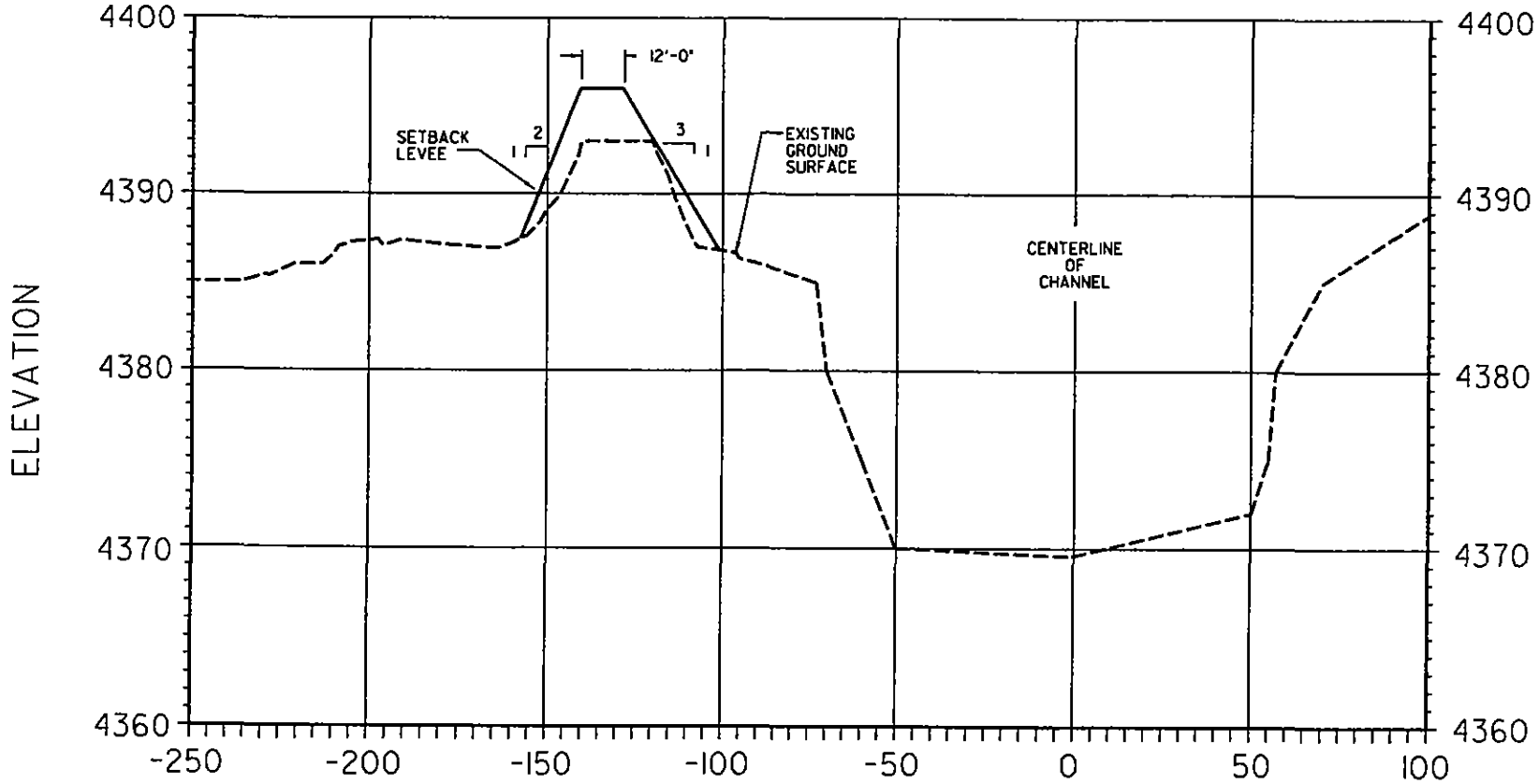
| U.S. ARMY CORPS OF ENGINEERS<br>TRUCKEE MEADOWS, NEVADA<br>SELECTED CROSS SECTIONS | FIGURE<br>4-21 |



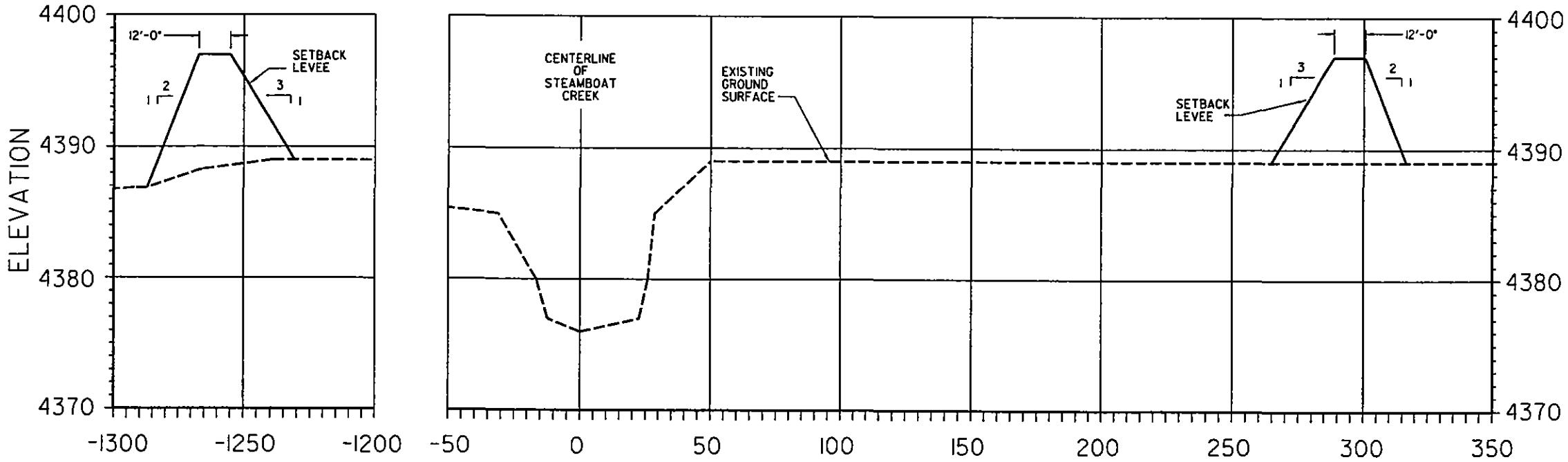

TRUCKEE RIVER
CROSS SECTION 9
STATION 72+00




TRUCKEE RIVER
CROSS SECTION 10
STATION 32+00

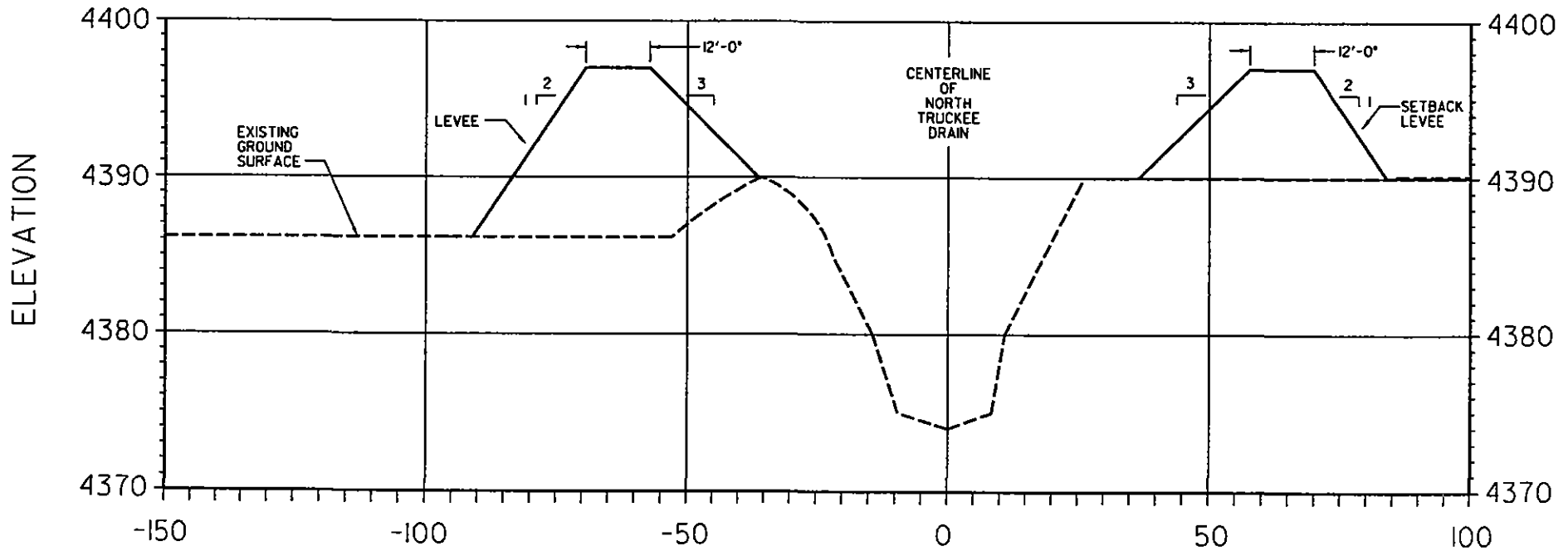
SCALE:
VERT: 1"=10'
HORIZ: 1"=50'

| | |
|---|---|
| U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| TRUCKEE MEADOWS, NEVADA | 4-22 |
| SELECTED CROSS SECTIONS | |




STEAMBOAT CREEK
CROSS SECTION II
STATION 108+00

HORIZONTAL SCALE: 1" = 50'




NORTH TRUCKEE DRAIN
CROSS SECTION 12
STATION 12+00

HORIZONTAL SCALE: 1" = 30'

VERT: 1"=10'
HORIZ: AS NOTED

| | | |
|---|---|---|
| | U.S. ARMY CORPS OF ENGINEERS | FIGURE |
| | TRUCKEE MEADOWS, NEVADA | 4-23 |
| | SELECTED CROSS SECTIONS | |

## COSTS

The volume of concrete, embankment, excavation, and other facilities was calculated for 26,000 cfs facilities. The unit costs developed for the Authorized Project were applied to these volumes and costs were developed (Table 4-1).

After applying unit cost to the quantities, a contingency factor was applied to cover miscellaneous unknowns. The costs are summarized in Table 4-1 and detailed in Tables 4-2 (with detention basin) and 4-3 (without detention basin).

**Table 4-1**
**Annualized Cost Estimate for the Approved Project**
**(in 1996 dollars)**

| Costs | With Detention Basin | Without Detention Basin |
|---|---|---|
| **First Cost** | $98,384,552 | $90,456,243 |
| **Annualized Capital** | 7,261,759 | 6,676,571 |
| **Annualized O&M** | 2,482,899 | 2,065,906 |
| **Annualized Interest** | 100,000 | 90,000 |
| **Annualized Replacement** | 129,430 | 116,487 |
| **TOTAL ANNUAL COSTS:** | **$9,974,088** | **$8,948,964** |

**Table 4-2**
**Truckee Meadows Reconnaissance Report**
**Annualized Cost Estimate (1996 dollars)**
**(With Detention Basin)**

**ASSUMPTIONS:**

| | |
|---|---|
| Base (First Cost) | $98,384,552 |
| Months of Construction | 44 |
| Interest Rate -- Annual | 7.375% |
| -- Monthly | 0.615% |
| Amortization Period --Years | 100 |
| Major Replacement Costs | $400,000 |
| Use Escalated Costs for Replacement? | Y |
| Replacement Period -- Years | 50 |
| With Inflation | $1,753,562 |
| Annual Inflation Rate | 3.00% |

**RESULTS:**

| | | |
|---|---|---|
| Annualized Capital Costs | $7,261,759 | Annualized Cost Based on Assumptions Above, Using Payment Function |
| Annualized Interest Costs | $2,482,899 | Annualized Cost Based on Assumptions Above and Calculated Interest, Using Payment Function |
| Annual O&M Costs | $100,000 | Annual O&M Costs |
| Annualized Replacement Costs | $129,430 | Replacement Costs, Annualized Over 100 Year Period |
| **TOTAL ANNUAL COSTS:** | **$9,974,084** | |

Major Replacement Costs were estimated as $20,000 per mile of floodwall or levee
Annual O&M Costs were estimated as $5,000 per year per mile of floodwall or levee

**Table 4-3**
**Truckee Meadows Reconnaissance Report**
**Annualized Cost Estimate (1996 dollars)**
**(Without Detention Basin)**

**ASSUMPTIONS:**

| | |
|---|---|
| Base (First Cost) | $90,456,243 |
| Months of Construction | 44 |
| Interest Rate -- Annual | 7.375% |
| -- Monthly | 0.615% |
| Amortization Period --Years | 100 |
| Major Replacement Costs | $360,000 |
| Use Escalated Costs for Replacement? | Y |
| Replacement Period -- Years | 50 |
| With Inflation | $1,578,206 |
| Annual Inflation Rate | 3.00% |

**RESULTS:**

| | | |
|---|---|---|
| Annualized Capital Costs | $6,676,571 | Annualized Cost Based on Assumptions Above, Using Payment Function |
| Annualized Interest Costs | $2,065,906 | Annualized Cost Based on Assumptions Above and Calculated Interest, Using Payment Function |
| Annual O&M Costs | $90,000 | Annual O&M Costs |
| Annualized Replacement Costs | $116,487 | Replacement Costs, Annualized Over 100 Year Period |
| **TOTAL ANNUAL COSTS:** | **$8,948,964** | |

Major Replacement Costs were estimated as $20,000 per mile of floodwall or levee
Annual O&M Costs were assumed to be $5,000 per year per mile of floodwall or levee

## STANDARD PROJECT FLOOD

The Feasibility Report presented an alternative (Alternative 13) to convey the standard project flood through Reno. At the time, the standard project flood was estimated to be 39,800 cfs. The alternative was presented at a conceptual level of detail without detailed engineering design and analysis.

Alternative 13 consisted of four subalternatives involving levees, an overflow basin, or a bypass tunnel. The bypass tunnel would convey about 25,000 cfs past Reno and discharge the water back to the River near Wells Avenue. The preliminary costs developed for the Feasibility Report were excessive relative to the other alternatives considered and, therefore, the alternative was dropped from further consideration.

For this Reconnaissance Report, updated costs were prepared for Alternative 13 to provide additional economic data for the evaluation of a federal interest in a regional flood control project. This analysis is only for the overall economic assessment and is not being presented as a viable alternative. The cost update was developed by converting the Feasibility Report costs from 1983 dollars to 1996 dollars (Table 4-4) The concept presented in the Feasibility Report was not modified for this analysis.

Several constraints may influence the feasibility of this alternative, including:

- development through Reno relative to locating right-of-way for a bypass tunnel,
- discharge of the bypass flow near Wells Avenue, and
- difficulty in conveying the standard project flood through Sparks.

**Table 4-4**
**Estimated Costs for Standard Project Flood Facilities**
**(1996 dollars)**

| | Jul-79 ENR = 3003 | Oct-96 ENR = 5708 |
|---|---|---|
| **Levee Plan with Tunnel in Reno** | | |
| First Cost | $112,476,000 | $213,790,545 |
| Annualized Capital | $8,293,500 | $15,764,002 |
| Annualized O&M and Replacement | $317,100 | $602,733 |
| Total Annual Costs | $8,610,600 | $16,366,735 |
| **Channel Plan with Tunnel in Reno** | | |
| First Cost | $119,576,000 | $227,285,983 |
| Annualized Capital | 8,231,500 | 15,646,155 |
| Annualized O&M and Replacement | 315,900 | 600,452 |
| Total Annual Costs | $8,547,400 | $16,246,607 |
| **Levee Plan with Tunnel in Reno and Overflow** | | |
| First Cost | $125,983,000 | $239,464,190 |
| Annualized Capital | 8,672,600 | 16,484,582 |
| Annualized O&M and Replacement | 317,400 | 603,303 |
| Total Annual Costs | $8,990,000 | $17,087,885 |
| **Channel Plan with Tunnel in Reno and Jones Ranch Overflow** | | |
| First Cost | $123,533,000 | $234,807,314 |
| Annualized Capital | 8,503,900 | 16,163,923 |
| Annualized O&M and Replacement | 312,700 | 594,369 |
| Total Annual Costs | $8,816,600 | $16,758,292 |

NOTE:
Costs are for Alternative 13 of the Feasibility Report (COE, 1985)
ENR - Engineering News Record Cost Index

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## BACKUP CALCULATIONS

# Truckee Meadows Reconnaissance Report
## Annualized Cost Estimate
## (Without Detention Basin)

### ASSUMPTIONS:

| | |
|---|---|
| Base (First Cost) --1997 $ | $90,591,644 |
| Months of Construction | 44 |
| Interest Rate -- Annual | 7.375% |
| -- Monthly | 0.615% |
| Amortization Period --Years | 100 |
| Major Replacement Costs --1997 $ | $360,000 |
| Use Escalated Costs for Replacement? | Y |
| Replacement Period -- Years | 50 |
| With Inflation | $1,578,206 |
| Annual Inflation Rate | 3.00% |

### RESULTS:

| | | |
|---|---|---|
| Annualized Capital Costs | $6,686,565 | Annualized Cost Based on Assumptions Above, Using Payment Function |
| Annualized Interest Costs | $2,068,999 | Annualized Cost Based on Assumptions Above and Calculated Interest, Using Payment Function |
| Annual O&M Costs | $90,000 | Annual O&M Costs |
| Annualized Replacement Costs | $116,487 | Replacement Costs, Annualized Over 100 Year Period |
| **TOTAL ANNUAL COSTS:** | **$8,962,051** | |

Major Replacement Costs were estimated as $20,000 per mile of floodwall or levee

Annual O&M Costs were assumed to be $5,000 per year per mile of floodwall or levee

# Truckee Meadows Reconnaissance Report
## Annualized Cost Estimate
## (With Detention Basin)

### ASSUMPTIONS:

| | |
|---|---|
| Base (First Cost) --1997 $ | $98,519,953 |
| Months of Construction | 48 |
| Interest Rate -- Annual | 7.375% |
| -- Monthly | 0.615% |
| Amortization Period --Years | 100 |
| Major Replacement Costs --1997 $ | $400,000 |
| Use Escalated Costs for Replacement? | Y |
| Replacement Period -- Years | 50 |
| With Inflation | $1,753,562 |
| Annual Inflation Rate | 3.00% |

### RESULTS:

| | | |
|---|---|---|
| Annualized Capital Costs | $7,271,753 | Annualized Cost Based on Assumptions Above, Using Payment Function |
| Annualized Interest Costs | $2,486,316 | Annualized Cost Based on Assumptions Above and Calculated Interest, Using Payment Function |
| Annual O&M Costs | $100,000 | Annual O&M Costs |
| Annualized Replacement Costs | $129,430 | Replacement Costs, Annualized Over 100 Year Period |
| **TOTAL ANNUAL COSTS:** | **$9,987,500** | |

Major Replacement Costs were estimated as $20,000 per mile of floodwall or levee
Annual O&M Costs were estimated as $5,000 per year per mile of floodwall or levee

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 1 - Upstream of Booth Street

Levees: Length = NA Height = NA
Floodwalls: Length = NA Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 06 | Fish and Wildlife Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 11 | Floodwalls | | | | | | |
| | Excavation | 6,466 | CY | $ 3.00 | $ 19,398 | $ 4,850 | $ 24,248 |
| | Formed Concrete Wall | 2,496 | CY | $ 475 | $ 1,185,600 | $ 296,400 | $ 1,482,000 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Cleanup | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Div of Water-Temp Sheet Piles [1] | 32,400 | SF | $ 16 | $ 518,400 | $ 129,600 | $ 648,000 |
| Task Subtotal | | | | | $ 1,733,398 | | $ 2,166,748 |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 208,008 | | $ 208,008 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 138,672 | | $ 138,672 |

TOTAL PROJECT FIRST COST = $ 2,513,427

[1] Temporary Sheet Piles used to divert water from Sta 481 to Sta 508

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 2 - Booth to Lake Street

Levees: Length = NA Floodwalls: Length = Variable
Height = NA Height = Variable

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 02 | Relocations[1] | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 100,000 | $ 100,000 | $ 25,000 | $ 125,000 |
| | Bridges: Booth Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 1,950,000 | $ 1,950,000 | $ 487,500 | $ 2,437,500 |
| | Construct New Flood Gate | 206 | SF | $ 48 | $ 9,888 | $ 2,472 | $ 12,360 |
| | Relocate Utilities on Bridge | 1 | LS | $ 50,000 | $ 50,000 | $ 12,500 | $ 62,500 |
| | Bridges: N. Arlington Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 3,435,000 | $ 3,435,000 | $ 858,750 | $ 4,293,750 |
| | Construct New Flood Gate | 450 | SF | $ 48 | $ 21,600 | $ 5,400 | $ 27,000 |
| | Relocate Utilities on Bridge | 1 | LS | $ 50,000 | $ 50,000 | $ 12,500 | $ 62,500 |
| | Bridges: S. Arlington Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 1,761,000 | $ 1,761,000 | $ 440,250 | $ 2,201,250 |
| | Construct New Flood Gate | 600 | SF | $ 48 | $ 28,800 | $ 7,200 | $ 36,000 |
| | Relocate Utilities on Bridge | 1 | LS | $ 50,000 | $ 50,000 | $ 12,500 | $ 62,500 |
| | Bridges: Sierra Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 3,009,750 | $ 3,009,750 | $ 752,438 | $ 3,762,188 |
| | Construct New Flood Gate | 1,367 | SF | $ 48 | $ 65,616 | $ 16,404 | $ 82,020 |
| | Relocate Utilities on Bridge | 1 | LS | $ 100,000 | $ 100,000 | $ 25,000 | $ 125,000 |
| | Bridges: Virginia Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 4,056,000 | $ 4,056,000 | $ 1,014,000 | $ 5,070,000 |
| | Construct New Flood Gate | 1,072 | SF | $ 48 | $ 51,456 | $ 12,864 | $ 64,320 |
| | Relocate Utilities on Bridge | 1 | LS | $ 100,000 | $ 100,000 | $ 25,000 | $ 125,000 |
| | Bridges: Center Street | | | | | | |
| | Construct New Flood Gate | 780 | SF | $ 48 | $ 37,440 | $ 9,360 | $ 46,800 |
| | Bridges: Lake Street | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 1 | LS | $ 3,313,500 | $ 3,313,500 | $ 828,375 | $ 4,141,875 |
| | Construct New Flood Gate | 780 | SF | $ 48 | $ 37,440 | $ 9,360 | $ 46,800 |
| | Relocate Utilities on Bridge | 1 | LS | $ 50,000 | $ 50,000 | $ 12,500 | $ 62,500 |
| Task Subtotal | | | | | $ 19,177,490 | | $ 23,971,863 |
| 06 | Fish and Wildlife Facilities | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 09 | Channels and Canals | | | | | | |
| | Channel Excavation | 13,661 | CY | $ 4.75 | $ 64,890 | $ 16,222 | $ 81,112 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Div of Water-Temp Sheet Piles[2] | 1,680 | SF | $ 16 | $ 26,880 | $ 6,720 | $ 33,600 |
| Task Subtotal | | | | | $ 96,770 | | $ 120,962 |
| 11 | Floodwalls | | | | | | |
| | Excavation | 2,489 | CY | $ 3.00 | $ 7,467 | $ 1,867 | $ 9,334 |
| | Soil Anchors | 34,800 | LF | $ 40 | $ 1,392,000 | $ 348,000 | $ 1,740,000 |
| | Steel Sheet Piles | 34,800 | SF | $ 21 | $ 730,800 | $ 182,700 | $ 913,500 |
| | Gabbions | 4,481 | CY | $ 140 | $ 627,340 | $ 156,835 | $ 784,175 |
| | Formed Concrete Wall | 7,667 | CY | $ 475 | $ 3,641,825 | $ 910,456 | $ 4,552,281 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Cleanup | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Div of Water-Temp Sheet Piles[3] | 112,800 | SF | $ 16 | $ 1,804,800 | $ 451,200 | $ 2,256,000 |
| Task Subtotal | | | | | $ 8,214,232 | | $ 10,267,790 |
| 14 | Recreation Facilities | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 18 | Cultural Resources Pres | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 3,298,619 | | $ 3,298,619 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 2,199,079 | | $ 2,199,079 |
| | | | | | TOTAL PROJECT FIRST COST = | | $ 39,858,313 |

[1] All Bridge Costs are Based on $225/sf + $600,000 for potential hydrocarbon contamination
[2] Sheet Piles used to divert water to adjacent channel
[3] Sheet Piles used on North side from Sta. 427-481 and on South side from Sta 427-464 and 475-478

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 3 - Lake Street to Hwy 395

Levees: Length = NA Height = NA
Floodwalls: Length = NA Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 06 | Fish and Wildlife Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 11 | Floodwalls | | | | | | |
| | Excavation | 18,614 | CY | $ 3.00 | $ 55,842 | $ 13,961 | $ 69,803 |
| | Formed Concrete Wall | 6,945 | CY | $ 475 | $ 3,298,875 | $ 824,719 | $ 4,123,594 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Cleanup | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Div of Water-Temp Sheet Piles [1] | 21,600 | SF | $ 16 | $ 345,600 | $ 86,400 | $ 432,000 |
| Task Subtotal | | | | | $ 3,710,317 | | $ 4,637,896 |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 445,238 | | $ 445,238 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 296,825 | | $ 296,825 |
| | TOTAL PROJECT FIRST COST = | | | | | | $ 5,379,960 |

[1] Temporary Steel Sheet Piles used to divert water on north and south side from Sta 418 to Sta 427

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 4 - Hwy 395 to McCarran Boulevard

Levees: Length = NA Floodwalls: Length = Variable
Height = NA Height = Variable

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 01 | Relocations | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| Task Subtotal | | | | | $ 20,000 | | $ 25,000 |
| 06 | Fish and Wildlife Facilities | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 09 | Channels and Canals | | | | | | |
| | Channel Excavation | 89,595 | CY | $ 4.75 | $ 425,576 | $ 106,394 | $ 531,970 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 430,576 | | $ 538,220 |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 22 | AC | $ 2,400 | $ 52,800 | $ 13,200 | $ 66,000 |
| | Embankment | 100,606 | CY | $ 5 | $ 503,030 | $ 125,758 | $ 628,788 |
| | Exc Inspection Trench | 27,580 | CY | $ 2.50 | $ 68,950 | $ 17,238 | $ 86,188 |
| | Excavation | 12,858 | CY | $ 3.00 | $ 38,574 | $ 9,644 | $ 48,218 |
| | Rip Rap | 2,222 | CY | $ 40 | $ 88,880 | $ 22,220 | $ 111,100 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Stab Aggregate Patrol Road | 4,495 | TON | $ 7 | $ 31,465 | $ 7,866 | $ 39,331 |
| | Formed Concrete | 4,222 | CY | $ 475 | $ 2,005,450 | $ 501,363 | $ 2,506,813 |
| | Seeding | 19 | AC | $ 2,000 | $ 38,000 | $ 9,500 | $ 47,500 |
| Task Subtotal | | | | | $ 2,832,149 | | $ 3,540,186 |
| 11 | Floodwalls | | | | | | |
| | Excavation | 41,923 | CY | $ 3.00 | $ 125,769 | $ 31,442 | $ 157,211 |
| | Rip Rap | 2,667 | CY | $ 40 | $ 106,680 | $ 26,670 | $ 133,350 |
| | Embankment Fill | 6,134 | CY | $ 5 | $ 30,670 | $ 7,668 | $ 38,338 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Formed Concrete Wall | 13,598 | CY | $ 475 | $ 6,459,050 | $ 1,614,763 | $ 8,073,813 |
| | Cleanup | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Div of Water-Temp Sheet Piles [1] | 16,800 | SF | $ 16 | $ 268,800 | $ 67,200 | $ 336,000 |
| Task Subtotal | | | | | $ 7,000,969 | | $ 8,751,211 |
| 14 | Recreation Facilities | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 18 | Cultural Resources Pres | | (TO BE PROVIDED BY THE USACOE) | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 1,234,043 | | $ 1,234,043 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 822,696 | | $ 822,696 |

| TOTAL PROJECT FIRST COST = | $ 14,911,357 |
|---|---|

[1] Sheet Piles used on South Side from Sta 223-237

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 5 - McCarran to Vista, excludes University Farm Area Levees

Levees: Length = Variable Floodwalls: Length = NA
Height = Variable Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 02 | Relocations | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| 06 | Fish and Wildlife Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 29 | AC | $ 2,400 | $ 69,600 | $ 17,400 | $ 87,000 |
| | Embankment | 185,586 | CY | $ 5 | $ 927,930 | $ 231,983 | $ 1,159,913 |
| | Exc Inspection Trench | 36,220 | CY | $ 2.50 | $ 90,550 | $ 22,638 | $ 113,188 |
| | Excavation | 18,269 | CY | $ 3.00 | $ 54,807 | $ 13,702 | $ 68,509 |
| | Stab Aggregate Patrol Road | 5,903 | TON | $ 7 | $ 41,321 | $ 10,330 | $ 51,651 |
| | Seeding | 25 | AC | $ 2,000 | $ 50,000 | $ 12,500 | $ 62,500 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 1,239,208 | | $ 1,549,010 |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 151,105 | | $ 151,105 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 100,737 | | $ 100,737 |

| TOTAL PROJECT FIRST COST = | $ 1,825,852 |
|---|---|

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 6 - Steamboat Creek and Boynton Slough

Levees: Length = Variable Floodwalls: Length = NA
Height = Variable Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 02 | Relocations | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| | Bridges: Pembrook Drive | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 64,000 | SF | $ 150 | $ 9,600,000 | $ 2,400,000 | $ 12,000,000 |
| | Relocate Utilities on Bridge | 1 | LS | $ 75,000 | $ 75,000 | $ 18,750 | $ 93,750 |
| | Bridges: S. McCarran Blvd. | | | | | | |
| | Remove Existing Bridge | 1 | LS | $ 150,000 | $ 150,000 | $ 37,500 | $ 187,500 |
| | Construct New Bridge | 10,000 | SF | $ 150 | $ 1,500,000 | $ 375,000 | $ 1,875,000 |
| | Relocate Utilities on Bridge | 1 | LS | $ 75,000 | $ 75,000 | $ 18,750 | $ 93,750 |
| Task Subtotal | | | | | $ 11,570,000 | | $ 14,462,500 |
| 06 | Fish and Wildlife Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 11 | Floodwalls | | | | | | |
| | Excavation | 7,700 | CY | $ 3.00 | $ 23,100 | $ 5,775 | $ 28,875 |
| | Formed Concrete Wall | 4,165 | CY | $ 475 | $ 1,978,375 | $ 494,594 | $ 2,472,969 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Cleanup | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Div of Water-Temp Sheet Piles [1] | 7,200 | SF | $ 16 | $ 115,200 | $ 28,800 | $ 144,000 |
| Task Subtotal | | | | | $ 2,126,675 | | $ 2,658,344 |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 41 | AC | $ 2,400 | $ 98,400 | $ 24,600 | $ 123,000 |
| | Embankment | 264,342 | CY | $ 5 | $ 1,321,710 | $ 330,428 | $ 1,652,138 |
| | Exc Inspection Trench | 51,492 | CY | $ 2.50 | $ 128,730 | $ 32,183 | $ 160,913 |
| | Excavation | 27,393 | CY | $ 3.00 | $ 82,179 | $ 20,545 | $ 102,724 |
| | Rip Rap | 12,748 | CY | $ 40 | $ 509,920 | $ 127,480 | $ 637,400 |
| | Stab Aggregate Patrol Road | 8,391 | TON | $ 7 | $ 58,737 | $ 14,684 | $ 73,421 |
| | Seeding | 35 | AC | $ 2,000 | $ 70,000 | $ 17,500 | $ 87,500 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 2,274,676 | | $ 2,843,345 |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 1,916,562 | | $ 1,916,562 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 1,277,708 | | $ 1,277,708 |
| | TOTAL PROJECT FIRST COST = | | | | | | $ 23,158,459 |

[1] Temporary Sheet Piles to Divert Water for 600 feet on Boynton Slough

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 7 - University Farm Area, without Detention Basin

Levees: Length = Variable Height = Variable
Floodwalls: Length = NA Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 02 | Relocations | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 20 | AC | $ 2,400 | $ 48,000 | $ 12,000 | $ 60,000 |
| | Embankment | 196,215 | CY | $ 5 | $ 981,075 | $ 245,269 | $ 1,226,344 |
| | Exc Inspection Trench | 25,320 | CY | $ 2.50 | $ 63,300 | $ 15,825 | $ 79,125 |
| | Excavation | 12,089 | CY | $ 3.00 | $ 36,267 | $ 9,067 | $ 45,334 |
| | Stab Aggregate Patrol Road | 4,126 | TON | $ 7 | $ 28,882 | $ 7,221 | $ 36,103 |
| | Seeding | 17 | AC | $ 2,000 | $ 34,000 | $ 8,500 | $ 42,500 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 1,196,524 | | $ 1,495,655 |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 145,983 | | $ 145,983 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 97,322 | | $ 97,322 |

| TOTAL PROJECT FIRST COST = | $ 1,763,960 |
|---|---|

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 7A - University Farm Area, with Detention Basin

Levees: Length = Variable Height = Variable
Floodwalls: Length = NA Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 02 | Relocations [1] | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| | Roads: | | | | | | |
| | Construct New Bridge | 12,000 | SF | $ 150 | $ 1,800,000 | $ 450,000 | $ 2,250,000 |
| | Excavation | 1,556 | CY | $ 3.00 | $ 4,668 | $ 1,167 | $ 5,835 |
| | Road Surface | 40,000 | SF | $ 4 | $ 160,000 | $ 40,000 | $ 200,000 |
| Task Subtotal | | | | | $ 1,984,668 | | $ 2,480,835 |
| 03 | Reservoirs - Detention Basin | | | | | | |
| | BLS/Marking | 1 | LS | $ 2,000 | $ 2,000 | $ 500 | $ 2,500 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 7,000 | | $ 8,750 |
| 04 | Inlet Weir | | | | | | |
| | Clearing and Grubbing | 2 | AC | $ 2,400 | $ 4,800 | $ 1,200 | $ 6,000 |
| | Excavation | 1,778 | CY | $ 2.50 | $ 4,445 | $ 1,111 | $ 5,556 |
| | Cleanup | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Bedding Material | 463 | CY | $ 5 | $ 2,315 | $ 579 | $ 2,894 |
| | Formed Concrete | 1,778 | CY | $ 475 | $ 844,550 | $ 211,138 | $ 1,055,688 |
| | Reinforcing Steel | 355,556 | LBS | $ 0.60 | $ 213,334 | $ 53,333 | $ 266,667 |
| | Rip Rap | 1,070 | CY | $ 40 | $ 42,800 | $ 10,700 | $ 53,500 |
| | Miscellaneous Items | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 1,122,244 | | $ 1,402,805 |
| 06 | Fish and Wildlife Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 09 | Channels and Canals | | | | | | |
| | Excavation | 138,723 | CY | $ 3.00 | $ 416,169 | $ 104,042 | $ 520,211 |
| | Div of Water-Temp Sheet Piles [2] | 21,600 | SF | $ 16 | $ 345,600 | $ 86,400 | $ 432,000 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 766,769 | | $ 958,461 |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 36 | AC | $ 2,400 | $ 86,400 | $ 21,600 | $ 108,000 |
| | Embankment | 343,515 | CY | $ 5 | $ 1,717,575 | $ 429,394 | $ 2,146,969 |
| | Exc Inspection Trench | 45,100 | CY | $ 2.50 | $ 112,750 | $ 28,188 | $ 140,938 |
| | Excavation | 25,836 | CY | $ 3.00 | $ 77,508 | $ 19,377 | $ 96,885 |
| | Rip Rap | 17,274 | CY | $ 40 | $ 690,960 | $ 172,740 | $ 863,700 |
| | Stab Aggregate Patrol Road | 7,350 | TON | $ 7 | $ 51,450 | $ 12,863 | $ 64,313 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| | Seeding | 31 | AC | $ 2,000 | $ 62,000 | $ 15,500 | $ 77,500 |
| Task Subtotal | | | | | $ 2,803,643 | | $ 3,504,554 |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 802,119 | | $ 802,119 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 534,746 | | $ 534,746 |

TOTAL PROJECT FIRST COST = $ 9,692,269

[1] Access to WWTP from Larkin Circle - 300' Long Bridge and 1600' Access Road
[2] Sheet Piles used on South Side from Sta 167-185

# Truckee Meadows Reconnaissance Report
## Cost Estimate

Prices as of 1 October 1996
Interest Rate: 7.375%
Project Area: Reach 8 - North Truckee Drain and Peoples Ditch

Levees: Length = Variable Height = Variable

Floodwalls: Length = NA Height = NA

| Acct. No. | Item | Quantity | Unit | Unit Price | Subtotal | Contingency | Total First Cost |
|---|---|---|---|---|---|---|---|
| 01 | Lands and Damages | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 02 | Relocations | | | | | | |
| | Miscellaneous Utilities | 1 | LS | $ 20,000 | $ 20,000 | $ 5,000 | $ 25,000 |
| 06 | Fish and Wildlife Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 11 | Levees | | | | | | |
| | Clearing and Grubbing | 19 | AC | $ 2,400 | $ 45,600 | $ 11,400 | $ 57,000 |
| | Embankment | 118,181 | CY | $ 5 | $ 590,905 | $ 147,726 | $ 738,631 |
| | Exc Inspection Trench | 24,230 | CY | $ 2.50 | $ 60,575 | $ 15,144 | $ 75,719 |
| | Excavation | 10,096 | CY | $ 3.00 | $ 30,288 | $ 7,572 | $ 37,860 |
| | Stab Aggregate Patrol Road | 3,949 | TON | $ 7 | $ 27,643 | $ 6,911 | $ 34,554 |
| | Seeding | 17 | AC | $ 2,000 | $ 34,000 | $ 8,500 | $ 42,500 |
| | Miscellaneous | 1 | LS | $ 5,000 | $ 5,000 | $ 1,250 | $ 6,250 |
| Task Subtotal | | | | | $ 794,011 | | $ 992,514 |
| 14 | Recreation Facilities | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 18 | Cultural Resources Pres | (TO BE PROVIDED BY THE USACOE) | | | | | |
| 30 | Planning, Eng, Design | 12% OF SUBTOTAL | | | $ 97,681 | | $ 97,681 |
| 31 | Construction Mgmt | 8% OF SUBTOTAL | | | $ 65,121 | | $ 65,121 |

| TOTAL PROJECT FIRST COST = | $ 1,180,316 |
|---|---|

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000cfs Date: 7/18/97

Reach 1: Truckee River, Upstream of Booth Street

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| | | Length | Width | Height | Total |
| FLOODWALLS | | | | | |
| | Excavation | 3,233 LF | 9 FT | 6 FT | 6,466 CY |
| | Soil Anchors | | | | LF |
| | Steel Sheet Piles | | | | SF |
| | Gabions | | | | CY |
| | Formed Reinf Concrete Wall | | | | 2,496 CY |
| | Cleanup | | | | |
| | Care and Diversion of Water | | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 2: Truckee River, Booth Street to Lake Street

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| RELOCATIONS | | Length | Width | Height | Total |
| Bridges: Booth Street | | | | | |
| | Remove Existing Bridge | 120 LF | 37.5 FT | | 4,500 SF |
| | Construct New Bridge | 160 LF | 37.5 FT | | 6,000 SF |
| | Relocate Utilities on Bridge | 1-Gas-4 inch<br>6-Telephone-3.5 inch | | | |
| | Flood Gate (2 steel plates) left bank | 0.02 FT | 37.5 FT | 5.5 FT | 0 CY |
| Bridges: N. Arlington Street | | | | | |
| | Remove Existing Bridge | 128 LF | 75 FT | | 9,600 SF |
| | Construct New Bridge | 168 LF | 75 FT | | 12,600 SF |
| | Relocate Utilities on Bridge | Street Lighting-Power Line<br>9-Telephone -3.5 inch | | | |
| | Flood Gate (2 steel plates) left bank | 0.02 FT | 75 FT | 6 FT | 1 CY |
| Bridges: S. Arlington Street | | | | | |
| | Remove Existing Bridge | 46 LF | 60 FT | | 2,760 SF |
| | Construct New Bridge | 86 LF | 60 FT | | 5,160 SF |
| | Relocate Utilities on Bridge | Street Lighting-Power Line<br>9-Telephone -3.5 inch | | | |
| | Flood Gate (2 steel plates) right bank | 0.02 FT | 60 FT | 10 FT | 1 CY |
| Bridges: Sierra Street | | | | | |
| | Remove Existing Bridge | 130 LF | 63 FT | | 8,190 SF |
| | Construct New Bridge | 170 LF | 63 FT | | 10,710 SF |
| | Relocate Utilities on Bridge | 1-Water-12 inch<br>4-Gas-3.5 inch<br>1-Power-Transmission Line | | | |
| | Flood Gate (2 steel plates) left bank | 0.02 FT | 63 FT | 9.6 FT | 1 CY |
| | Flood Gate (2 steel plates) right bank | 0.02 FT | 63 FT | 12.1 FT | 1 CY |
| Bridges: Virginia Street | | | | | |
| | Remove Existing Bridge | 152 LF | 80 FT | | 12,160 SF |
| | Construct New Bridge | 192 LF | 80 FT | | 15,360 SF |
| | Relocate Utilities on Bridge | 1-Water-8 inch CIP<br>3-Telephone-2 inch<br>9-Telephone -6 inch PVC<br>1-Unknown-1 inch<br>1-Unknown-3 inch | | | |
| | Flood Gate (2 steel plates) left bank | 0.02 FT | 80 FT | 6.7 FT | 1 CY |
| | Flood Gate (2 steel plates) right bank | 0.02 FT | 80 FT | 6.7 FT | 1 CY |
| Bridges: Center Street | | | | | |
| | Flood Gate (2 steel plates) left bank | 0.02 FT | 65 FT | 7 FT | 1 CY |
| | Flood Gate (2 steel plates) right bank | 0.02 FT | 65 FT | 5 FT | 1 CY |
| Bridges: Lake Street | | | | | |
| | Remove Existing Bridge | 161 LF | 60 FT | | 9,660 SF |
| | Construct New Bridge | 201 LF | 60 FT | | 12,060 SF |
| | Relocate Utilities on Bridge | 6-Telephone-3.5 inch | | | |
| | Flood Gate (2 steel plates) left bank | 0.02 FT | 60 FT | 7 FT | 1 CY |
| | Flood Gate (2 steel plates) right bank | 0.02 FT | 60 FT | 6 FT | 1 CY |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs  Date: 7/18/97

Reach 2: Truckee River, Booth Street to Lake Street

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| | | Length | Width | Height | Total |
| CHANNELS AND CANALS - Near Booth Street, North Arlington, and South Arlington | | | | | |
| | Channel Excavation | | | | 13,661 CY |
| FLOODWALLS | | | | | |
| | Excavation | | | | 2,489 CY |
| | Soil Anchors | 34,800 LF | | | 34,800 LF |
| | Steel Sheet Piles | 5,800 LF | | 6 FT | 34,800 SF |
| | Gabions | 3,361 LF | 3 FT | 12 FT | 4,481 CY |
| | Formed Reinf Concrete Wall | | | | 7,667 CY |
| | Cleanup | | | | |
| | Care and Diversion of Water | | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs  Date: 7/18/97

Reach 3: Truckee River, Lake Street to Hwy 395

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| | | Length | Width | Height | Total |
| FLOODWALLS | | | | | |
| | Excavation | 9,307 LF | 9 FT | 6 FT | 18,614 CY |
| | Soil Anchors | | | | LF |
| | Steel Sheet Piles | | | | SF |
| | Gabions | | | | CY |
| | Formed Reinf Concrete Wall | | | | 6,945 CY |
| | Cleanup | | | | |
| | Care and Diversion of Water | | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs  Date: 7/18/97

Reach 4: Truckee River, Hwy 395 to McCarran Boulevard

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| CHANNELS AND CANALS - Glendale Park | | Length | Width | Height | Total |
| | Channel Excavation | | | | 89,595 CY |
| LEVEES | | | | | |
| | Clear and Grub | 13,790 LF | 70 FT | | 22 AC |
| | Embankment fill | | | | 100,606 CY |
| | Exc inspection trench | | | | 27,580 CY |
| | Excavation | | | | 12,858 CY |
| | Riprap | 4,000 LF | 10 FT | 1.5 FT | 4,889 TON |
| | Aggregate patrol road | 13,790 LF | 12 FT | 4 IN | 4,495 TON |
| | Formed Reinforced Concrete | 1,900 LF | 40 FT | 1.5 FT | 4,222 CY |
| | Fencing | | | | LF |
| | Seeding | 13,790 LF | 60 FT | | 19 AC |
| FLOODWALLS | | | | | |
| | Excavation | | | | 41,923 CY |
| | Formed Reinf Concrete Wall | | | | 13,598 CY |
| | Rip Rap | 4,800 LF | 10 FT | 1.5 FT | 2,667 CY |
| | Fill | | | | 6,134 CY |
| | Cleanup | | | | |
| | Care and Diversion of Water | | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs Date: 7/18/97

Reach 5: Truckee River, McCarran Boulevard to Vista (Excludes University Farms Flood Control Facilities or Truckee River's Right Bank)

| Item | Description | QUANTITIES | | | | |
|---|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | Total | |
| | Clear and Grub | 18,110 | LF 70 | FT | 29 | AC |
| | Embankment fill | | | | 185,586 | CY |
| | Exc inspection trench | 18,110 | LF 9 | FT 6.0 FT | 36,220 | CY |
| | Excavation | | | | 18,269 | CY |
| | Riprap | | | | | TON |
| | Aggregate patrol road | 18,110 | LF 12 | FT 4 IN | 5,903 | TON |
| | Fencing | | | | | LF |
| | Seeding | 18,110 | LF 60 | FT | 25 | AC |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs  Date: 7/18/97
Reach 6: Steamboat Creek and Boynton Slough

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| RAISE BRIDGE-Pembrook Drive | | Length | Width | Height | Total |
| | Remove Existing Bridge | 800 LF | 40 LF | | 32,000 SF |
| | Construct New Bridge | 800 LF | 80 LF | | 64,000 SF |
| | Relocate Utilities on Bridge | 1-Gas-6 inch<br>1-Water-14 inch | | | |
| RAISE BRIDGE-South McCarran Blvd on Boynton Slough | | | | | |
| | Remove Existing Bridge | 100 LF | 100 LF | | 10,000 SF |
| | . | 100 LF | 100 LF | | 10,000 SF |
| | . | | | | |
| LEVEES | | | | | |
| | Clear and Grub | 25,746 LF | 70 FT | | 41 AC |
| | Embankment fill | | | | 264,342 CY |
| | Exc inspection trench | 25,746 LF | 9 FT | 6.0 FT | 51,492 CY |
| | Excavation | | | | 27,393 CY |
| | Riprap | 8,605 LF | 40 FT | 1 FT | 28,046 TON |
| | Aggregate patrol road | 25,746 LF | 12 FT | 4 IN | 8,391 TON |
| | Fencing | | | | LF |
| | Seeding | 25,746 LF | 60 FT | | 35 AC |
| FLOODWALLS | | | | | |
| | Ecavation-Stripping | | | | |
| | Excavation | 3,850 LF | 9 FT | 6 FT | 7,700 CY |
| | Formed Reinf Concrete Wall | | | | 4,165 CY |
| | Cleanup | | | | |
| | Care and Diversion of Water | | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs Date: 7/18/97

Reach 7: University Farms Area (Without a Detention Basin, Includes Truckee River Levee)

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | Total |
| | Clear and Grub | 12,660 LF | 70 FT | | 20 AC |
| | Embankment fill | | | | 196,215 CY |
| | Exc inspection trench | 12,660 LF | 9 FT | 6.0 FT | 25,320 CY |
| | Excavation | | | | 12,089 CY |
| | Riprap | | | | TON |
| | Aggregate patrol road | 12,660 LF | 12 FT | 4 IN | 4,126 TON |
| | Fencing | | | | LF |
| | Seeding | 12,660 LF | 60 FT | | 17 AC |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs Date: 7/18/97

Reach 7A: University Farms Area (Includes Detention Basin and Truckee River Levee)

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| WEIR CONSTRUCTION - Inlet weir, outlet weir, low level outlet | | Length | Width | Height | Total |
| | Clear and Grub | 1,350 LF | 70 FT | | 2 AC |
| | Excavation | | | | 1,778 CY |
| | Bedding Material | 1,250 LF | 20 FT | 6 IN | 1,019 TON |
| | Formed Concrete | | | | 1,778 CY |
| | Reinforcing Steel | | | | 355,556 LBS |
| | Rip Rap | 1,650 LF | 35 FT | 0.5 FT | 2,353 TON |
| | 48" RCP | | | | 100 LF |
| | 48" Control gates | | | | 2 EA |
| | 48" Flap gates | | | | 2 EA |
| CHANNELS AND CANALS - In front of 1000' inlet weir | | | | | |
| | Excavation | | | | 138,723 CY |
| LEVEES | | | | | |
| | Clear and Grub | 22,550 LF | 70 FT | | 36 AC |
| | Embankment fill | | | | 343,515 CY |
| | Exc inspection trench | | | | 45,100 CY |
| | Excavation | | | | 25,836 CY |
| | Riprap | 11,660 LF | 40 FT | 1 FT | 38,003 TON |
| | Aggregate patrol road | 22,550 LF | 12 FT | 4 IN | 7,350 TON |
| | Fencing | | | | LF |
| | Seeding | 22,550 LF | 60 FT | | 31 AC |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs Date: 7/18/97

Reach 8: North Truckee Drain and Peoples Ditch

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | Total |
| | Clear and Grub | 12,115 LF | 70 FT | | 19 AC |
| | Embankment fill | | | | 118,181 CY |
| | Exc inspection trench | 12,115 LF | 9 FT | 6.0 FT | 24,230 CY |
| | Excavation | 12,115 LF | 45 FT | 0.5 FT | 10,096 CY |
| | Riprap | | | | TON |
| | Aggregate patrol road | 12,115 LF | 12 FT | 4 IN | 3,949 TON |
| | Fencing | | | | LF |
| | Seeding | 12,115 LF | 60 FT | | 17 AC |

# Backup Calculations

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs  Date: 7/18/97
Reach 1: Truckee River, Upstream of Booth Street
Location: Truckee River, Upstream of Booth Street

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | 3,233 | LF | 9 | FT | 6 | FT | 6,466 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 2,496 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Notes:
Assumed the use of inverted T Floodwalls

INVERTED T FLOODWALL VOLUME CALCULATIONS

Truckee River, Upstream of Booth Street 26,000 cfs

| | Approx Station | Length | Width | W.S. + 3 Ft | G.S. Elev | Height | Volume |
|---|---|---|---|---|---|---|---|
| Above Ground | 480+70 to 480+81 | 11 LF | 1.5 FT | 4515.8 FT | 4510 FT | 5.8 FT | 4 CY |
| | 480+81 to 483+58 | 277 LF | 1.5 FT | 4516 FT | 4513 FT | 3 FT | 46 CY |
| | 483+58 to 489+25 | 567 LF | 1.5 FT | 4517 FT | 4512 FT | 5 FT | 158 CY |
| | 489+25 to 490+00 | 198 LF | 1.5 FT | 4518 FT | 4513 FT | 5 FT | 55 CY |
| | 490+00 to 494+15 | 415 LF | 1.5 FT | 4521 FT | 4515 FT | 6 FT | 138 CY |
| | 494+15 to 508+00 | 1,235 LF | 1.5 FT | 4524 FT | 4521 FT | 3 FT | 206 CY |
| | 480+70 to 480+81 (LB) | 11 LF | 1.5 FT | 4515.8 FT | 4513 FT | 2.8 FT | 2 CY |
| | 480+81 to 483+58 (LB) | 277 LF | 1.5 FT | 4516 FT | 4514 FT | 2 FT | 31 CY |
| | 483+58 to 486+00 (LB) | 242 LF | 1.5 FT | 4517 FT | 4516 FT | 1 FT | 13 CY |
| Below Ground | 480+70 to 508+00 | 3,233 LF | 3.5 FT | | | 1.2 FT | 503 CY |
| | | 3,233 LF | 4 FT | | | 2.8 FT | 1,341 CY |
| | | | | | | | **2,496 CY** |

# CONSTRUCTION ESTIMATES

CHANNEL EXCAVATION VOLUME CALCULATIONS

Reach 2: Truckee River, Booth Street to Lake Street 26,000 cfs

| Location | Length | Width | Height | Volume |
|---|---|---|---|---|
| Booth Street | 400 FT | 15 FT | 12 FT | 2,667 CY |
| North Arlington | 700 FT | 97 FT | 1.5 FT | 3,772 CY |
| South Arlington | 400 FT | 50 FT | 1.5 FT | 1,111 CY |
| South Arlington | 300 FT | 100 FT | 1.5 FT | 1,667 CY |
| Sierra Street | 400 FT | 200 FT | 1.5 FT | 4,444 CY |
| | | | | 13,661 CY |

FLOODWALL CONCRETE VOLUME CALCULATIONS

Reach 2: Truckee River, Booth Street to Lake Street 26,000 cfs

| Location | Length | Width | W.S. + 3 ft | G.S. Elev | Height | Volume |
|---|---|---|---|---|---|---|
| Booth to Arlington | 300 LF | 1.5 FT | 4508 FT | 4489.5 FT | 20.5 FT | 342 CY |
| | 525 LF | 1.5 FT | 4507 FT | 4488 FT | 21 FT | 613 CY |
| | 1,075 LF | 1.5 FT | 4506 FT | 4485 FT | 23 FT | 1,374 CY |
| New Portion | 200 LF | 1.5 FT | 4513 FT | 4511 FT | 2 FT | 22 CY |
| Arlington to Sierra | 346 LF | 1.5 FT | 4506 FT | 4477 FT | 31 FT | 596 CY |
| | 1,186 LF | 1.5 FT | 4504 FT | 4476 FT | 30 FT | 1,977 CY |
| Sierra to Virginia | 582 LF | 1.5 FT | 4503 FT | 4476 FT | 29 FT | 938 CY |
| Virginia to Center | 630 LF | 1.5 FT | 4498 FT | 4475 FT | 25 FT | 875 CY |
| Center to Lake | 714 LF | 1.5 FT | 4495 FT | 4473.5 FT | 23.5 FT | 932 CY |
| | | | | | **Total Volume** | **7,667 CY** |

FLOODWALL EXCAVATION VOLUME CALCULATIONS

Reach 2: Truckee River, Booth to Lake 26,000 cfs

| Location | Length | Width | Height | Volume |
|---|---|---|---|---|
| Gabion | 3,361 LF | 3 FT | 4 FT | 1,494 CY |
| I Pile | 5,358 LF | 1.5 FT | 2 FT | 595 CY |
| Inverted T | 200 LF | 9 FT | 6 FT | 400 CY |
| | | | **Total Volume** | **2,489 CY** |

Notes:

All the new floodwalls for the 26,000 cfs are inverted T type floodwalls

Assume the I pile floodwall has 6 ft high steel sheet piles.

Assume the I pile floodwall has two soil anchors that are 30 ft in length at 10 foot spacing

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 3: Truckee River, Lake Street to Hwy 395
Location: Truckee River, Lake Street to East 2nd Street

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | 986 | LF | 9 | FT | 6 | FT | 1,972 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 749 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Location: Truckee River, Kuenzli Street to Wells Avenue

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | 976 | LF | 9 | FT | 6 | FT | 1,952 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 659 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 3: Truckee River, Lake Street to Hwy 395
Location: Truckee River, Wells Avenue to Sutro Street

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | 2,535 | LF | 9 | FT | 6 | FT | 5,070 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 1,812 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 3: Truckee River, Lake Street to Hwy 395
Location: Truckee River,Sutro Street to Kietzke Avenue

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping Excavation | 4,410 | LF | 9 | FT | 6 | FT | 8,820 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 3,442 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 3: Truckee River, Lake Street to Hwy 395
Location: Truckee River, Kietzke Avenue to Hwy 395

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping Excavation | 400 | LF | 9 | FT | 6 | FT | 800 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 284 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Note: Assumed the use of inverted T type floodwalls

INVERTED T FLOODWALL VOLUME CALCULATIONS

Truckee River, Lake Street to East 2nd Street

| | Approx Station | Length | Width | W.S. + 3 ft | G.S. Elev | Height | Volume |
|---|---|---|---|---|---|---|---|
| Above Ground | 427+00 to 425+66 (RB) | 134 LF | 1.5 FT | 4492 FT | 4488 FT | 4 FT | 30 CY |
| | 427+00 to 425+66 (LB) | 134 LF | 1.5 FT | 4492 FT | 4487 FT | 5 FT | 37 CY |
| | 425+66 to 418+15 | 718 LF | 1.5 FT | 4491 FT | 4488 FT | 3 FT | 120 CY |
| Below Ground | 427+00 to 418+15 | 986 LF | 3.5 FT | | | 1.2 FT | 153 CY |
| | | 986 LF | 4 FT | | | 2.8 FT | 409 CY |
| | | | | | | | **749 CY** |

Truckee River, Kuenzli Street to Wells Avenue

| | Approx Station | Length | Width | W.S. + 3 ft | G.S. Elev | Height | Volume |
|---|---|---|---|---|---|---|---|
| Above Ground | 413+00 to 406+28 (RB) | 672 LF | 1.5 FT | 4483 FT | 4482 FT | 1 FT | 37 CY |
| | 406+28 to 403+74 (RB) | 254 LF | 1.5 FT | 4482 FT | 4479 FT | 3 FT | 42 CY |
| | 403+74 to 403+24 (RB) | 50 LF | 1.5 FT | 4482 FT | 4474 FT | 8 FT | 22 CY |
| Below Ground | 413+00 to 403+24 | 976 LF | 3.5 FT | | | 1.2 FT | 152 CY |
| | | 976 LF | 4 FT | | | 2.8 FT | 405 CY |
| | | | | | | | **659 CY** |

Truckee River, Wells Avenue to Sutro Street

| | Approx Station | Length | Width | W.S. +3ft | RB Height | LB Height | Volume |
|---|---|---|---|---|---|---|---|
| Above Ground | 402+02 to 400+86 | 108 LF | 1.5 FT | 4479.1 FT | 2.6 FT | 0 FT | 16 CY |
| | 400+86 to 399+22 | 162 LF | 1.5 FT | 4479.1 FT | 3.1 FT | 0 FT | 28 CY |
| | 399+22 to 397+16 | 205 LF | 1.5 FT | 4477.6 FT | 2.1 FT | 0.4 FT | 28 CY |
| | 397+16 to 395+21 | 195 LF | 1.5 FT | 4477 FT | 3 FT | 2 FT | 54 CY |
| | 395+21 to 393+31 | 195 LF | 1.5 FT | 4474.4 FT | 1.4 FT | 1.4 FT | 30 CY |
| | 393+31 to 391+41 | 190 LF | 1.5 FT | 4474.5 FT | 3.5 FT | 2.5 FT | 63 CY |
| | 391+41 to 388+77 | 264 LF | 1.5 FT | 4472.7 FT | 3.7 FT | 1.7 FT | 79 CY |
| | 388+77 to 386+92 | 170 LF | 1.5 FT | 4471.9 FT | 4.9 FT | 1.4 FT | 60 CY |
| | 386+92 to 386+91 | 16 LF | 1.5 FT | 4472.2 FT | 6.2 FT | 2.2 FT | 7 CY |
| Below Ground | 402+02 to 377+93 | 2,535 LF | 3.5 FT | | | 1.2 FT | 394 CY |
| | | 2,535 LF | 4 FT | | | 2.8 FT | 1,052 CY |
| | | | | | | | **1,812 CY** |

Truckee River,Sutro Street to Kietzke Avenue

| | Approx Station | Length | Width | WS + 3ft | RB Height | LB Height | Volume |
|---|---|---|---|---|---|---|---|
| Above Ground | 383+49 to 383+06 | 43 LF | 1.5 FT | 4470.7 FT | 4.7 FT | 4.7 FT | 22 CY |
| | 383+06 to 380+21 | 275 LF | 1.5 FT | 4470.8 FT | 4.8 FT | 5.3 FT | 154 CY |
| | 380+21 to 378+21 | 200 LF | 1.5 FT | 4467.5 FT | 2 FT | 3.5 FT | 61 CY |
| | 378+21 to 376+25 | 196 LF | 1.5 FT | 4463.5 FT | 0.5 FT | 0.5 FT | 11 CY |
| | 376+25 to 374+30 | 195 LF | 1.5 FT | 4462.9 FT | 1.9 FT | 1.9 FT | 41 CY |
| | 374+30 to 372+40 | 194 LF | 1.5 FT | 4461.5 FT | 3.5 FT | 2.5 FT | 65 CY |
| | 372+40 to 371+40 | 100 LF | 1.5 FT | 4461.6 FT | 5.6 FT | 3.6 FT | 51 CY |
| | 371+40 to 369+97 | 138 LF | 1.5 FT | 4461 FT | 5.5 FT | 1 FT | 50 CY |
| | 369+97 to 367+96 | 201 LF | 1.5 FT | 4458.5 FT | 4.5 FT | 0 FT | 50 CY |
| | 367+96 to 366+54 | 145 LF | 1.5 FT | 4458.7 FT | 5.7 FT | 0 FT | 46 CY |
| | 366+54 to 364+11 | 240 LF | 1.5 FT | 4458.5 FT | 6.5 FT | 0 FT | 87 CY |
| | 364+11 to 361+42 | 270 LF | 1.5 FT | 4458.7 FT | 7.7 FT | 2.3 FT | 150 CY |
| | 361+42 to 360+10 | 131 LF | 1.5 FT | 4455.7 FT | 4.7 FT | 1.7 FT | 47 CY |
| | 360+10 to 358+41 | 170 LF | 1.5 FT | 4456.1 FT | 5.6 FT | 4.1 FT | 92 CY |
| Below Ground | 383+49 to 358+03 | 4,410 LF | 3.5 FT | | | 1.2 FT | 686 CY |
| | | 4,410 LF | 4 FT | | | 2.8 FT | 1,829 CY |
| | | | | | | | **3,442 CY** |

Truckee River, Kietzke Avenue to Hwy 395

| | Approx Station | Length | Width | W.S. + 3 ft | RB Height | LB Height | Volume |
|---|---|---|---|---|---|---|---|
| Above Ground | 356+56 to 354+76 | 191 LF | 1.5 FT | 4452.2 FT | 2.2 FT | 0 FT | 23 CY |
| | 354+76 to 352+97 | 191 LF | 1.5 FT | 4451.7 FT | 2.7 FT | 0 FT | 29 CY |
| | 352+97 to 352+96 | 9 LF | 1.5 FT | 4451.1 FT | 4.1 FT | 2.9 FT | 4 CY |
| Below Ground | 356+56 to 352+96 | 400 LF | 3.5 FT | | | 1.2 FT | 62 CY |
| | | 400 LF | 4 FT | | | 2.8 FT | 166 CY |
| | | | | | | | **284 CY** |

RB=Right Bank
LB=Left Bank
W.S. = Water Surface

# CONSTRUCTION ESTIMATES

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK 26,000 cfs
Reach 4: Truckee River, Hwy 395 to McCarran

Station 221+00 to 223+00
Channel Invert Elevation: 4390 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 200 LF | 4400 FT | 10 FT | 2,200 SFT | 16,296 CY | 40 FT |
| Add 2:1 Slope | 2.5 LF | 4400 FT | 10 FT | 2,200 SFT | 204 CY | 40 FT |
| | | | | **Total Cummulative Volume** | **16,500 CY** | |

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK
Station 223+00 to 228+00
Channel Invert Elevation: 4392 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 500 LF | 4400 FT | 8 FT | 400 SFT | 7,407 CY | 50 FT |
| | 500 LF | 4405 FT | 13 FT | 390 SFT | 7,222 CY | 30 FT |
| | 500 LF | 4400 FT | 8 FT | 560 SFT | 10,370 CY | 70 FT |
| Add 2:1 Slope | 2 LF | 4400 FT | 8 FT | 560 SFT | 41 CY | 70 FT |
| | | | | **Total Cummulative Volume** | **41,541 CY** | |

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK
Station 228+00 to 232+00
Channel Invert Elevation: 4395 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 400 LF | 4400 FT | 5 FT | 200 SFT | 2,963 CY | 40 FT |
| | 400 LF | 4405 FT | 10 FT | 400 SFT | 5,926 CY | 40 FT |
| | 400 LF | 4401 FT | 6 FT | 600 SFT | 8,889 CY | 100 FT |
| Add 2:1 Slope | 1.5 LF | 4401 FT | 6 FT | 600 SFT | 33 CY | 100 FT |
| | | | | **Total Cummulative Volume** | **59,353 CY** | |

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK
Station 232+00 to 236+00
Channel Invert Elevation: 4395 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 400 LF | 4400 FT | 5 FT | 200 SFT | 2,963 CY | 40 FT |
| | 400 LF | 4403 FT | 8 FT | 800 SFT | 11,852 CY | 100 FT |
| Add 2:1 Slope | 2 LF | 4403 FT | 8 FT | 800 SFT | 59 CY | 100 FT |
| | | | | **Total Cummulative Volume** | **74,227 CY** | |

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK
Station 236+00 to 240+00
Channel Invert Elevation: 4395 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 400 LF | 4400 FT | 5 FT | 100 SFT | 1,481 CY | 20 FT |
| | 400 LF | 4405 FT | 10 FT | 750 SFT | 11,111 CY | 75 FT |
| Add 2:1 Slope | 2.5 LF | 4405 FT | 10 FT | 750 SFT | 69 CY | 75 FT |
| | | | | **Total Cummulative Volume** | **86,889 CY** | |

EXCAVATION VOLUME CALCULATIONS-GLENDALE PARK
Station 240+00 to 242+00
Channel Invert Elevation: 4393 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 200 LF | 4405 FT | 12 FT | 360 SFT | 2,667 CY | 30 FT |
| Add 2:1 Slope | 3 LF | 4405 FT | 12 FT | 360 SFT | 40 CY | 30 FT |
| | | | | **Total Cummulative Volume** | **89,595 CY** | |

## CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs  Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Glendale to Greg Street (Left Bank)

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 1,700 | LF | 70 | FT | | | 2.7 | AC |
| | Embankment fill | | | | | | | 29,217 | CY |
| | Exc inspection trench | 1,700 | LF | 9 | FT | 6.0 | FT | 3,400 | CY |
| | Excavation | 1,700 | LF | 70 | FT | 0.5 | FT | 2,204 | CY |
| | Riprap | 200 | LF | 10 | FT | 1.5 | FT | 244 | TON |
| | Aggregate patrol road | 1,700 | LF | 12 | FT | 4 | IN | 554 | TON |
| | Formed Reinforced Concrete | 100 | LF | 40 | FT | 1.5 | FT | 222 | CY |
| | Fencing | | | | | | | | LF |
| | Seeding | 1,700 | LF | 60 | FT | | | 2.3 | AC |

Project: Truckee Meadows 26,000 cfs  Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Greg Street Bridge to Rock Boulevard

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 5,315 | LF | 70 | FT | | | 8.5 | AC |
| | Embankment fill | | | | | | | 26,784 | CY |
| | Exc inspection trench | 5,315 | LF | 9 | FT | 6.0 | FT | 10,630 | CY |
| | Excavation | 5,315 | LF | 70 | FT | 0.5 | FT | 6,890 | CY |
| | Riprap | 3,600 | LF | 10 | FT | 18 | IN | 4,400 | TON |
| | Formed Reinforced Concrete | 1,800 | LF | 40 | FT | 1.5 | FT | 4,000 | CY |
| | Aggregate patrol road | 5,315 | LF | 12 | FT | 4 | IN | 1,732 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 5,315 | LF | 60 | FT | | | 7.3 | AC |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Rock Boulevard to McCarren Boulevard

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 6,775 | LF | 70 | FT | | | 10.9 | AC |
| | Embankment fill | | | | | | | 44,605 | CY |
| | Exc inspection trench | 6,775 | LF | 9 | FT | 6.0 | FT | 13,550 | CY |
| | Excavation | 6,775 | LF | 30 | FT | 0.5 | FT | 3,764 | CY |
| | Riprap | 0 | LF | 0 | FT | 0 | IN | 0 | TON |
| | Aggregate patrol road | 6,775 | LF | 12 | FT | 4 | IN | 2,208 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 6,775 | LF | 60 | FT | | | 9.3 | AC |

Notes:
1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.
4. Assume 12" riprap on northern and eastern basin levees, per 1983 report.
5. Assume 200 lb rebar per cubic-yard formed concrete, per 1991 report.
6. Assume 6" bedding/drain material beneath detentino basin weirs.
7. Assume levee breakout sections have a 10ft width and 1.5ft height of rip rap
8. Assume levee breakout sections have 40ft width and 1.5 ft height of concrete

LEVEE FILL VOLUME CALCULATIONS
Truckee River, Glendale to Greg Street (Left Bank)

| Station | Length | Base Elev | W.S. Elev + 3 ft | Height | X-Sect | Volume |
|---|---|---|---|---|---|---|
| 312+00 to 302+00 | 1,000 LF | 4424 FT | 4437 FT | 13 FT | 579 SFT | 21,426 CY |
| 100ft breakout | 100 LF | 4424 FT | 4436 FT | 12 FT | 504 SFT | 1,867 CY |
| 301+00 to 300+70 | 30 LF | 4424 FT | 4431 FT | 7 FT | 207 SFT | 229 CY |
| 300+70 to 299+50 | 120 LF | 4422 FT | 4431 FT | 9 FT | 311 SFT | 1,380 CY |
| 299+50 to 296+60 | 290 LF | 4425 FT | 4431 FT | 6 FT | 162 SFT | 1,740 CY |
| 296+00 to 295+00 | 160 LF | 4417 FT | 4428 FT | 11 FT | 435 SFT | 2,575 CY |
| | **1,700 LF Total Length** | | | | **Total Volume** | **29,217 CY** |
| | **11.2 FT Avg Height** | | | | | |

LEVEE FILL VOLUME CALCULATIONS
Truckee River, Greg Street Bridge to Rock Boulevard

| | Length | Base Elev | W.S. Elev + 3 ft | Height | X-Sect | Volume |
|---|---|---|---|---|---|---|
| Left Bank | 800 LF | 4420 FT | 4426 FT | 6 FT | 162 SFT | 4,800 CY |
| 278+00 to 274+60 | 340 LF | 4413 FT | 4420.8 FT | 7.8 FT | 246 SFT | 3,094 CY |
| 274+60 to 269+70 | 490 LF | 4412 FT | 4419.2 FT | 7.2 FT | 216 SFT | 3,920 CY |
| 269+70 to 266+00 | 370 LF | 4411 FT | 4417.8 FT | 6.8 FT | 197 SFT | 2,702 CY |
| 266+00 to 263+40 | 260 LF | 4412 FT | 4417.6 FT | 5.6 FT | 146 SFT | 1,402 CY |
| 263+40 to 263+35 | 5 LF | 4410 FT | 4415.9 FT | 5.9 FT | 158 SFT | 29 CY |
| Right Bank | 200 LF | 4425 FT | 4426 FT | 1 FT | 15 SFT | 107 CY |
| 292+00 to 288+00 | 400 LF | 4424 FT | 4425 FT | 1 FT | 15 SFT | 215 CY |
| 1000 ft breakout | 1,000 LF | 4416 FT | 4422 FT | 6 FT | 162 SFT | 6,000 CY |
| 278+00 to 277+00 | 100 LF | 4417 FT | 4420.8 FT | 3.8 FT | 82 SFT | 303 CY |
| 277+00 to 274+00 | 300 LF | 4416 FT | 4419.2 FT | 3.2 FT | 64 SFT | 711 CY |
| 800ft Breakout | 800 LF | 4415 FT | 4418.5 FT | 3.5 FT | 73 SFT | 2,152 CY |
| 266+00 to 263+50 | 250 LF | 4412 FT | 4417.6 FT | 5.6 FT | 146 SFT | 1,348 CY |
| | **5,315 LF Total Length** | | | | **Total Volume** | **26,784 CY** |
| | **5.1 FT Avg Height** | | | | | |

LEVEE FILL VOLUME CALCULATIONS
Truckee River, Rock Boulevard to McCarren Boulevard

| | Length | Base Elev | W.S. Elev + 3 ft | Height | X-Sect | Volume |
|---|---|---|---|---|---|---|
| Right Bank | 380 LF | 4413 FT | 4415.5 FT | 3 FT | 46 SFT | 642 CY |
| 258+95 to 256+35 | 260 LF | 4412.5 FT | 4414.4 FT | 2 FT | 32 SFT | 306 CY |
| 256+35 to 256+00 | 35 LF | 4412 FT | 4413.3 FT | 1 FT | 20 SFT | 26 CY |
| 256+00 to 254+00 | 200 LF | 4408 FT | 4413.3 FT | 5 FT | 134 SFT | 991 CY |
| 254+00 to 252+00 | 200 LF | 4407 FT | 4413.3 FT | 6 FT | 175 SFT | 1,295 CY |
| 252+00 to 246+00 | 600 LF | 4405 FT | 4412.8 FT | 8 FT | 246 SFT | 5,460 CY |
| 246+00 to 240+00 | 600 LF | 4401 FT | 4412 FT | 11 FT | 435 SFT | 9,656 CY |
| 240+00 to 238+00 | 300 LF | 4402 FT | 4410.8 FT | 9 FT | 299 SFT | 3,324 CY |
| 222+00 to 214+00 | 800 LF | 4404 FT | 4407 FT | 3 FT | 59 SFT | 1,733 CY |
| 214+00 to 200+00 | 1,400 LF | 4400 FT | 4405 FT | 5 FT | 123 SFT | 6,352 CY |
| 200+00 to 199+00 | 100 LF | 4397 FT | 4403.4 FT | 6 FT | 179 SFT | 664 CY |
| Left Bank | 1,200 LF | 4400 FT | 4405 FT | 5 FT | 123 SFT | 5,444 CY |
| 206+00 to 202+00 | 400 LF | 4395 FT | 4404 FT | 9 FT | 311 SFT | 4,600 CY |
| 202+00 to 199+00 | 300 LF | 4392 FT | 4402 FT | 10 FT | 370 SFT | 4,111 CY |
| | **6,775 LF** | **Total Length** | | | **Total Volume** | **44,605 CY** |
| | **6.8 FT** | **Avg Height** | | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Hwy 395 to Glendale

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | 2,950 | LF | 9 | FT | 6 | FT | 5,900 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 2,804 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Glendale Ave to Greg Street Bridge

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | | | | | | | 17,011 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 3,622 | CY |
| | Rip Rap | 2,800 | LF | 10 | FT | 1.5 | FT | 1,556 | CY |
| | Fill | 1,400 | LF | 12 | FT | 7.0 | FT | 4,356 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Greg Street Bridge to Rock Boulevard

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | 770 | LF | 9 | FT | 6 | FT | 1,540 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 672 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 4: Truckee River, Hwy 395 to McCarran
Location: Truckee River, Rock Boulevard to McCarren Boulevard

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOODWALLS | | Length | | Width | | Height | | Total | |
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | | | | | | | 17,472 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 6,500 | CY |
| | Fill | 1,000 | LF | 12 | FT | 4 | FT | 1,778 | CY |
| | Rip Rap | 2,000 | LF | 10 | FT | 2 | FT | 1,111 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Notes:
1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.
4. Assume 12" riprap on northern and eastern basin levees, per 1983 report.
5. Assume 200 lb rebar per cubic-yard formed concrete, per 1991 report.
6. Assume 6" bedding/drain material beneath detentino basin weirs.
7. Assume 10ft width and 1.5ft high rip rap for breakout floodwalls.
8. Assume concrete dimensions are close to the breakout cross section in 1985 report.
9. Assume breakout fill height is 1 ft above the floodwall height and the width is 12ft, per 1985 report.

FLOODWALL VOLUME CALCULATIONS

Truckee River, Hwy 395 to Glendale

| | | Length | Width | W.S. + 3 ft | Ground Elev | Height | Volume |
|---|---|---|---|---|---|---|---|
| Above Ground | Right Bank | 140 LF | 1.5 FT | 4449.9 FT | 4446 FT | 3.9 FT | 30 CY |
| | | 195 LF | 1.5 FT | 4449.7 FT | 4443.5 FT | 6.2 FT | 67 CY |
| | | 210 LF | 1.5 FT | 4449.4 FT | 4442 FT | 7.4 FT | 86 CY |
| | | 540 LF | 1.5 FT | 4449 FT | 4440 FT | 9 FT | 270 CY |
| | | 680 LF | 1.5 FT | 4448 FT | 4439.5 FT | 8.5 FT | 321 CY |
| | | 680 LF | 1.5 FT | 4444.8 FT | 4437 FT | 7.8 FT | 295 CY |
| | | 400 LF | 1.5 FT | 4442.9 FT | 4442 FT | 0.9 FT | 20 CY |
| | | 190 LF | 1.5 FT | 4442.9 FT | 4440 FT | 2.9 FT | 31 CY |
| | | 5 LF | 1.5 FT | 4442.4 FT | 4437 FT | 5.4 FT | 1 CY |
| Below Ground | Right Bank | 2,950 LF | 3.5 FT | | | 1.2 FT | 459 CY |
| | | 2,950 LF | 4 FT | | | 2.8 FT | 1,224 CY |
| | | | | | | | **2,804 CY** |

FLOODWALL VOLUME CALCULATIONS

Truckee River, Glendale Ave to Greg Street Bridge

| | | Length | Width | W.S. + 3 ft | Ground Elev | Height | Volume |
|---|---|---|---|---|---|---|---|
| Above Ground | Left Bank | 450 LF | 1.5 FT | 4440 FT | 4435 FT | 5 FT | 125 CY |
| | 800ft Breakout | 800 LF | 12 FT | 4438 FT | 4430 FT | 1 FT | 356 CY |
| | 800ft Breakout | 800 LF | 1 FT | 4438 FT | 4430 FT | 10 FT | 296 CY |
| | 312+80 to 312+00 | 80 LF | 1.5 FT | 4437.6 FT | 4429.5 FT | 8.1 FT | 36 CY |
| | Right Bank | 1,500 LF | 1.5 FT | 4439 FT | 4434 FT | 5 FT | 417 CY |
| | 600ft Breakout | 600 LF | 12 FT | 4435.6 FT | 4427 FT | 1 FT | 267 CY |
| | 600ft Breakout | 600 LF | 1 FT | 4435.6 FT | 4427 FT | 10.6 FT | 236 CY |
| | 303+00 to 299+95 | 305 LF | 1.5 FT | 4435 FT | 4424 FT | 11 FT | 186 CY |
| | 299+95 to 296+05 | 390 LF | 1.5 FT | 4431 FT | 4425 FT | 6 FT | 130 CY |
| | 296+05 to 295+00 | 105 LF | 1.5 FT | 4428 FT | 4427 FT | 1 FT | 6 CY |
| Below Ground | Left & Right Bank | 2,750 LF | 3.5 FT | | | 1.2 FT | 428 CY |
| | | 2,750 LF | 4 FT | | | 2.8 FT | 1,141 CY |
| | | | | | | | **3,622 CY** |

FLOODWALL EXCAVATION VOLUME CALCULATIONS

Truckee River, Glendale Ave to Greg Street Bridge

| | Length | Width | Height | Volume |
|---|---|---|---|---|
| | 2,750 LF | 9 FT | 6 FT | 5,500 CY |
| | 1,400 LF | 37 FT | 6 FT | 11,511 CY |
| | | | | **17,011 CY** |

FLOODWALL VOLUME CALCULATIONS

Truckee River, Greg Street to South Rock

| | | Length | Width | W.S. + 3 ft | Ground Elev | Height | Volume |
|---|---|---|---|---|---|---|---|
| Above Ground | Left Bank | 100 LF | 1.5 FT | 4422.1 FT | 4421 FT | 1.1 FT | 6 CY |
| | | 670 LF | 1.5 FT | 4422.1 FT | 4416 FT | 6.1 FT | 227 CY |
| Below Ground | Left Bank | 770 LF | 3.5 FT | | | 1.2 FT | 120 CY |
| | | 770 LF | 4 FT | | | 2.8 FT | 319 CY |
| | | | | | | | **672 CY** |

FLOODWALL VOLUME CALCULATIONS

Truckee River, South Rock to South McCarran

| | | Length | Width | W.S. + 3 ft | Ground Elev | Height | Volume |
|---|---|---|---|---|---|---|---|
| Above Ground | Left Bank | 150 LF | 1.5 FT | 4415.5 FT | 4407 FT | 8.5 FT | 71 CY |
| | Breakout 1000ft | 1,000 LF | 12 FT | 4414 FT | 4410 FT | 1 FT | 444 CY |
| | | 1,000 LF | 1 FT | 4414 FT | 4410 FT | 6 FT | 222 CY |
| | | 2,275 LF | 1.5 FT | 4422 FT | 4404 FT | 18 FT | 2,275 CY |
| | | 1,050 LF | 1.5 FT | 4408 FT | 4400 FT | 8 FT | 467 CY |
| | Right Bank | 1,150 LF | 1.5 FT | 4408 FT | 4402 FT | 6 FT | 383 CY |
| Below Ground | Left & Right Bank | 4,625 LF | 3.5 FT | | | 1.2 FT | 719 CY |
| | | 4,625 LF | 4 FT | | | 2.8 FT | 1,919 CY |
| | | | | | | | **6,500 CY** |

FLOODWALL EXCAVATION VOLUME CALCULATIONS

Truckee River, South Rock to South McCarran

| | Length | Width | Height | Volume |
|---|---|---|---|---|
| | 4,625 LF | 9 FT | 6 FT | 9,250 CY |
| | 1,000 LF | 37 FT | 6 FT | 8,222 CY |
| | | | | **17,472 CY** |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs — Date: 7/18/97
Reach 5: Truckee River, McCarran to Vista
Location: Truckee River east of North Truckee Drain

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | TOTAL |
| | Clear and Grub | 4,050 LF | 70 FT | | 6.5 AC |
| | Embankment fill | | | | 58,756 CY |
| | Exc inspection trench | 4,050 LF | 9 FT | 6.0 FT | 8,100 CY |
| | Excavation | 4,050 LF | 70 FT | 0.5 FT | 5,250 CY |
| | Riprap | 0 LF | 0 FT | 0 FT | 0 TON |
| | Aggregate patrol road | 4,050 LF | 12 FT | 4 IN | 1,320 TON |
| | Fencing | | | | 0 LF |
| | Seeding | 4,050 LF | 60 FT | | 5.6 AC |

Project: Truckee Meadows 26,000 cfs — Date: 7/18/97
Reach 5: Truckee River, McCarran to Vista
Location: Left Bank: McCarran Blvd to N.T. Drain; Rt Bank: McCarran to inlet weir

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | TOTAL |
| | Clear and Grub | 14,060 LF | 70 FT | | 22.6 AC |
| | Embankment fill | | | | 126,830 CY |
| | Exc inspection trench | 14,060 LF | 9 FT | 6.0 FT | 28,120 CY |
| | Excavation | 14,060 LF | 50 FT | 0.5 FT | 13,019 CY |
| | Riprap | 0 LF | 40 FT | 12 IN | 0 TON |
| | Aggregate patrol road | 14,060 LF | 12 FT | 4 IN | 4,583 TON |
| | Fencing | | | | 0 LF |
| | Seeding | 14,060 LF | 60 FT | | 19.4 AC |

Notes:

1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.

LEVEE FILL VOLUME CALCULATIONS
Truckee River east of North Truckee Drain

| | Length | Base Elev | W.S. Elev + 3ft | Height | X-Sect | Volume |
|---|---|---|---|---|---|---|
| E/o NTDrain | 1,200 LF | 4386 FT | 4397 FT | 11 FT | 435 SFT | 19,311 CY |
| midsection | 1,650 LF | 4387 FT | 4396 FT | 9 FT | 311 SFT | 18,975 CY |
| Larkin Circle area | 450 LF | 4384 FT | 4396 FT | 12 FT | 504 SFT | 8,400 CY |
| east end | 750 LF | 4385 FT | 4396 FT | 11 FT | 435 SFT | 12,069 CY |
| | **4,050 LF** | **Total Length** | | | **Total Volume** | **58,756 CY** |
| | **10.3 FT** | **Avg Height** | | | | |

LEVEE FILL VOLUME CALCULATIONS
Left Bank: McCarran Blvd to N.T. Drain; Rt Bank: McCarran to inlet weir
Finished Height of Levee: 4401 FT

| | Length | Base Elev | W.S. Elev + 3ft | Height | X-Sect | Volume |
|---|---|---|---|---|---|---|
| Upstrm of NTDrain | 1,200 LF | 4390 FT | 4397 FT | 7 FT | 207 SFT | 9,178 CY |
| 86+00 to 100+00 | 1,400 LF | 4389 FT | 4397 FT | 8 FT | 256 SFT | 13,274 CY |
| | 650 LF | 4389 FT | 4397 FT | 8 FT | 256 SFT | 6,163 CY |
| 106+00 to 116+00 | 1,000 LF | 4391 FT | 4397 FT | 6 FT | 162 SFT | 6,000 CY |
| | 400 LF | 4390 FT | 4397 FT | 7 FT | 207 SFT | 3,059 CY |
| 120+00 to 136+00 | 1,600 LF | 4391 FT | 4398 FT | 7 FT | 207 SFT | 12,237 CY |
| 136+00 to 146+00 | 1,000 LF | 4393 FT | 4399 FT | 6 FT | 162 SFT | 6,000 CY |
| 146+00 to 158+00 | 1,200 LF | 4393 FT | 4400 FT | 7 FT | 207 SFT | 9,178 CY |
| 158+00 to 160+00 | 860 LF | 4394 FT | 4400 FT | 6 FT | 162 SFT | 5,160 CY |
| | 750 LF | 4395 FT | 4401 FT | 6 FT | 162 SFT | 4,500 CY |
| Dwnstrm of McCarran | 1,400 LF | 4396 FT | 4403 FT | 7 FT | 207 SFT | 10,707 CY |
| Dwnstrm of McCarran | 1,200 LF | 4395 FT | 4403 FT | 8 FT | 256 SFT | 11,378 CY |
| Rt Bank McC to weir | 1,400 LF | 4390 FT | 4403 FT | 13 FT | 579 SFT | 29,996 CY |
| | **14,060 LF** | **Total Length** | | | **Total Volum** | **126,830 CY** |
| | **7.6 FT** | **Avg Height** | | | | |

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# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs — Date: 7/18/97
Reach 6: Steamboat Creek and Boynton Slough
Location: Boynton Slough from McCarran to Pembrook to Steamboat Cr.

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 10,590 | LF | 70 | FT | | | 17.0 | AC |
| | Embankment fill | | | | | | | 112,787 | CY |
| | Exc inspection trench | 10,590 | LF | 9 | FT | 6.0 | FT | 21,180 | CY |
| | Excavation | 10,590 | LF | 60 | FT | 0.5 | FT | 11,767 | CY |
| | Riprap | 0 | LF | 0 | FT | 0 | FT | 0 | TON |
| | Aggregate patrol road | 10,590 | LF | 12 | FT | 4 | IN | 3,452 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 10,590 | LF | 60 | FT | | | 14.6 | AC |

| FLOODWALLS | | Length | | Width | | Height | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | Ecavation-Stripping | | | | | | | | |
| | Excavation | 3,850 | LF | 9 | FT | 6 | FT | 7,700 | CY |
| | Formed Reinf Concrete Wall | | | | | | | 4,165 | CY |
| | Cleanup | | | | | | | | |
| | Care and Diversion of Water | | | | | | | | |

Project: Truckee Meadows 26,000 cfs — Date: 7/18/97
Reach 6: Steamboat Creek and Boynton Slough
Location: East of Steamboat Creek

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 8,605 | LF | 70 | FT | | | 13.8 | AC |
| | Embankment fill | 8,605 | LF | | | | | 93,473 | CY |
| | Exc inspection trench | 8,605 | LF | 9 | FT | 6.0 | FT | 17,210 | CY |
| | Excavation | 8,605 | LF | 60 | FT | 0.5 | FT | 9,561 | CY |
| | Riprap | 8,605 | LF | 40 | FT | 12 | IN | 28,046 | TON |
| | Aggregate patrol road | 8,605 | LF | 12 | FT | 4 | IN | 2,805 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 8,605 | LF | 60 | FT | | | 11.9 | AC |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 6: Steamboat Creek and Boynton Slough
Location: South of Boynton Slough

| Item | Description | QUANTITIES | | | | | | |
|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | TOTAL | |
| | Clear and Grub | 1 | LF | 70 | FT | | 0.0 | AC |
| | Embankment fill | 1 | LF | | | | 0 | CY |
| | Exc inspection trench | 1 | LF | 9 | FT | -5.0 FT | -2 | CY |
| | Excavation | 1 | LF | 10 | FT | 0.5 FT | 0 | CY |
| | Riprap | 1 | LF | 30 | FT | 12 IN | 2 | TON |
| | Aggregate patrol road | 1 | LF | 12 | FT | 4 IN | 0 | TON |
| | Fencing | | | | | | 0 | LF |
| | Seeding | 1 | LF | 60 | FT | | 0.0 | AC |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 6: Steamboat Creek and Boynton Slough
Location: Bridge Replacements: Pembrook and McCarran

| Item | Description | QUANTITIES | | |
|---|---|---|---|---|
| REPLACEMENT | | | Total | |
| | Demo existing bridges | Pembrook | | LS |
| | | McCarran | | LS |
| | Construct new bridges | Pembrook | | LS |
| | | McCarran | | LS |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 6: Steamboat Creek and Boynton Slough
Location: South of Boynton Slough

| Item | Description | QUANTITIES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | | Height | | TOTAL | |
| | Clear and Grub | 6,550 | LF | 70 | FT | | | 10.5 | AC |
| | Embankment fill | 6,550 | LF | | | | | 58,082 | CY |
| | Exc inspection trench | 6,550 | LF | 9 | FT | 6.0 | FT | 13,100 | CY |
| | Excavation | 6,550 | LF | 50 | FT | 0.5 | FT | 6,065 | CY |
| | Riprap | | | | | | | | TON |
| | Aggregate patrol road | 6,550 | LF | 12 | FT | 4 | IN | 2,135 | TON |
| | Fencing | | | | | | | 0 | LF |
| | Seeding | 6,550 | LF | 60 | FT | | | 9.0 | AC |

Notes:
1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.
4. The 18,500 cfs levee elevation was lowered to 4397ft.

LEVEE FILL VOLUME CALCULATIONS

Boynton Slough from McCarran to Pembrook to Steamboat Cr.

Finished Height of Levee: 4397 FT

| | Length | Base Elev | Height | X-Sect | Volume | |
|---|---|---|---|---|---|---|
| N. BankN/o Boynton | 3,720 LF | 4387 FT | 10 FT | 370 SFT | 50,978 CY | 37200 |
| N/o Boynton | 2,160 LF | 4390 FT | 7 FT | 207 SFT | 16,520 CY | 15120 |
| Pembrook to Steam. | 2,100 LF | 4390 FT | 7 FT | 207 SFT | 16,061 CY | 14700 |
| S.Bank e/o McCarran | 1,700 LF | 4390 FT | 7 FT | 207 SFT | 13,002 CY | 11900 |
| e/o McCarran | 60 LF | 4391 FT | 6 FT | 162 SFT | 360 CY | 360 |
| w/o McCarran | 850 LF | 4385 FT | 12 FT | 504 SFT | 15,867 CY | 10200 |
| | **10,590 LF** | **Total Length** | | **Total Volume** | **112,787 CY** | 89480 |
| | **8.4 FT** | **Avg Height** | | | | |

FLOODWALL VOLUME CALCULATIONS

| | Length | Width | W.S. Elev | Ground Elev | Height | Volume |
|---|---|---|---|---|---|---|
| Above Ground | 850 LF | 1.5 FT | 4397 FT | 4385 FT | 12 FT | 567 CY |
| | 150 LF | 1.5 FT | 4397 FT | 4395 FT | 2 FT | 17 CY |
| | 1,000 LF | 1.5 FT | 4397 FT | 4385 FT | 12 FT | 667 CY |
| | 1,850 LF | 1.5 FT | 4397 FT | 4390 FT | 7 FT | 719 CY |
| Below Ground | 3,850 LF | 3.5 FT | | | 1.2 FT | 599 CY |
| | 3,850 LF | 4 FT | | | 2.8 FT | 1,597 CY |
| | | | | | | **4,165 CY** |

LEVEE FILL VOLUME CALCULATIONS

East of Steamboat Creek

Finished Height of Levee: 4397 FT

| | Length | Base Elev | Height | X-Sect | Volume | |
|---|---|---|---|---|---|---|
| N/o Pembrook | 1,500 LF | 4388 FT | 9 FT | 311 SFT | 17,250 CY | 13500 |
| N/o Pembrook | 1,200 LF | 4387 FT | 10 FT | 370 SFT | 16,444 CY | 12000 |
| N/o Pembrook | 1,320 LF | 4389 FT | 8 FT | 256 SFT | 12,516 CY | 10560 |
| S/o Pembrook | 600 LF | 4389 FT | 8 FT | 256 SFT | 5,689 CY | 4800 |
| S/o Pembrook | 1,080 LF | 4385 FT | 12 FT | 504 SFT | 20,160 CY | 12960 |
| S/o Pembrook | 1,085 LF | 4394 FT | 3 FT | 59 SFT | 2,351 CY | 3255 |
| S/o Pembrook | 1,620 LF | 4388 FT | 9 FT | 311 SFT | 18,630 CY | 14580 |
| tie into hills | 200 LF | 4394 FT | 3 FT | 59 SFT | 433 CY | 600 |
| | 0 LF | 4398 FT | -1 FT | -10 SFT | 0 CY | 0 |
| | **8,605 LF** | **Total Length** | | **Total Volume** | **93,473 CY** | 72255 |
| | **8.4 FT** | **Avg Height** | | | | |

LEVEE FILL VOLUME CALCULATIONS
South of Boynton Slough
Finished Height of Levee: 4397 FT

| Length | Base Elev | Height | X-Sect | Volume | |
|---|---|---|---|---|---|
| 0 LF | 4402 FT | -5 FT | 3 SFT | 0 CY | 0 |
| 0 LF | 4402 FT | -5 FT | 3 SFT | 0 CY | 0 |
| 0 LF | 4402 FT | -5 FT | 3 SFT | 0 CY | 0 |
| 0 LF | 4402 FT | -5 FT | 3 SFT | 0 CY | 0 |
| 1 LF | 4402 FT | -5 FT | 3 SFT | 0 CY | -5 |
| **1 LF** | **Total Length** | | **Total Volume** | **0 CY** | -5 |
| **-5.0 FT** | **Avg Height** | | | | |

LEVEE FILL VOLUME CALCULATIONS

South of Boynton Slough

Finished Height of Levee: 4397 FT

| | Length | Base Elev | Height | X-Sect | Volume | |
|---|---|---|---|---|---|---|
| | 150 LF | 4390 FT | 7 FT | 207 SFT | 1,147 CY | 1050 |
| | 800 LF | 4388 FT | 9 FT | 311 SFT | 9,200 CY | 7200 |
| Subdivision | 2,500 LF | 4387 FT | 10 FT | 370 SFT | 34,259 CY | 25000 |
| | 500 LF | 4388 FT | 9 FT | 311 SFT | 5,750 CY | 4500 |
| | 200 LF | 4390 FT | 7 FT | 207 SFT | 1,530 CY | 1400 |
| | 700 LF | 4391 FT | 6 FT | 162 SFT | 4,200 CY | 4200 |
| | 1,500 LF | 4395 FT | 2 FT | 34 SFT | 1,889 CY | 3000 |
| tie into hills | 200 LF | 4396 FT | 1 FT | 15 SFT | 107 CY | 200 |
| | **6,550 LF** | **Total Length** | | **Total Volume** | **58,082 CY** | 46550 |
| | **7.1 FT** | **Avg Height** | | | | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 7: University Farms Area, Without Detention Basin
Location: Eastern Levees: West of Steamboat overflow area

| Item | Description | QUANTITIES | | | | | |
|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | Height | TOTAL | |
| | Clear and Grub | 6,660 | LF | 70 FT | | 10.7 | AC |
| | *Embankment fill* | | | | | 148,158 | CY |
| | Exc inspection trench | 6,660 | LF | 9 FT | 6.0 FT | 13,320 | CY |
| | Excavation | 6,660 | LF | 80 FT | 0.5 FT | 9,867 | CY |
| | Riprap | | | | | | TON |
| | Aggregate patrol road | 6,660 | LF | 12 FT | 4 IN | 2,171 | TON |
| | Fencing | | | | | 0 | LF |
| | Seeding | 6,660 | LF | 60 FT | | 9.2 | AC |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 7 University Farms Area, Without Detention Basin
Location: North Bank: Truckee River Levee

| Item | Description | QUANTITIES | | | | | |
|---|---|---|---|---|---|---|---|
| LEVEES | | Length | | Width | Height | TOTAL | |
| | Clear and Grub | 6,000 | LF | 70 FT | | 9.6 | AC |
| | Embankment fill | | | | | 48,057 | CY |
| | Exc inspection trench | 6,000 | LF | 9 FT | 6.0 FT | 12,000 | CY |
| | Excavation | 6,000 | LF | 20 FT | 0.5 FT | 2,222 | CY |
| | Riprap | | | | | | TON |
| | Aggregate patrol road | 6,000 | LF | 12 FT | 4 IN | 1,956 | TON |
| | Fencing | | | | | | LF |
| | Seeding | 6,000 | LF | 60 FT | | 8.3 | AC |

1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.
4. Assume 12" riprap on northern and eastern basin levees, per 1983 report.
5. Assume 200 lb rebar per cubic-yard formed concrete, per 1991 report.
6. Assume 6" bedding/drain material beneath detentino basin weirs.

LEVEE FILL VOLUME CALCULATIONS

Eastern Levees: West of Steamboat overflow area

Finished Height of Levee: 4401 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| Pembrook | 2,400 LF | 4388.5 FT | 12.5 FT | 541 SFT | 48,056 CY |
| north to knoll | 2,280 LF | 4388.5 FT | 12.5 FT | 541 SFT | 45,653 CY |
| tie into knoll | 1,980 LF | 4386 FT | 15 FT | 743 SFT | 54,450 CY |
| | **6,660 LF** | **Total Length** | | **Total Volum** | **148,158 CY** |
| | **13.2 FT** | **Avg Height** | | | |

LEVEE FILL VOLUME CALCULATIONS

Northern Levees: Truckee River Right Bank

| | Length | Base Elev | WS + 3ft | Height | X-Sect | Volume |
|---|---|---|---|---|---|---|
| 182+00 to 172+00 | 1,000 LF | 4393 FT | 4401 | 8 FT | 256 SFT | 9,481 CY |
| 172+00 to 169+00 | 300 LF | 4392 FT | 4401 | 9 FT | 311 SFT | 3,450 CY |
| 169+00 to 168+00 | 100 LF | 4395 FT | 4401 | 6 FT | 162 SFT | 600 CY |
| 168+00 to 162+00 | 600 LF | 4392 FT | 4400 | 8 FT | 256 SFT | 5,689 CY |
| 162+00 to 158+00 | 400 LF | 4395 FT | 4399 | 4 FT | 88 SFT | 1,304 CY |
| 158+00 to 138+00 | 2,000 LF | 4391 FT | 4398 | 7 FT | 207 SFT | 15,296 CY |
| 138+00 to 122+00 | 1,600 LF | 4390 FT | 4397 | 7 FT | 207 SFT | 12,237 CY |
| | **6,000 LF** | **Total Length** | | | **Total Volume** | **48,057 CY** |
| | **7.2 FT** | **Avg Height** | | | | |

**Reach 7A: University Farms Area, Includes Detention Basin**

EXCAVATION VOLUME CALCULATIONS - 1000FT WEIR 26,000 cfs

Station 184+75 to 184+00

Channel Invert Elevation: 4381 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 75 LF | 4390 FT | 9 FT | 1,980 SFT | 5,500 CY | 40 FT |
| | 75 LF | 4394 FT | 13 FT | 2,860 SFT | 7,944 CY | 50 FT |
| Subtract 2:1 Slope | 3 LF | 4394 FT | 13 FT | 2,860 SFT | 344 CY | 50 FT |
| | | | **Total Cummulative Volume** | | **13,100 CY** | |

Station 184+00 to 180+00

Channel Invert Elevation: 4380 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 400 LF | 4390 FT | 10 FT | 100 SFT | 1,481 CY | 10 FT |
| | 400 LF | 4393 FT | 13 FT | 2,600 SFT | 38,519 CY | 200 FT |
| Subtract 2:1 Slope | 3 LF | 4393 FT | 13 FT | 2,600 SFT | 313 CY | 200 FT |
| | | | **Total Cummulative Volume** | | **52,787 CY** | |

Station 180+00 to 174+00

Channel Invert Elevation: 4382 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 600 LF | 4390 FT | 8 FT | 80 SFT | 1,778 CY | 10 FT |
| | 600 LF | 4393 FT | 11 FT | 2,090 SFT | 46,444 CY | 190 FT |
| | 400 LF | 4393 FT | 11 FT | 550 SFT | 8,148 CY | 50 FT |
| | 200 LF | 4395 FT | 13 FT | 650 SFT | 4,815 CY | 50 FT |
| Subtract 2:1 Slope | 3 LF | 4395 FT | 13 FT | 650 SFT | 78 CY | 50 FT |
| | | | **Total Cummulative Volume** | | **113,894 CY** | |

Station 174+00 to 168+00

Channel Invert Elevation: 4385 FT

| | Length | Base Elev | Height | X-Sect | Volume | Width |
|---|---|---|---|---|---|---|
| | 600 LF | 4390 FT | 5 FT | 200 SFT | 4,444 CY | 40 FT |
| | 200 LF | 4395 FT | 10 FT | 600 SFT | 4,444 CY | 60 FT |
| | 400 LF | 4391 FT | 6 FT | 1,080 SFT | 16,000 CY | 180 FT |
| Subtract 2:1 Slope | 2 LF | 4391 FT | 6 FT | 1,080 SFT | 60 CY | 180 FT |
| | | | **Total Cummulative Volume** | | **138,723 CY** | |

# CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs  Date: 7/18/97
Reach 7A: University Farms Area, Includes Detention Basin
Location: Western & Southern Levees: East side McCarran, North side Pembrook

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | TOTAL |
| | Clear and Grub | 10,890 LF | 70 FT | | 17.5 AC |
| | Embankment fill | | | | 156,781 CY |
| | Exc inspection trench | 10,890 LF | 9 FT | 6.0 FT | 21,780 CY |
| | Excavation | 10,890 LF | 70 FT | 0.5 FT | 14,117 CY |
| | Riprap | 0 LF | 0 FT | 0 FT | 0 TON |
| | Aggregate patrol road | 10,890 LF | 12 FT | 4 IN | 3,549 TON |
| | Fencing | | | | 0 LF |
| | Seeding | 10,890 LF | 60 FT | | 15.0 AC |

Project: Truckee Meadows 26,000 cfs  Date: 7/18/97
Reach 7A: University Farms Area, Includes Detention Basin
Location: Eastern Levees: West of Steamboat overflow area

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | TOTAL |
| | Clear and Grub | 6,660 LF | 70 FT | | 10.7 AC |
| | Embankment fill | | | | 148,158 CY |
| | Exc inspection trench | 6,660 LF | 9 FT | 6.0 FT | 13,320 CY |
| | Excavation | 6,660 LF | 80 FT | 0.5 FT | 9,867 CY |
| | Riprap | 6,660 LF | 40 FT | 12 IN | 21,707 TON |
| | Aggregate patrol road | 6,660 LF | 12 FT | 4 IN | 2,171 TON |
| | Fencing | | | | 0 LF |
| | Seeding | 6,660 LF | 60 FT | | 9.2 AC |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 7A: *University Farms Area, Includes Detention Basin*
Location: Northern Levees: Truckee River

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | TOTAL |
| | Clear and Grub | 5,000 LF | 70 FT | | 8.0 AC |
| | Embankment fill | | | | 38,576 CY |
| | Exc inspection trench | 5,000 LF | 9 FT | 6.0 FT | 10,000 CY |
| | Excavation | 5,000 LF | 20 FT | 0.5 FT | 1,852 CY |
| | Riprap | 5,000 LF | 40 FT | 12 IN | 16,296 TON |
| | Aggregate patrol road | 5,000 LF | 12 FT | 4 IN | 1,630 TON |
| | Fencing | | | | 0 LF |
| | Seeding | 5,000 LF | 60 FT | | 6.9 AC |

Project: Truckee Meadows 26,000 cfs Date: 7/18/97
Reach 7A: University Farms Area, Includes Detention Basin
Location: Detention basin facilities: inlet weir, outlet weir, low level outlet

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| FACILITIES | | Length | Width | Height | TOTAL |
| | Clear and Grub | 1,350 LF | 70 FT | | 2.2 AC |
| | Excavation | 1,350 LF | | | 1,778 CY |
| | Bedding material | 1,250 LF | 20 FT | 6 IN | 1,019 TON |
| | Formed concrete | | | | 1,778 CY |
| | Reinforcing steel | | | | 355,556 LBS |
| | Riprap | 1,650 LF | 35 LF | 6 IN | 2,353 TON |
| | 48" RCP | | | | 100 LF |
| | 48" Control gates | | | | 2 EA |
| | 48" Flap gates | | | | 2 EA |

Notes:
1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee. (EM-1110-2-1913)
2. Assume clearing and grubbing at 70' wide along the length of the levee per 1991 estimates (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.
4. Assume 12" riprap on northern and eastern basin levees, per 1983 report.
5. Assume 200 lb rebar per cubic-yard formed concrete, per 1991 report.
6. Assume 6" bedding/drain material beneath detentino basin weirs.

LEVEE FILL VOLUME CALCULATIONS

Western and Southern Levees: East side McCarran, North side Pembrook

Finished Height of Levee: 4401 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| river to Kimlick | 780 LF | 4392 FT | 9 FT | 311 SFT | 8,970 CY |
| Kimlick to McCarran | 780 LF | 4394 FT | 7 FT | 207 SFT | 5,966 CY |
| S/o McCarran | 1,800 LF | 4393 FT | 8 FT | 256 SFT | 17,067 CY |
| S/o McCarran | 1,200 LF | 4392 FT | 9 FT | 311 SFT | 13,800 CY |
| to Pembrook | 2,790 LF | 4390 FT | 11 FT | 435 SFT | 44,898 CY |
| Pembrook | 3,540 LF | 4389 FT | 12 FT | 504 SFT | 66,080 CY |
| | **10,890 LF** | **Total Length** | | **Total Volume** | **156,781 CY** |
| | **10.2 FT** | **Avg Height** | | | |

LEVEE FILL VOLUME CALCULATIONS

Eastern Levees: West of Steamboat overflow area

Finished Height of Levee: 4401 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| Pembrook | 2,400 LF | 4388.5 FT | 12.5 FT | 541 SFT | 48,056 CY |
| north to knoll | 2,280 LF | 4388.5 FT | 12.5 FT | 541 SFT | 45,653 CY |
| tie into knoll | 1,980 LF | 4386 FT | 15 FT | 743 SFT | 54,450 CY |
| | **6,660 LF** | **Total Length** | | **Total Volume** | **148,158 CY** |
| | **13.2 FT** | **Avg Height** | | | |

LEVEE FILL VOLUME CALCULATIONS

Northern Levees: Truckee River Right Bank

| | Length | Base Elev | WS + 3ft | Height | X-Sect | Volume |
|---|---|---|---|---|---|---|
| 172+00 to 169+00 | 300 LF | 4392 FT | 4401 | 9 FT | 311 SFT | 3,450 |
| 169+00 to 168+00 | 100 LF | 4395 FT | 4401 | 6 FT | 162 SFT | 600 |
| 168+00 to 162+00 | 600 LF | 4392 FT | 4400 | 8 FT | 256 SFT | 5,689 |
| 162+00 to 158+00 | 400 LF | 4395 FT | 4399 | 4 FT | 88 SFT | 1,304 |
| 158+00 to 138+00 | 2,000 LF | 4391 FT | 4398 | 7 FT | 207 SFT | 15,296 |
| 138+00 to 122+00 | 1,600 LF | 4390 FT | 4397 | 7 FT | 207 SFT | 12,237 |
| | **5,000 LF** | **Total Length** | | | **Total Volume** | **38,576** |
| | **7.0 FT** | **Avg Height** | | | | |

CONCRETE VOLUME CALCULATIONS

Detention basin facilities: inlet weir, outlet weir, low level outlet

| | Length | X-Sect | Volume |
|---|---|---|---|
| inlet weir | 1,000 LF | 38 SFT | 1,407 CY |
| outlet weir | 250 LF | 40 SFT | 370 CY |
| *low level outlet* | *100 LF* | *0 SFT* | *CY* |
| | **1,350 LF** | | **1,778 CY** |

## CONSTRUCTION ESTIMATES

Project: Truckee Meadows 26,000 cfs  Date: 7/18/97
Reach 8: N. Truckee Drain, Peoples Ditch
Location: N. Truckee Drain, Peoples Ditch

| Item | Description | QUANTITIES | | | |
|---|---|---|---|---|---|
| LEVEES | | Length | Width | Height | TOTAL |
| | Clear and Grub | 12,115 LF | 70 FT | | 19.5 AC |
| | Embankment fill | 12,115 LF | | | 118,181 CY |
| | Exc inspection trench | 12,115 LF | 9 FT | 6 FT | 24,230 CY |
| | Excavation | 12,115 LF | 45 FT | 0.5 FT | 10,096 CY |
| | Riprap | | | | TON |
| | Aggregate patrol road | 12,115 LF | 12 FT | 4 IN | 3,949 TON |
| | Fencing | | | | LF |
| | Seeding | 12,115 LF | 60 FT | | 16.7 AC |

Notes:
1. Inspection trench to be 6' deep for levees greater than 6' in total height. Depth of trench for levees less than 6' high shall equal height of levee.
2. Clearing and grubbing was estimated at 70' wide along the length of the levee in the 1991 report (no significant variance with levee height).
3. Assume 4" of aggregate on patrol road per 1991 estimations.

LEVEE FILL VOLUME CALCULATIONS
North Truckee Drain Area
Finished Height of Levee: 4397 FT

| | Length | Base Elev | Height | X-Sect | Volume |
|---|---|---|---|---|---|
| NTDR | 430 LF | 4388 FT | 9 FT | 311 SFT | 4,945 CY |
| NTDR | 430 LF | 4388 FT | 9 FT | 311 SFT | 4,945 CY |
| NTDR | 780 LF | 4389 FT | 8 FT | 256 SFT | 7,396 CY |
| NTDR | 600 LF | 4392 FT | 5 FT | 123 SFT | 2,722 CY |
| NTDR | 1,200 LF | 4386 FT | 11 FT | 435 SFT | 19,311 CY |
| S/o 80 | 4,875 LF | 4388 FT | 9 FT | 311 SFT | 56,063 CY |
| N/o 80 | 900 LF | 4391 FT | 6 FT | 162 SFT | 5,400 CY |
| N/o 80 | 900 LF | 4391 FT | 6 FT | 162 SFT | 5,400 CY |
| N/o 80 | 1,000 LF | 4391 FT | 6 FT | 162 SFT | 6,000 CY |
| N/o 80 | 1,000 LF | 4391 FT | 6 FT | 162 SFT | 6,000 CY |
| | **12,115 LF** | **Total Length** | | **Total Volume** | **118,181 CY** |
| | **8.0 FT** | **Avg Height** | | | |

# Section 5
# Related Topics

# Section 5
# R lated Topics

## UPSTREAM STORAGE OPTIONS

Potential detention or retention of floodwater as a means of reducing downstream flood peaks is discussed in this Reconnaissance Report. The effects of re-operation of upstream reservoirs such as Prosser , Stampede, or Lake Tahoe are discussed in the "Attachment 1" Hydrology Office Report." New large-scale storage, such as Dog Creek reservoir is also discussed in that attachment.

Discussion of small-scale detention facilities follows. All basins presented in this section are concepts and are subject to more detailed consideration if pursued further.

### Introduction

This Reconnaissance Report evaluates several concepts for temporary flood storage during Truckee River flood events. These options would reduce peak-flow volumes downstream, thereby reducing the size of other needed flood protection measures. Each option is evaluated based on its potential to meet the target volumes, and its estimated construction costs.

The volume of water to store during a flood was estimated using a theoretical 100-year hydrograph, developed by the COE, with a peak flow of 26,000 cfs. The storage volume was determined by truncating the hydrograph at a maximum downstream flow. This hydrograph was scaled to represent floods of different magnitudes. The truncated volume was stored and the remaining flow continued downstream.

The results of this evaluation indicate that there are two potential approaches to upstream storage of Truckee River flood waters. The first approach uses one large project for upstream diversion of the maximum targeted volume (17,400 acre-feet [af]). The second approach uses numerous smaller projects along the Truckee River from Truckee to Lawton. The first potential approach is a modified version of the Verdi Dam, which was first proposed by the COE in 1967. The original design was for a storage capacity of 37,000 af; the modified version would be for storage of 18,000 af, which approximates the targeted diversion quantity for the SPF.

The second approach involves a series of three smaller off-channel detention basins along the Truckee River (east of Truckee, at Fleish, and at Verdi). It is possible that this approach will be recommended in conjunction with a sequence of instream retention areas that will be formed using proportional weirs between Lawton and the state line.

The process used in this evaluation, features of each of the considered sites, and the specific issues surrounding the sites proposed for further consideration are presented in this report.

## Target Diversion Volumes

Table 5-1 summarizes the diversion volumes stored in detention basins for the three flow options evaluated for the project. Diversion of these volumes from the Truckee River upstream of Reno would provide a greater level of flood protection without modifying the existing flood control structures in the Truckee Meadows. The diverted or retained volumes would be released systematically or would be redirected into the channel once peak flows pass through the protected downstream area.

**Table 5-1**
**Target Diversion Volumes Considered**
**Truckee Meadows**

| Peak Flow (cfs) | Reduced Flow (cfs) | Required Storage Volume (af) |
|---|---|---|
| 18,500 | 14,000 | 4,350 |
| 26,000 | 18,500 | 8,250 |
| 39,800 | 26,000 | 17,400 |

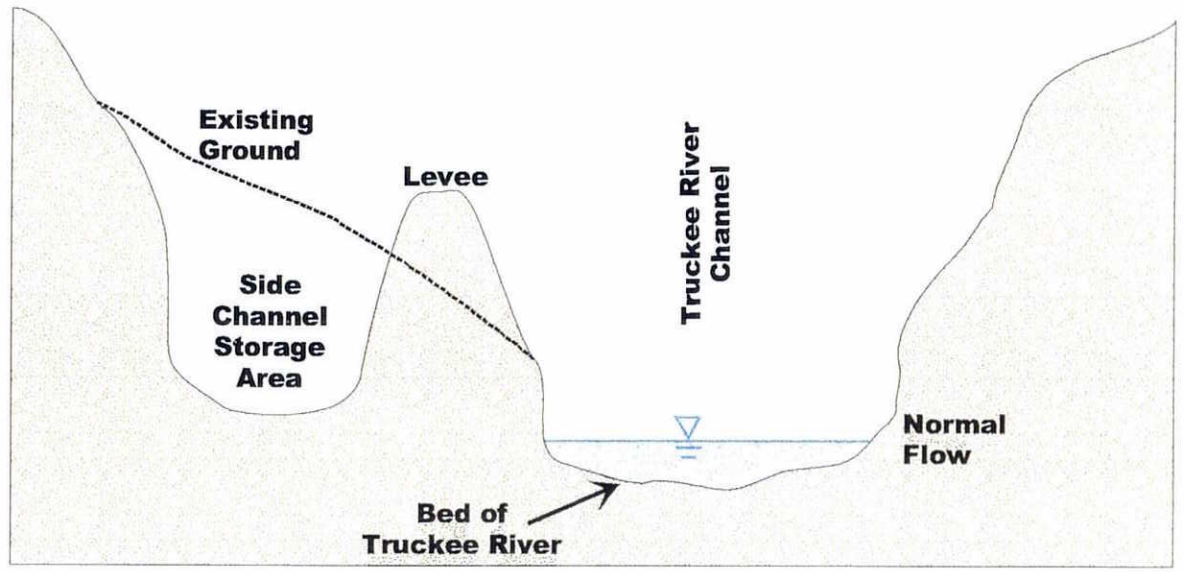
## Discussion of Options

### Types of Options Considered

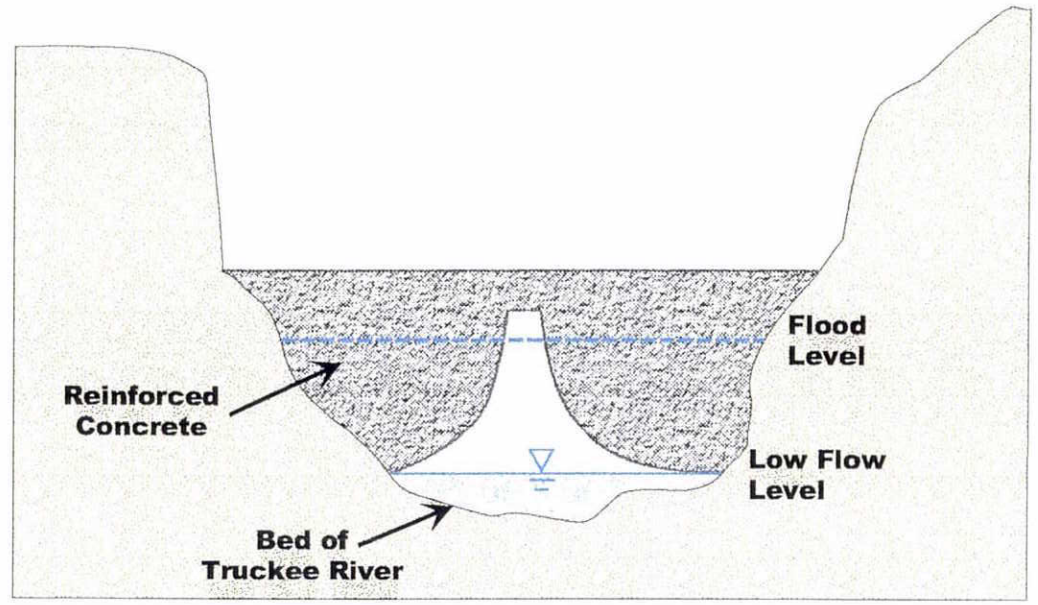
Three different types of temporary storage were considered along the Truckee River upstream of Reno (Figure 5-1):

- *In-stream retention* - in-stream impoundments using one or more proportional weirs, an inflatable dam, or a permanent dam,
- *Side-channel retention* - diversion of river flow through a weir into a retention basin adjacent to the river channel, and
- *Off-channel retention* - diversion of the river through a weir and channel into a retention basin located near the river.

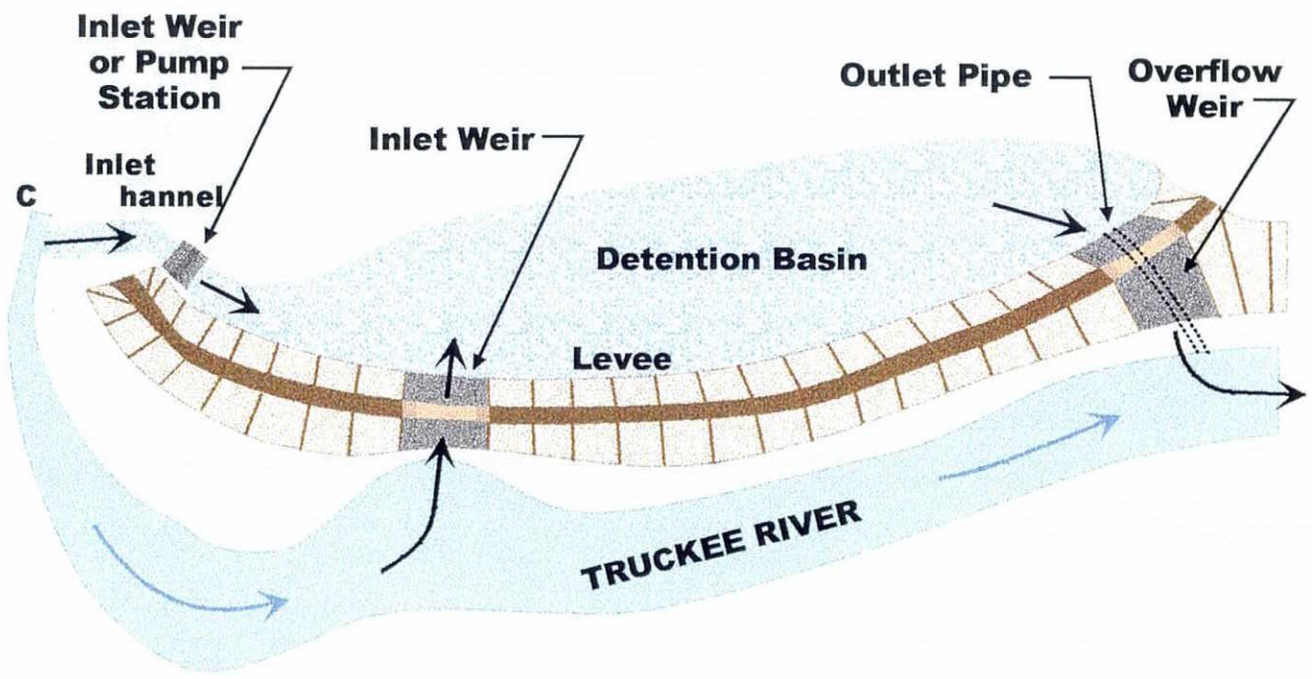
A full-size dam on the Truckee River in the Truckee River Canyon upstream of Verdi could possibly be constructed to store the target volume. In-stream dams



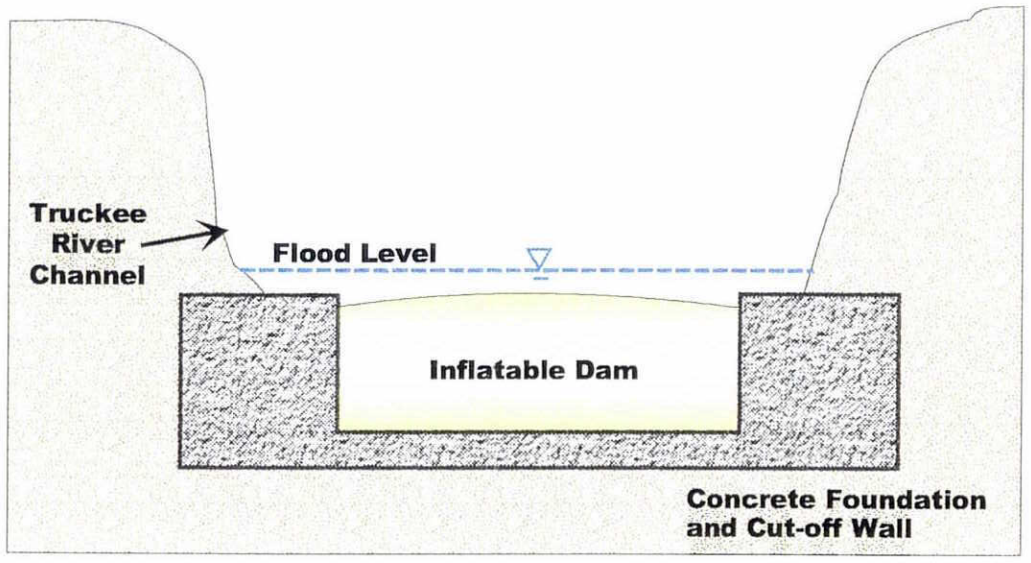

**TYPICAL SECTION**
**SIDE CHANNEL STORAGE**
**(NOT TO SCALE)**




**TYPICAL SECTION**
**IN-CHANNEL PROPORTIONAL WEIR**
***(NOT TO SCALE)***




**TYPICAL PLAN VIEW**
**SIDE CHANNEL STORAGE**
**(NOT TO SCALE)**




**TYPICAL CROSS-SECTION**
**INFLATABLE DAM**
**(NOT TO SCALE)**

FIGURE 5-1
TYPICAL CROSS SECTIONS AND PLAN VIEWS
OF IN-STREAM AND SIDE-CHANNEL STORAGE

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TRUCKEE MEADOWS, NEVADA

were not considered in this analysis because of the extensive cost, environmental regulations, and legal issues surrounding new outstream dams.

*In-Stream Retention*

In-stream retention structures consist of dams, proportional weirs, and inflatable dams. These facilities would store water at peak flow periods in the river channel. During normal flow periods, flow would pass through the dam. Permanent structures, such as proportional weirs or dams, would visually impact the river channel and could interfere with recreational uses of the river.

*Side- and Off-Channel Detention*

Two types of detention basins were evaluated: gravity-feed diversion and pumped diversion.

Gravity-feed diversion entails construction of a diversion channel that is at or near, the riverbed grade. The detention basin would be excavated at the proposed site, and levees would be placed as needed around the basin to retain the water. Inflow to the basin would be controlled by a weir; water would not enter the basin unless the water surface in the river exceeded the weir elevation. For example, the elevation of the weir could be set so that flow would not enter the basin until the Truckee River exceeded, 15,000 cfs. Flow would be returned to the river through an at-grade channel or pipe. For this analysis the excavation was assumed to be 20 feet. Actual depths of excavation may be deeper or shallower, depending on site-specific conditions and the projected depth of flooding. Site-specific information on area topography and depth to groundwater will be required to provide more specific design requirements and cost estimates.

Pumped diversion would require installation of a fish screen at the mouth of the diversion. Diverted water would then be pumped to the diversion basin. It was assumed that 22-foot levees or natural bluffs would create the above-grade impoundment. Water would be returned to the river via a gravity-feed channel.

These two scenarios are considered to represent extreme cases for diversion and detention of water. It is probable that a more realistic approach would include a combination of levee construction and excavation. However, more specific site information and hydraulic modeling would be required to provide actual site designs.

**Truckee River Channel Issues**

Diversion options along the Truckee River are limited by the configuration of the Truckee River, the proximity of major transportation routes (railroad and highway), and extensive residential and commercial development. Most areas

suitable for diversion have been developed, making construction of any type of detention basin problematic.

## Limitations of Evaluation

This evaluation is an initial assessment of temporary upstream storage options along the Truckee River. Issues such as land ownership, real estate costs at evaluated sites, site-specific constraints, and environmental issues have not been evaluated. As the COE progresses in developing an approach to flood control for the Truckee Meadows, these issues will have to be considered in more detail for the design of the selected project(s), if upstream diversion is considered. In addition, future detailed hydrologic modeling and routing of flows will be necessary to assess the predicted success of the proposed alternatives.

Preliminary storage volumes estimated during this evaluation for individual sites are assumed to be $\pm$ 25 percent of design volumes. More detailed site evaluation and design, beyond the scope of this reconnaissance, are required to more accurately estimate the volume of water that can be stored at individual sites.

## Discussion of Alternative Sites

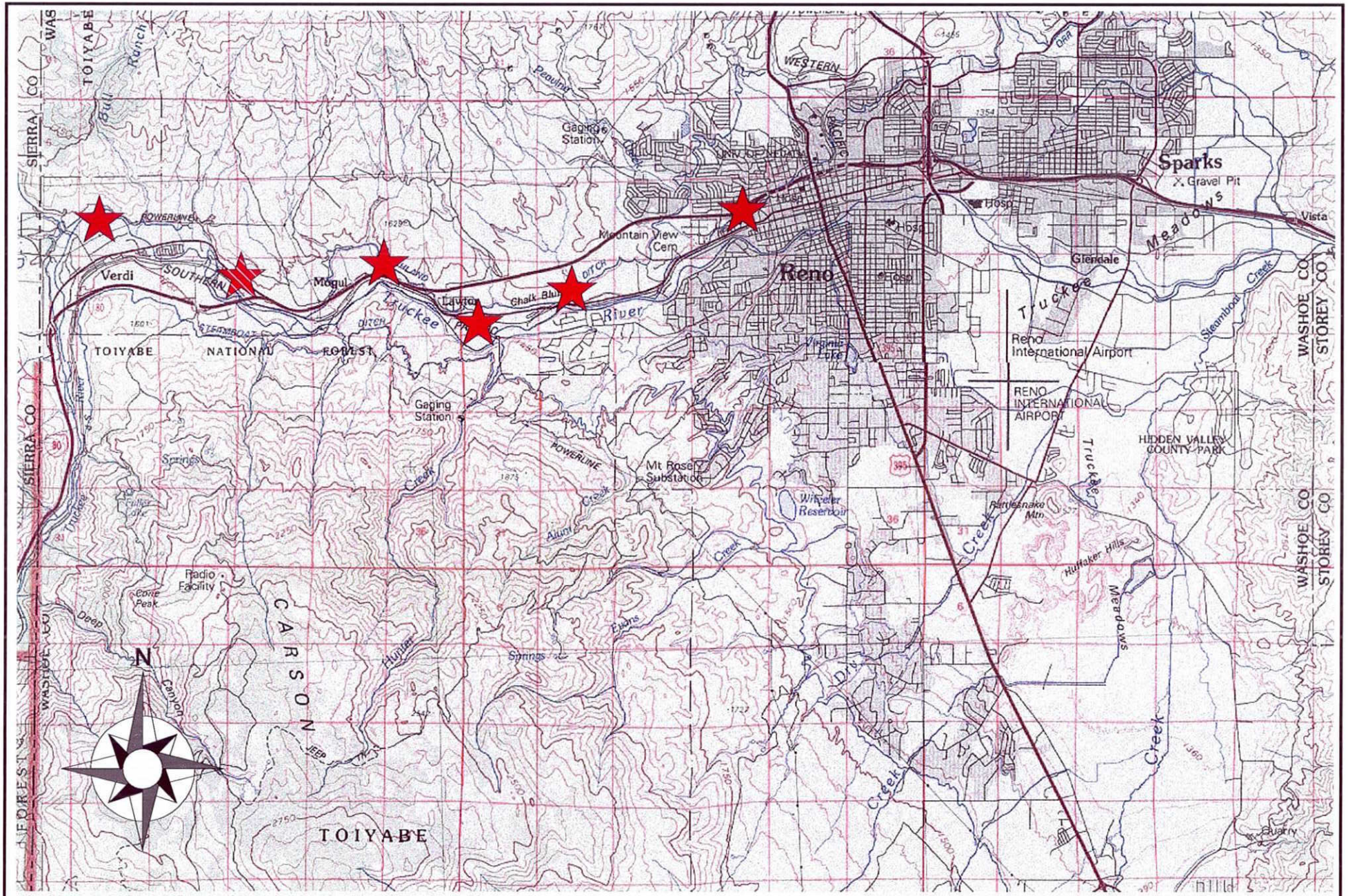
Undeveloped or slightly developed areas within the Truckee River valley were identified to establish whether suitable sites exist for in-stream or side-channel retention of flood waters. Topographic maps were used to identify areas with potential; a site reconnaissance was then conducted to ascertain the current level of development in those areas.

Numerous small sites (ranging in size from 20 to 80 acres) between Verdi and Reno were initially considered as potential sites for in-stream and side channel retention basins (Figure 5-2), including sites near Boomtown, Mogul, and Idlewild Park. For in-stream and side-channel sites of 60 acres or less, potential storage was less than 1,000 af. These areas also tended to require large levees relative to the potential storage. Once the volumes of targeted flow diversions were established, it became apparent that larger detention areas would be needed to meet these targeted volumes. For this reason, in-stream and side-channel sites smaller than 60 acres were not considered further. However, these sites are considered to have the highest potential for in-stream retention by proportional or inverted weirs.

### In-Stream Retention

*Verdi Dam*

In 1967, the COE, Sacramento District, evaluated the option of constructing a 160-foot-high earthen dam on the Truckee River at Verdi for the dual purpose of flood control and recreation (Figure 5-2). The proposed capacity of the reservoir

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**LEGEND**

**Potential instream detention site or side-channel storage**

**Proposed Verdi Dam site**

**FIGURE 5-2**
**POTENTIAL INSTREAM DETENTION SITES**
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TRUCKEE MEADOWS, NEVADA

was 37,000 af. The proposed design would require relocation of approximately 2 miles of railroad, the State fish hatchery, and the Verdi powerhouse.

Since this project was initially proposed, there has been extensive development in the Verdi area. Developing an in-stream dam of this size in a growing area would be difficult to implement from both an economic and an environmental standpoint. However, the proposed Verdi Dam would provide flood control over a large percentage of the Truckee River drainage basin upstream of Reno because it is located downstream of most of the uncontrolled Truckee River tributaries.

The COE estimated the construction cost of the 37,000 acre-foot dam (assuming a 4-year construction schedule) to be $32 million in 1966 dollars. This estimate would be $146 million in 1996 dollars. The conversion of the original estimate into 1996 dollars does not account for expected increases in relocation, land, and damages costs, which probably have escalated at a rate faster than have construction costs.

A scaled-back version of the Verdi Dam (assumed to be 18,000 af) would still require relocation of the railroad, the Verdi Powerhouse, and, probably, the State fish hatchery. This structure would be a dry dam and would only store water during floods. Cost estimates for this smaller Verdi Dam have not been developed at this time. If this option is to be pursued further, the COE would need to develop a preliminary design and cost estimate for a smaller dam.

*Lawton to Stateline*

A series of proportional or inverted weirs could be constructed in the vicinity of the small areas initially considered for in-stream or side-channel detention (Figure 5-2). Inflatable dams at these sites could also be considered. These facilities would retain a portion of the peak flows and would allow the remainder of the flow to pass. Proportional weirs pass low- to mid-level floods, but begin to store water at high flows.

The quantity of water that could be retained with in-stream storage has not been evaluated at this time. More detailed hydrologic modeling of the river would be necessary to estimate potential volumes. However, based on the estimated volume of the side-channel storage sites excavated for this report, up to 1,500 af of storage would be available at the six sites considered. The modeling would also provide an estimate of the number, size, and types of weirs for this approach to in-stream retention.

Costs have not been estimated for this project.

**Side-Channel Diversion at Union Bend**

A 140-acre side-channel diversion could be located within a sharp bend in the Truckee River upstream, near Truckee and the mouth of Union Valley

(Figure 5-3). The majority of the overbank area within the bend would be included in the impoundment. Some excavation of the site would be needed to lower the area to the approximate level of the diversion weir. Construction of 22-foot levees could provide up to 2,800 af of storage. Water could be diverted through a side weir when the depth exceeds a certain point.

This site offers several advantages. It is away from developed areas and is not adjacent to the railroad. One roadway (Glenshire Drive) goes through the area, but it could be re-routed along the levee (Figure 5-3).

Cost estimates for this project range from $23.2 million for a pump inlet to $68.1 million for a gravity flow.

**Off-Channel Diversion**

*East Truckee A and B*

This site is just downstream of the town of Truckee, near the confluence of the Truckee River and Martis Creek (Figure 5-3). The area currently has two primary uses: land application of recycled water by Tahoe-Truckee Sanitation Agency (TTSA), and sand and gravel quarrying by the Teichert Company.

If the entire area were developed into a detention basin, the area currently being used for land application of recycled water and the existing quarry would be included. Discussions with the current landowners to assess the feasibility of such an option have not been conducted.

Other issues that impact the area's use for temporary water storage include numerous utility crossings and the gravelly soil that underlies the area and rapidly recharges the underlying groundwater.

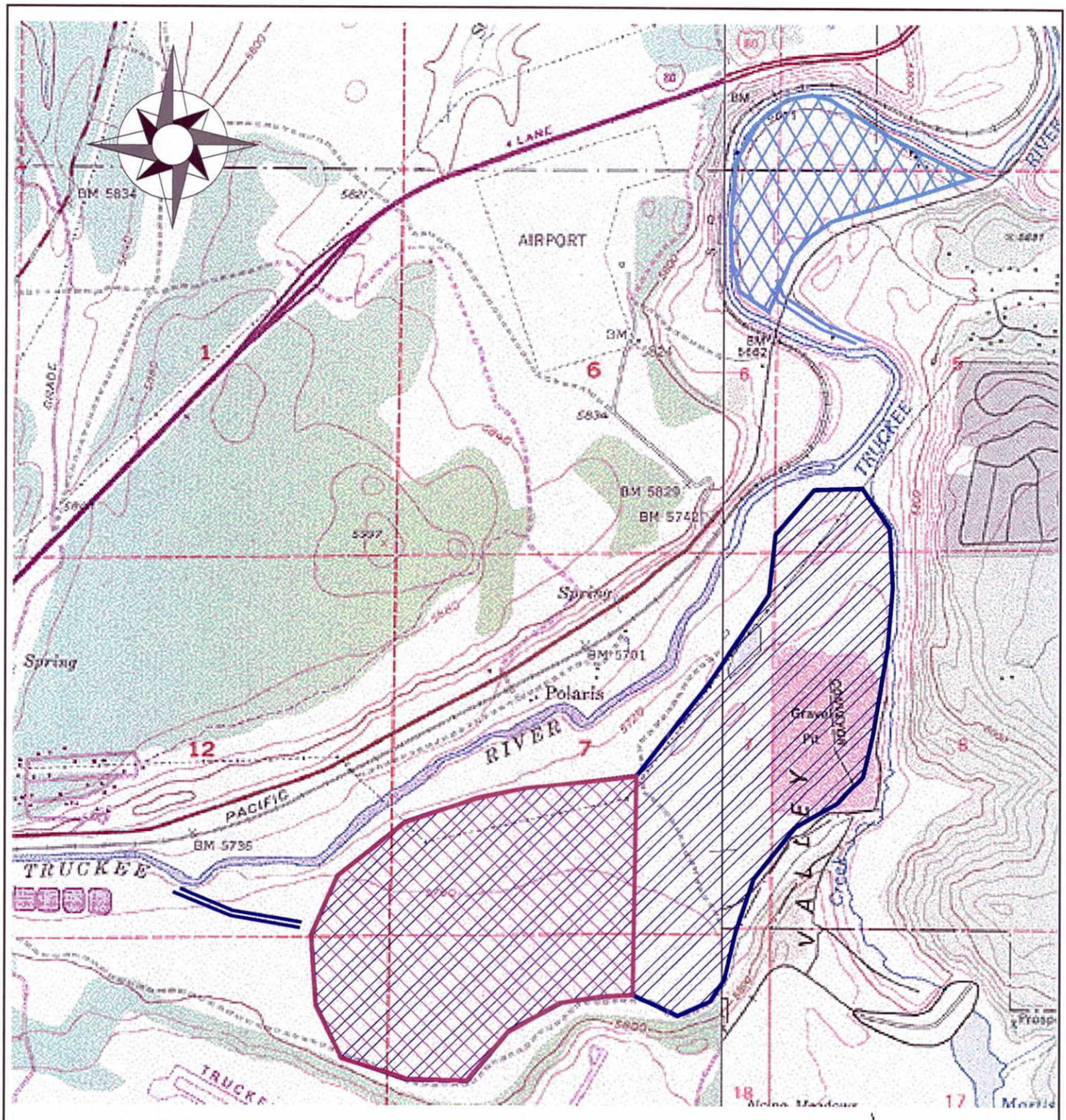
Construction of the East Truckee A site (680 acres), could provide up to 13,600 af of storage, but extensive excavation of the area would be required to lower the site to the river's elevation at the diversion point. Maximum development of the area could meet the standard project flood diversion volume.

East Truckee B is assumed to be a smaller-scale development (340 acres) of the same area, which could provide up to 6,800 af of storage. East Truckee B is located in the western portion of East Truckee A, because it is away from the quarry and the area TTSA is currently plumbing for land application of wastewater effluent.

Cost estimates for East Truckee A range from $229 million for a pump inlet to $413 million for gravity feed, and the cost for East Truckee B range from $94 million for a pump inlet to $234 million for gravity feed.

*North Flat A and B*

North Flat A is an 80-acre site located near Verdi, just downstream of the confluence of Ranch Creek with the Truckee River. It is bounded on the north by

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## LEGEND

- East Truckee A
- East Truckee B
- Union Bend

**FIGURE 5-3**
**POTENTIAL UPSTREAM SITES NEAR TRUCKEE**

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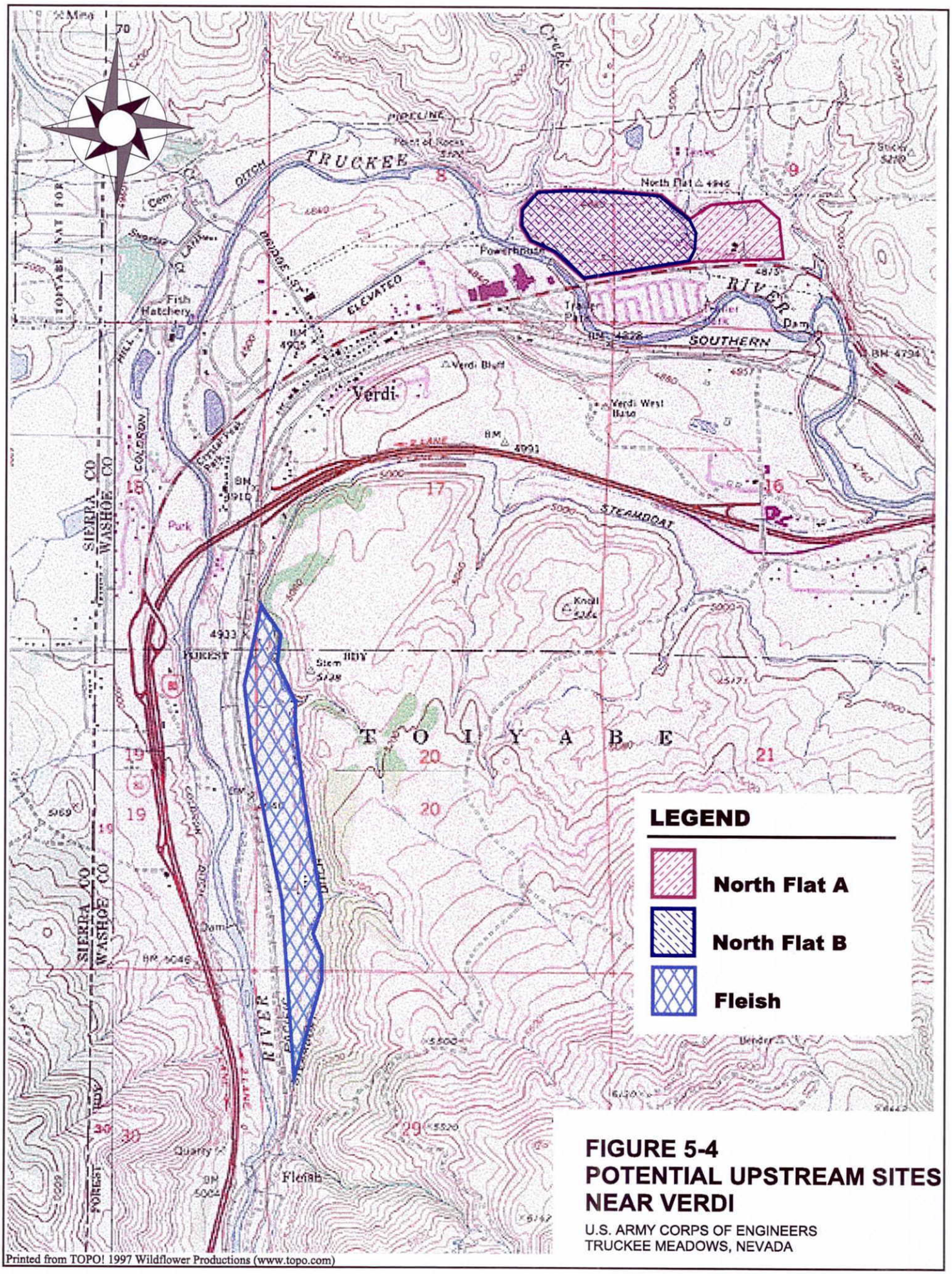


# FIGURE 5-4
# POTENTIAL UPSTREAM SITES NEAR VERDI

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## Table 5-2
## Potential Detention Basin Projects

| Specific Site | Site Size (acres) | Potential Water Storage* (af) | Necessary Facilities to Implement | Preliminary Cost ($ million) (1996 dollars) | | |
|---|---|---|---|---|---|---|
| | | | | Large Dam | Pumped Diversion | Gravity Diversion |
| **In-Channel Detention** | | | | | | |
| Verdi Dam A | Not Estimated | 37,000 | Earthfill dam and dikes. | $146 | NA | NA |
| Verdi Dam B | Not Estimated | 18,000 | See above. | Not Estimated | NA | NA |
| Lawton to Stateline Weirs | Not Estimated | Not Estimated | Weirs or inflatable dams. Some levees may be needed, depending on the volume of water to be impounded. | Not Estimated | NA | NA |
| **Side-Channel Detention** | | | | | | |
| Union Bend | 140 | 2,800 | Re-route road along levee. Remove soil to central part of area to increase storage area; evaluate option of excavating if local groundwater conditions allow. | | $23.2 | $68.1 |
| **Off-Channel Detention** | | | | | | |
| East Truckee A | 680 | 13,600 | 18,600 feet of levees, assuming bluff north of airport would not require levees. | | $229 | $413 |
| East Truckee B | 340 | 6,800 | 14,800 feet of levees, assuming bluff north of airport would not require levees. | | $94 | $234 |
| North Flat A | 80 | 1,600 | Off-stream weir and 100-foot channel. Return gate and 200-foot channel to local tributary. 9,500 feet of levees. | | $16.7 | $35.8 |
| North Flat B | 60 | 1,200 | Off-stream weir and 100-foot channel. Return gate and 200-foot channel to local tributary. 6,300 feet of levees. | | $12.2 | $26.8 |
| Fleish | 80 | 1,600 | Off stream weir and 800-foot channel with bridge under railroad. Return gate and 1,000-foot channel with bridges under railroad and powerhouse canal. 14,500 feet of levees. | | $6.4 | $6.4 |

Notes: *Instream - not estimated. Off-Channel and Side-Channel - assumed to be 20 feet times the size of the impoundment. NA = Not applicable.

have logistical problems that may make implementation difficult. Additional analysis is needed that focuses on reducing the amount of excavation (a significant cost element) and uses pumping to lift the water to the basin.

Development of a series of projects versus construction of single, larger projects provides several benefits, including:

- It provides flexibility in using flood control options along the Truckee River.
- It provides options downstream of the majority of the uncontrolled tributaries upstream of Reno.

Any of the sites could be developed to provide wildlife habitat.

## SPILLWAY ENLARGEMENT

The estimated costs, assumptions, and limitations associated with raising the spillway crests at Prosser and Stampede Dams by 5 and 10 feet, respectively, are summarized here. The COE performed hydraulic modeling to estimate the spillway length needed to accommodate the increased spillway crest height, while still maintaining existing storage conditions in the reservoirs. Please see the "Attachment 1 Hydrology Office Report" for a discussion of the hydrologic analysis of raising the spillways. This section presents an order-of-magnitude cost estimate for spillway construction intended to increase in-stream retention capacity in the Truckee River Basin reservoirs.

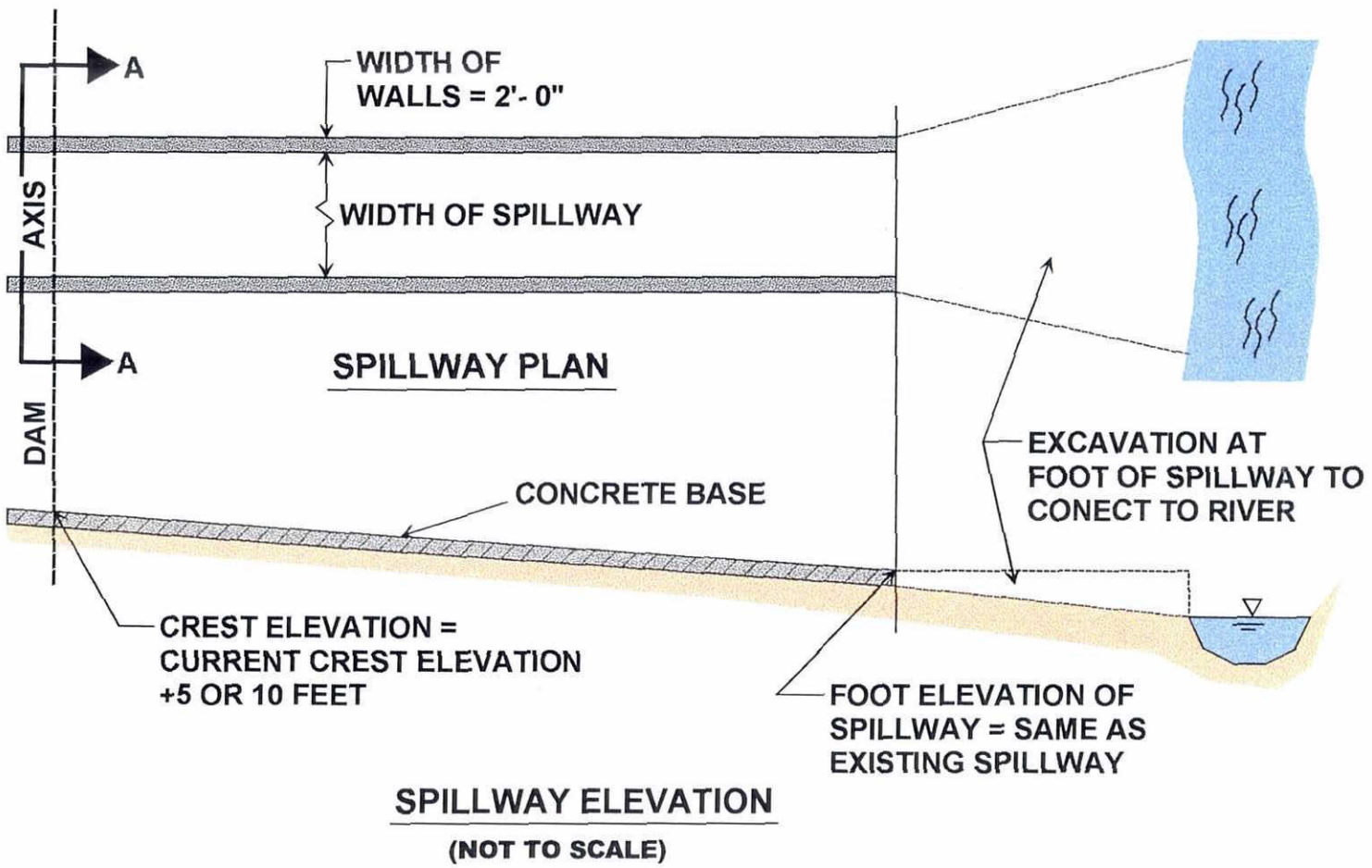
### Assumptions

This analysis is a reconnaissance-level study that uses available data from the *Truckee River Basin Reservoirs Water Control Manual* (COE, 1985). Assumptions designed to provide a conservative cost estimate were used.

No modifications to either dam were assumed necessary to raise the spillway. The additional width of spillway will be built into native soil next to the dam structure.

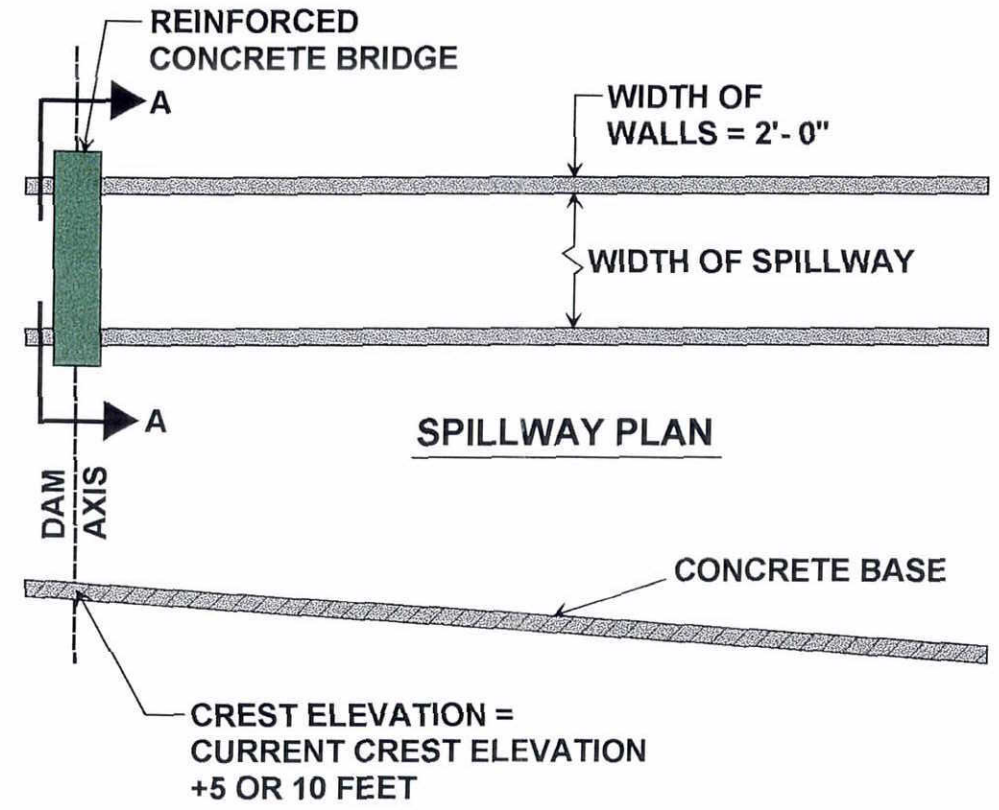
As discussed below, the width of the spillway refers to the dimension parallel to the dam axis and perpendicular to water flow. The spillway is always assumed to be straight, with a constant width and depth.

A simple spillway design similar to the existing Prosser Creek Dam Spillway (Plate 4-2, *Truckee River Basin Reservoirs Water Control Manual*) was used to estimate volumes of excavation and concrete. Figure 5-5 shows the assumed dimensions of the widened spillways. The width of the existing spillway ranges from 10 to 25 feet. This analysis assumed that the spillway was 10 feet wide, and once widened by 135 feet, for instance, would increase to 145 feet wide.




SPILLWAY ELEVATION

(NOT TO SCALE)




SPILLWAY ELEVATION

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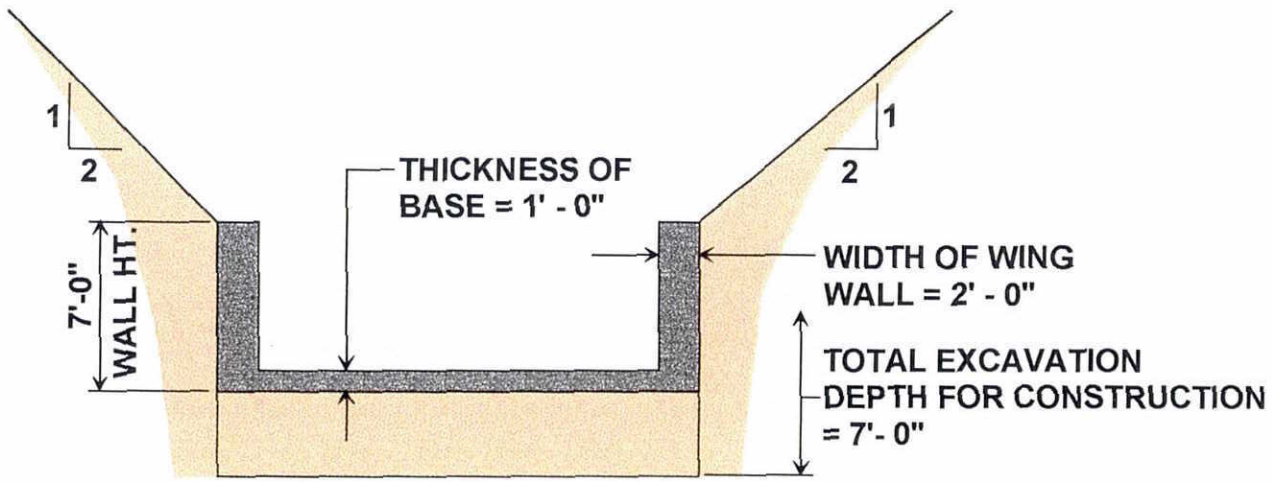
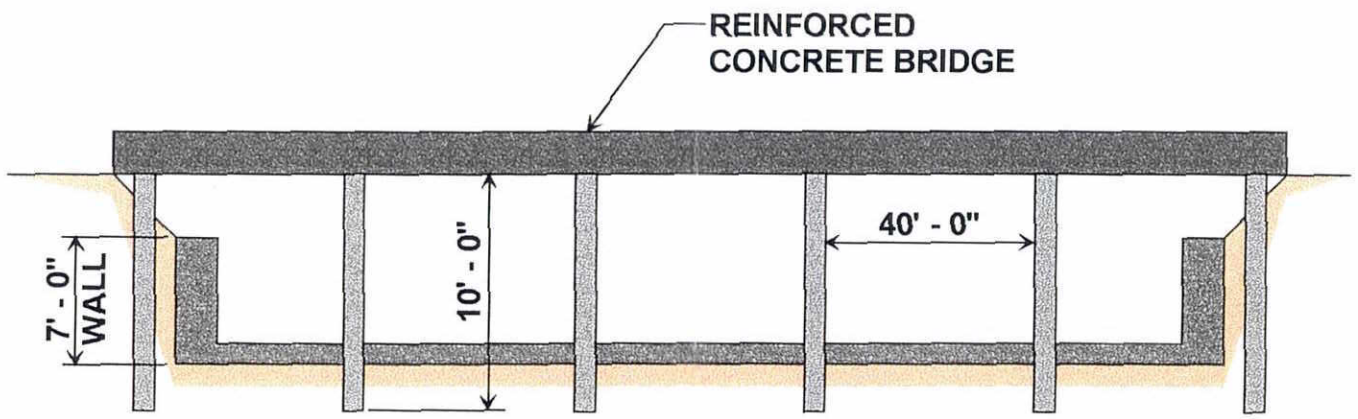



SECTION A-A
SPILLWAY SECTION

(NOT TO SCALE)




SECTION A-A
REINFORCED CONCRETE
BRIDGE SECTION OVER ALL
OR PART OF SPILLWAY CREST

(NOT TO SCALE)

FIGURE 5-5
SPILLWAY AND BRIDGE PLAN AND SECTIONS
PROSSER CREEK AND STAMPEDE DAMS

U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA

The bulk of the construction cost is assumed to be the result of excavating the new spillway, constructing the new concrete spillway, and implementing other construction required to preserve existing facilities such as roads and utilities. A 50 percent contingency factor was added to all costs because of the remote location of the construction and the very preliminary nature of these estimates.

Excavation was assumed to be into bedrock. If the excavation can avoid bedrock, the cost of excavation would be reduced from the $4 per cubic yard assumed to $3 per cubic yard.

Excavation volumes account for 7 feet of overexcavation beneath the spillway, as well as a 2:1 graded slope from the spillway edge to the surrounding terrain. Additional excavation at the foot of the spillway would be required to allow the spilled water to reach the river.

The design assumes a 1-foot-thick concrete spillway base and two wing walls 7 feet high by 2 feet wide. Concrete energy dissipation blocks (3 by 3 by 9 feet in dimension) were assumed at the toe of the spillway so that a wall 3 blocks high would cross the width of the spillway (Figure 5-5).

### Constraints

A number of constraints could influence the cost of the enlarged spillway. There is a two-lane road over some or all of the proposed spillways at both sites. There is a 32-foot-wide bridge over the required width of the spillway. Included in the cost of construction is costs for the bridge assume $90 per square foot plus a 50 percent contingency. Figure 5-5 shows design details for the bridge over the spillway crest. The spillway design width was increased to account for the reduction of flow capacity from the bridge piers obstruction.

Utilities at the proposed construction site impose additional constraints. The Prosser Dam site has electrical utility lines that will need to be relocated. In the case of a 5-foot increase in crest height, 200 feet of utilities must be relocated, and in the case of the spillway crest being raised 10 feet, 1,000 feet of utilities must be relocated. It is assumed that the electrical utility relocation will not require moving the existing spillway.

The Stampede Dam spillway construction is constrained by the location of the outlet works and powerhouse. The existing spillway must be removed and backfilled and a new spillway must be built on the other side of the outlet works and powerhouse. The cost for this work is included in the estimate.

### Conclusions

This cost analysis is an initial estimate; before construction could commence, detailed structural analysis, soil surveying, and hydraulic design must be completed. Costs could be substantially reduced if soil surveys showed evidence that excavation would not be into bedrock or if the configuration of the spillway

(e.g. tapering and deepening) could be altered to reduce the required excavation. Table 5-3 shows the detailed estimated project costs for 5-foot and 10-foot spillway crest height increases at Prosser Dam and Stampede Dam.

## INTERIOR DRAINAGE

### Introduction

Within the Project Area, interior drainage is conveyed to the Truckee River via open channels, street gutters, and regional storm drain systems. During small volume runoff events, the river stage associated with the Truckee River is low and the interior drainage systems typically function adequately, allowing runoff to drain to the Truckee River. With larger runoff events, influenced on a regional basis by complex weather patterns, the stage on the Truckee River is elevated, creating backwater conditions for interior drainage. As a result, flooding resulting from interior drainage occurs at varying depths and aerial distributions. As proposed, the Truckee Meadows flood control project levees and floodwalls restrict the river flow to the main channel, thereby making drainage of interior runoff to the Truckee River and contributor channels more difficult.

### Drainage Regions

Within the Truckee Meadows much of the interior drainage is conveyed to the Truckee River drains via several main regional drainage interceptors. These structures accept runoff from interior regional storm drain systems.

On the north side of the Truckee River, runoff is principally drained to the Truckee River at several key locations. Beginning west of US Highway 395, runoff originating on the southeast slopes of the Peavine Mountains flows south and enters the Truckee River immediately downstream of Arlington Avenue.

Table 5-3
Annualized Cost Estimate for the Raising the Spillways at
Stampede Dam and Prosser Creek Dam
(in 1996 dollars)

| | Prosser Creek Dam | | Stampede Dam | |
|---|---|---|---|---|
| | 5-foot increase | 10-foot increase | 5-foot increase | 10-foot increase |
| First Cost | $7,429,701 | $54,675,369 | $8,987,668 | $32,980,231 |
| Annualized Capital | 548,386 | 4,035,586 | 663,379 | 2,434,269 |
| Annualized O&M | 41,839 | 307,894 | 50,612 | 185,722 |
| Annualized Interest | 10,000 | 10,000 | 10,000 | 10,000 |
| Annualized Replacement | 1,197,231 | 8,736,549 | 1,456,092 | 5,177,214 |
| TOTAL ANNUAL COSTS: | **$1,797,456** | **$13,090,029** | **$2,180,083** | **7,807,205** |

Several detention basins have been constructed and others are still proposed. All of these will reduce the peak flows into the Truckee River. Currently runoff peaks and volumes are small enough to not be considered a drainage hazard in downtown Reno.

Further downstream from the Arlington Avenue area, additional runoff flows into the Truckee River via a regional drainage interceptor located in the vicinity of Kuenzli Lane and U.S. Highway 395.

East of U.S. Highway 395, the majority of the interior runoff enters the Truckee River via the North Truckee Drain. Runoff collected in this drain is generated from Sparks, Spanish Springs, and areas north of Spanish Springs. Runoff volumes and peak flows draining from this channel can be large.

Along the south side of the Truckee River, interior runoff drains to three locations. The first location is near Booth Street Bridge. The volume and peak flows are small and historically have not caused problems. The second location drains to the Truckee River downstream of Arlington Avenue. Similar to the Booth street area, runoff draining to the Arlington Avenue area is small and is not currently a drainage issue.

The third location is east of U.S. Highway 395. One regional drainage interceptor flows to the Truckee River between Rock Boulevard and East McCarran

Boulevard. The remaining volume that is generated from interior sections south of the Truckee River drains to either the Boynton Slough or Steamboat Creek. Typically runoff draining to Boynton Slough is generated from the urban drainage network comprising west Reno. The drainage efficiency of this slough depends on the water surface elevation of Steamboat Creek.

A mix of urban and rural runoff drains to Steamboat Creek (many small undeveloped watersheds located south of the Truckee Meadows, as well as some urban areas located in South Reno). Table 5-4 lists interior drainage information for some of the watersheds in the Truckee Meadows.

Table 5-4

Interior Drainage Information

| Watershed Name | Drainage Area (sq. mi.) | 100-Year Discharge (cfs) |
|---|---|---|
| North Truckee Drain at confluence with Truckee River | 87 | 2,240 |
| Boynton Slough at East McCarran Boulevard | 41 | 5,100 |
| Steamboat Creek at confluence of Truckee River | 154 | 7,000 |

Source: *Washoe County Flood Insurance Study*, September 30, 1994.

## Drainage Issues

Implementation of the approved project plan will influence interior drainage in the Truckee Meadows. Runoff now enters the Truckee River via one of the paths discussed above. Under pre-project conditions, the Truckee River backwater influence inhibits interior drainage movement and results in differing amounts of localized flooding. If the Truckee River stage is large (like that experienced during January 1997), the backwater conditions can cause widespread flooding even without any interior runoff volume.

When the preferred project is implemented, levees will be constructed and overbank storage will be reduced. Sheet flow that once freely drained to the Truckee River will pond at numerous locations along the levees, causing minor localized flooding. Because, the levees will essentially eliminate overbank storage, river stages for a given river discharge will be greater with the levees than without them. These higher stages will further impede the flow of interior runoff into the Truckee River. Thus, there is a possibility that smaller, more

frequent, types of runoff events that did not cause flooding problems in the past would cause flooding once the levees are constructed.

### Drainage Improvements

To enhance interior drainage after construction of the levee system, several improvements are required to convey interior runoff to the Truckee River. Flap gates are proposed for the existing culverts draining to the Truckee River to prevent elevated river stages from causing flow to behind the levee system. These flap gates would be of benefit only when the river stages were elevated and the interior watershed were not producing runoff. This situation would be typical during spring runoff, or during major dam releases.

During large-scale precipitation events typically associated with above-bank flood stages, the flap gates would be of little benefit because interior runoff would not drain. Large-scale regional precipitation events are generally associated with rain on snow events and usually, but not always, produce precipitation on a watershed-wide basis. With this type of occurrence, Truckee River stages would most likely be above bank stage and interior drainage would pond behind the levee system. Additionally, backwater from the Truckee River would migrate up the North Truckee Drain, Steamboat Creek, and Boynton Slough, potentially causing additional flooding.

Options to address this issue include flood gates installed at the confluences of both the North Truckee Drain and Steamboat Creek with the Truckee River. These gates would be designed to automatically close once the river stage at the Vista gage exceeded a pre-set elevation threshold. In the event of a regional power outage, standby power could be used to drive the two gate actuators.

With the gates closed, interior runoff would be pumped to the Truckee River. Two large pump facilities consisting of several low-lift-high volume pumps would be located in the vicinity of the flood gates. The pumps would be staged to correspond with increases in interior drainage needs. Thus, one pump would operate to handle the initial flow and more pumps would come on line as inflow increased. In areas where surface runoff drains directly to the Truckee River, culvert systems would be constructed to convey the runoff to smaller strategically located regional pump stations. These pump stations would then discharge to the Truckee River. It is anticipated that some areas behind the levee system would not drain to these regional facilities because of their existing topographic limitations. At these locations, ponding would occur and would remain until the stage on the Truckee River dropped allowing the runoff to drain via the culvert-flap gate systems.

All pump stations would be tied to alternative power generators. Generators would be used in the event that pump station power was lost during the flooding event. Operation and maintenance (O&M) of the pump station and alternative power generators, and location of the generators, as well as location

of other regional flood facilities, would need to be addressed in greater detail in the pre-design analysis.

### CHANNEL CAPACITY THROUGH RENO

The Truckee River channel capacity through Reno is currently limited by the available cross section, grade-control structures, and bridges. The capacity of the channel is estimated to be about 14,000 cfs, with the capacity at some bridges less than 10,000 cfs (COE, 1997).

The potential channel capacity through Reno if the obstructions were entirely removed was approximated with the HEC-RAS model. The purpose of the analysis was to evaluate the potential improvement in water surface elevation through Reno available by improving the existing bridges. Three discharges were simulated to assess the impacts of bridge improvements. Three flows were selected for the analysis: 18,500 cfs, 21,000 cfs, and 26,000 cfs. Knowledge of the impact of structures at different flows is important because a bridge may present a significant obstruction at 26,000 cfs, but a smaller degree of obstruction at 18,500 cfs. Because there are feasible options to reduce the discharge through Reno (detention basins discussed above), a project that uses these upstream facilities could reduce the need to modify bridges through town.

The authorized project proposed to replace or elevate the bridges through downtown. The specific modifications to these bridges, however, are not detailed in the Feasibility Report. The Feasibility Report suggests that the bridge openings would be increased to more efficiently convey water. Raising the bridges requires that approach roads be raised and, therefore, creates problems with ingress and egress to side streets and businesses. Therefore, it is assumed that improvements to the bridges are generally related to the bridge opening. To simulate this condition for the purposes of this report, one or more bridges were entirely removed for each simulation.

If raising bridges is proposed as an alternative, detailed site investigations would be required to assess the full impact of such actions. This reconnaissance-level assessment is only attempting to address the basic question of the potential effects of channel and bridge improvements.

The following assumptions were made for this analysis:

- The bridges were assumed to remain "as is" unless the bridge was improved under an option.

- For this simulation, no specific bridge design is proposed to bracket the potential benefits of improving bridges. Also, the greatest improvement in water surface was simulated as one bookend, while the obstruction posed by

the existing bridges simulated as the other bookend. Therefore, to simulate the least-obstructive bridge (and the largest improvement in water surface elevation), the bridge was entirely removed from the HEC-RAS file.

- Levees associated with the approved project, upsized for 26,000 cfs, were included.

- A 30-foot wide structure (such as a box culvert) was assumed in Option 6 to represent increasing the size of the channel within the limitations of the existing buildings. The structure could be placed under the roads adjoining the channel.

### Option 1

Option 1 represents the simulated water surfaces for a flow of 26,000 cfs without any flood control facilities. The cross sections used in the HEC-RAS model were developed by the COE for the Feasibility Report and describe the channel and immediate vicinity. These cross sections are acceptable for use in a simulation where flow is confined to the channel with levees or walls. However, during a flow of 26,000 cfs, water would overtop bridges and would exceed the channel banks. In order to keep the flow within the cross section in the model, the cross sections were extended using data from other sources such as the 1982 report by Leeds, Hill and Jewett, Inc.

In some cases, the extended cross sections are exceeded by the river flow and the model vertically extended the cross section. These cross sections are approximate representations of the channel geometry and should be updated with recent data. The cross sections are, however, acceptable for the reconnaissance level of detail and for use with a leveed condition.

Option 1 was only run for a flow of 26,000 cfs.

### Option 2

Option 2 represents the authorized project facilities upsized for 26,000 cfs. These facilities are described in Section 4 of this report. Because of the lack of detail in the Feasibility Report regarding the bridge modifications, the bridges were kept the same for this simulation. This option reflects the worst-case scenario for the water surface profile because the existing bridges obstruct flow during the extreme events. All of the bridges between Second Street and Keystone Avenue were simulated to be overtopped for this flow.

Options 3 through 6 were simulated with the authorized project facilities upsized for 26,000 cfs.

### Option 3

Option 3 reflects improving the Lake Street bridge. Because this analysis is supposed to evaluate the bookends of water surface conditions, the maximum potential improvement caused by bridge replacement was simulated. This simulation was accomplished by removing the bridge from the cross section.

Although a replacement bridge would pose some degree of obstruction, removing the bridge from the simulation presents the maximum accomplishment available from this action. The actual water surface with a new bridge would lie between these two bookends and would be a function of final bridge design.

### Option 4

Option 4 assumes that the Lake Street and Virginia Street bridges are improved. As with Option 3, the bridges are removed from the simulation to estimate the optimum benefit from bridge replacement.

### Option 5

Option 5 reflects improving all of the bridges from Second Street to Keystone Avenue, including Wells Avenue. As with previous options, the bridges are removed from the simulation.

### Option 6

Option 6 leaves the bridges "as is" but increases the channel width from Arlington Avenue downstream to Lake Street. This action could be accomplished several ways and is assumed, for this simulation, to be a 30-foot-wide box culvert placed adjacent to the channel. This culvert could be placed behind the existing floodwall, under the frontage road.

This analysis was supposed to assess the hydraulic benefits of increasing the channel width. Many issues associated with increasing the channel width, such as utilities, adjacent structures, possible soil contamination, construction methods, and right-of-way, should be explored in detail if a channel-widening alternative is pursued.

One channel-widening option that was not pursued in this analysis involved expanding the channel by "laying back" one or both banks. This option would involve excavating one or both channel banks and replacing the existing floodwall with an inclined bank. Although this action could be coordinated with developing recreation in the channel, it may conflict with existing buildings or urban redevelopment efforts.

### Conclusions

Improvement of a single bridge (Option 3) has an immediate effect of lowering the water surface elevation upstream of the bridge (Figure 5-6). The reduced water surface may be present for a distance upstream, but the effect begins to "die out." The potential benefits in the water surface are gone by the time the flows reach Arlington Avenue.

Combining several bridge improvements (Options 4 and 5) has a cumulative effect that can be significant. The benefits of this configuration however, decrease upstream of Arlington Avenue because of the increase in streambed elevation at the grade control structure upstream of the bridge. The results of the channel and bridge improvements simulation for all six options are shown in Table 5-5.

## DOWNSTREAM CHANNEL IMPROVEMENTS

Potential alternatives to improve water surface elevations downstream of McCarran Boulevard were investigated at a reconnaissance level as part of this report. The options considered included:

- Vista Channel Improvements: excavation in the right overbank to widening the flood channel in the vicinity of vista; and

- Lower Truckee River Improvements: excavation in the right overbank upstream of Steamboat Creek to about 0.5 mile downstream of McCarran Boulevard.

These two options are discussed below.

### Vista Channel Improvements

The Vista Reefs are located at the downstream end of the study area and consist a of bedrock outcrop that provides a fixed point on the river bed. The river cross section also narrows as the river enters the Truckee River Canyon. These horizontal and vertical controls of the cross section constrict the movement of water out of the Truckee Meadows and into the canyon. There have been efforts to improve the flow past Vista by lowering the elevation of the outcropping.

The HEC-RAS model was used to assess the potential to improve flow past Vista and thereby improve the water surface elevation upstream of Vista. This assessment was designed to provide an initial estimate of the hydraulic benefits of this type of improvement. Additional evaluation must be performed using a

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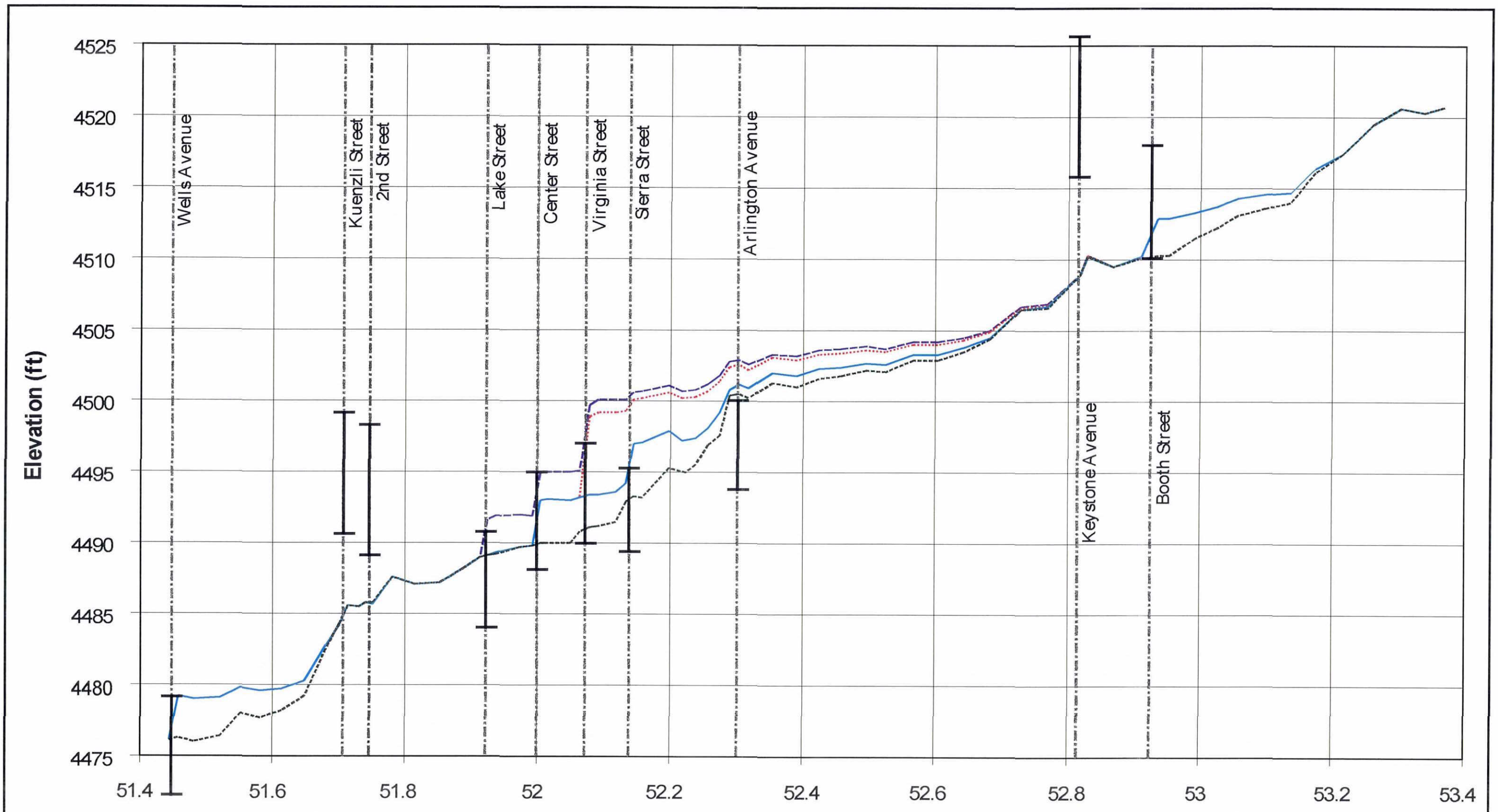



**FIGURE 5-6**
**WATER SURFACE PROFILES FOR BRIDGE IMPROVEMENTS IN RENO**

U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA

**Table 5-5**
**Simulation of Channel and**
**Bridge Improvements in Downtown Reno**
**(Water Surface Elevations Upstream of Bridges)**

| | Lake Street | Center Street | Virginia Street | Sierra Street | Arlington Street |
|---|---|---|---|---|---|
| **Option 1** | | | | | |
| 18,500 | NS | NS | NS | NS | NS |
| 21,000 | NS | NS | NS | NS | NS |
| 26,000 | 4491 | 4494 | 4500 | 4500 | 4502 |
| **Option 2** | | | | | |
| 18,500 | 4489 | 4491 | 4495 | 4497 | 4499 |
| 21,000 | 4490 | 4492 | 4497 | 4598 | 4501 |
| 26,000 | 4492 | 4495 | 4500 | 4501 | 4503 |
| **Option 3** | | | | | |
| 18,500 | 4486 | 4491 | 4495 | 4497 | 4499 |
| 21,000 | 4487 | 4492 | 4497 | 4498 | 4500 |
| 26,000 | 4489 | 4493 | 4499 | 4500 | 4503 |
| **Option 4** | | | | | |
| 18,500 | 4486 | 4491 | 4491 | 4494 | 4499 |
| 21,000 | 4487 | 4492 | 4492 | 4495 | 4500 |
| 26,000 | 4489 | 4493 | 4493 | 4497 | 4501 |
| **Option 5** | | | | | |
| 18,500 | 4486 | 4487 | 4489 | 4490 | 4498 |
| 21,000 | 4497 | 4488 | 4490 | 4491 | 4499 |
| 26,000 | 4489 | 4490 | 4491 | 4493 | 4501 |
| **Option 6** | | | | | |
| 18,500 | 4488 | 4488 | 4492 | 4494 | 4496 |
| 21,000 | 4489 | 4492 | 4494 | 4496 | 4598 |
| 26,000 | 4492 | 4494 | 4498 | 4500 | 4501 |

NOTE: NS=not simulated
Option 1-No Action
Option 2-Full Floodwalls
Option 3-Lake Street Bridge Improved
Option 4-Lake and Virginia Street Bridges Improved
Option 5-Wells, Lake, Center, Virginia, Sierra, and Arlington Street Bridges Improved
Option 6-Channel Width Increased by 30 Feet

model such as UNET, that can route flow, to fully evaluate the benefits. This analysis used a flow of 26,000 cfs.

The simulation assumed that the north bank of the river was leveed (as described in Section 4) and that the south bank was open (no levees) upstream of the channel improvement section to the detention basin. From the detention basin upstream, the facilities are similar to those described in Section 4. The potential improvements to the Vista area involve modifying the right bank of the model cross sections in the Vista area. These modifications simulate excavating a bench above the low-flow channel for conveying floodwater. This bench was assumed to be 13 feet above the bottom of the cross section (Figure 5-7).

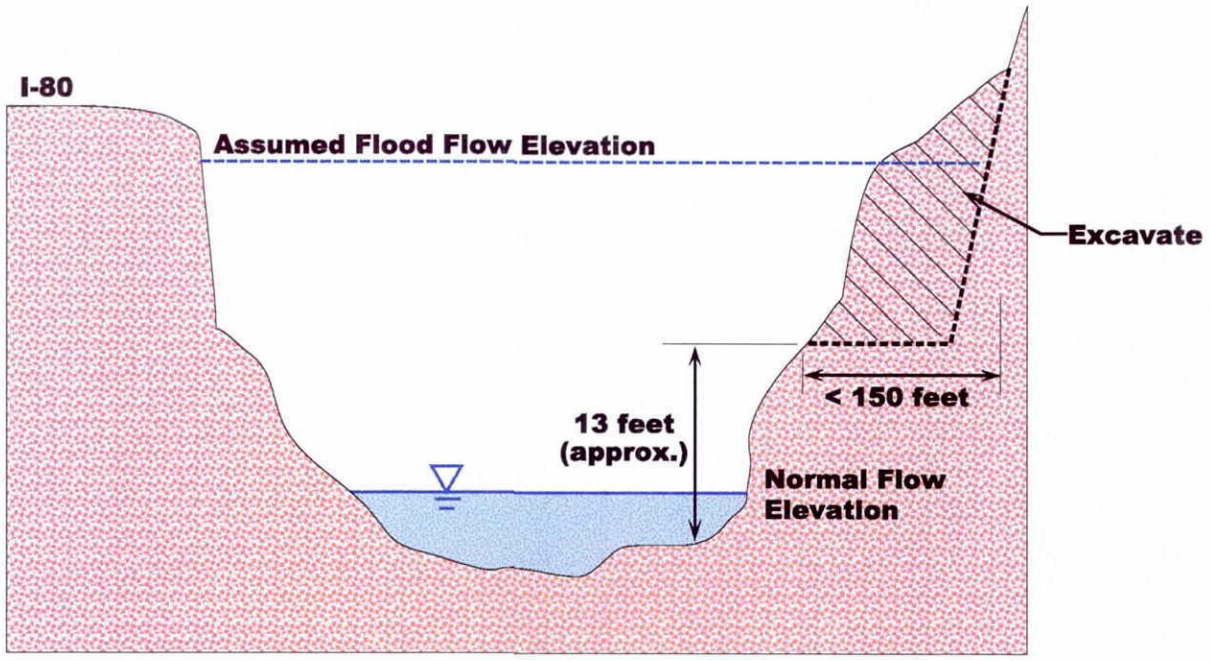
HEC-RAS model simulations of the Vista Channel Improvements indicate that channel widening near Vista could reduce the water surface elevations upstream in Sparks (Table 5-6). The simulated improvement in the water surface elevation ended before the flow reached McCarran Boulevard compared with a fully leveed condition, which offered greater improvement. Near the north Truckee River Drain and Steamboat Creek, the improvement in water surface elevation is about one foot. Because the Truckee River backwater extends a significant distance up both of these tributaries, any improvement in Truckee River backwater will reduce the extent of flooding in the Tributaries. A decrease of Truckee River flood elevation from 4393 to 4392 at Streamboat Creek can reduce the longitudinal extent of flooding by 0.5 mile.

Future studies should use a model such as UNET to route the flow through the reach and should include cross sections downstream of Vista to fully evaluate the feasibility and hydraulic significance of the improvements.

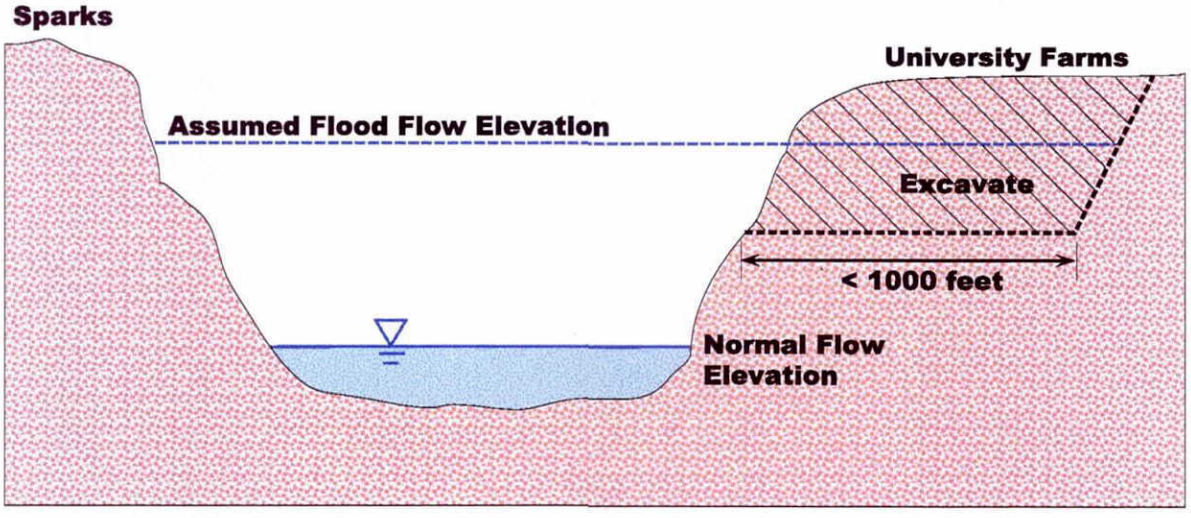
### Lower Truckee River Improvements

The potential benefits of improved channel cross sections downstream of McCarran Boulevard were simulated with the HEC-RAS model assuming that an elevated bench was excavated (Figure 5-7). The lower Truckee River Improvements were assumed to be on the elevated bench executed in the right bank of the cross sections downstream of McCarran Boulevard, in-lieu of the detention basin. The bench was assumed to be 13 feet above the channel invert. Upstream of McCarran Boulevard the approved project sized for 26,000 cfs was present. In this simulation, the area north of the river was protected with a levee and the area south of the river was subject to flooding.

Excavating the channel would improve the water surface elevation by up to 3 feet at McCarran Boulevard (Table 5-6) compared with the complete levee condition. This improvement could allow the downsizing of the levee along the north bank of the river to a point about 600 feet upstream of McCarran




**TYPICAL IMPROVED CROSS-SECTION**
**VISTA IMPROVEMENTS**
**(NOT TO SCALE)**




**TYPICAL IMPROVED CROSS-SECTION**
**FOR THE LOWER TRUCKEE RIVER**
**(NOT TO SCALE)**

## FIGURE 5-7
## TYPICAL IMPROVED CHANNEL SECTIONS

U.S. ARMY CORPS OF ENGINEERS
TRUCKEE MEADOWS, NEVADA

**Table 5-6**
**Estimated Water Surface Elevation**
**for Downstream Channel Improvements**
**(flow of 26,000 cfs)**

| Model Simulation | River Location R.M. 45.266 | R.M. 46.431 | R.M. 46.972 | R.M. 47.605 |
|---|---|---|---|---|
| No Action (No levees) | 4393 | 4394 | 4394 | 4398 |
| Leveed Section | 4393 | 4395 | 4398 | 4400 |
| Vista Channel Improvements | 4392 | 4394 | 4397 | 4400 |
| Lower Truckee River Improvements | 4393 | 4394 | 4394 | 4397 |
| Combined Improvements | 4392 | 4392 | 4393 | 4397 |

NOTE: River Mile 45.266 is about 300 feet upstream of the North Truckee Drain
River Mile 46.431 is upstream of Deming Way
River Mile 46.972 is at Cottonwood Park
River Mile 47.605 is immediately downstream of McCarran Boulevard

Boulevard.

A HEC-RAS simulation was performed assuming both the Vista improvements and Lower Truckee River Improvements (Table 5-6). The improvements in cross section would help reduce water surface elevations through the reach from Vista to McCarran Boulevard The improvement would be up to 3 feet in water surface elevation at McCarran Boulevard relative to the approved project levees upsized for 26,000 cfs.

## AUTHORIZED PROJECT CHANNEL EXCAVATION

### Introduction

The authorized project proposed to improve the Truckee River channel by excavating the channel bed and banks near:

- Booth Street Bridge;
- Arlington Street Bridge; and
- Glendale Park in Sparks.

The improvements are defined in the Feasibility Report only in general terms and detailed HEC-2 modeling of the improvements was not available (see Section 2). Therefore, the HEC-RAS modeling conducted to estimate the water surface elevation for 26,000 cfs for use in the cost estimates did not include the

channel improvements. A separate analysis was conducted to assess the hydraulic impacts of these improvements. The analysis, described below used the HEC-RAS model described in Section 2 and included reasonable estimates of channel improvements at these three locations.

Local city representatives have questioned the excavation proposed in the authorized project as being incompatible with aesthetic concerns (COE, 1997).

### Glendale Park And Vicinity

Glendale Park is located approximately halfway between Rock Boulevard Bridge and McCarran Boulevard Bridge. Potential benefits of an improved channel cross section in this area, as shown in Figures 3-6 and 3-18 of the authorized project, were assessed based on a hydraulic simulation using the HEC-RAS model. In general, an upper bench was excavated up to 200 feet horizontally, and 5 to 10 feet vertically to an approximate elevation of 4395 feet. The analysis was conducted for a flow of 26,000 cfs. Upstream of the channel excavation the facilities estimated for a flow of 26,000 cfs (Section 4) continued.

Table 5-7 shows the water surface elevations with and without the channel improvements assuming a flow of 26,000 cfs and levees. Simulations demonstrate that excavating the channel improves the upstream water surface elevation by up to 2 feet for about 500 to 1000 feet upstream of the improvement area.

This hydraulic improvement helps reduce the size and cost of flood control facilities but is a localized improvement and minor relative to the overall costs. An effective use of these proposed improvements would be to combine them with larger, more regional options.

### Arlington Bridge Area

The assumed channel improvements in the Arlington Bridge area consist of channel excavation just upstream of the bridge, and downstream of the bridge as shown in Figures 3-1 and continued on Figure 3-2 (Section 3). Based on narrative in the Feasibility Report, the improvements consisted of excavating up to 1 1/2 feet in portions of the channel.

Water surface profiles were developed based on flow simulation 26,000 cfs and the results were compared with the leveed condition (Section 4).

Minor changes in water surface elevations were estimated upstream of Arlington Bridge as a result of the assumed excavation. The simulated improvement in

**Table 5-7**
**Estimated Water Surface Elevation**
**with Channel Excavation near Glendale Park**

| | River Location | | | | | |
|---|---|---|---|---|---|---|
| Model Simulation | 48.105 | 48.209 | 48.364 | 48.47 | 48.584 | 48.698 |
| Leveed Condition | 4404 | 4405 | 4408 | 4408 | 4410 | 4410 |
| Leveed Condition with Channel Improvements | 4404 | 4405 | 4406 | 4406 | 4409 | 4410 |

Note: River mile 48.105 is at the downstream end of Glendale Park
River mile 48.209 is at the downstream end of Edison Way
River mile 48.364 is at the upstream end of Edison Way
River mile 48.47 is at Marietta Way
River mile 48.584 is 600 feet upstream of Marietta Way
River mile 48.698 is

water surface elevation ended before Keystone Bridge. In comparison to the leveed condition for 26,000 cfs, the water surface elevation improvements were less than 1 foot under all three flow conditions.

### Booth Street Bridge Area

The Booth Street Bridge excavation area extends downstream from Booth Street Bridge to just upstream of Keystone Avenue Bridge. Potential benefits of an improved channel cross section in this area, as shown in Figures 3-1 and 3-16 (Section 3), were assessed based on a hydraulic simulation using the HEC-RAS model. In general, the channel width was increased by approximately 15 to 20 feet and excavated down to a depth equivalent to elevation 4496. Water surface profiles were developed for a flow of 26,000 cfs. Project features assumed for a flow of 26,000 cfs (Section 4) were included upstream and downstream of the excavation.

Table 5-8 shows the water surface elevations with and without the excavation for the leveed condition under a flow of 26,000 cfs. The simulated water surface elevations for a flow of 26,000 cfs were limited to approximately 1 foot 500 feet upstream of Booth Street Bridge and the simulated water surface improvements ended less than one-half mile upstream from the bridge.

Based on this hydraulic analysis these channel improvements provide limited local benefits, and are judged to be minor relative to the study area. An effective

use of these proposed improvements would be to combine them with larger, more regional options.

**Table 5-8**
**Estimated Water Surface Elevations**
**with Channel Excavation near Booth Street Bridge**

| | River Location | | | |
|---|---|---|---|---|
| Model Simulation | 52.936 | 53.025 | 53.136 | 53.214 |
| Leveed Condition | 4513 | 4514 | 4514 | 4517 |
| Leveed Condition with Channel Improvements | 4513 | 4513 | 4514 | 4517 |

Note: River mile 52.936 is about 200 feet downstream of the Booth Street bridge
River mile 53.025 is about 200 feet upstream of the Booth Street bridge
River mile 53.136 is at the downstream end of Idlewild Park
River mile 53.214 is opposite Idelwild Park

## UTILITIES

Numerous utilities, inlets, and diversions intersect the Truckee River throughout the project area. A summary of the locations, types, and descriptions of these intersections is provided in Table 5-9. This table was taken from the 1985 Feasibility Report; the downtown Reno portions were updated during a reconnaissance level survey of the project site in June 1997.

A significant number of pipes in the downtown area terminate at the existing floodwalls and are open to inflow from the Truckee River. The source of the pipes will need to be further investigated to determine whether high river levels will cause backflow into the interior areas serviced by these pipes. With the high Truckee River water levels expected during either an 18,500 or a 26,000 cfs flood flow, positive closure devices, such as flap gates, may be required to prevent backflow into the pipes.

For the purpose of this report, it was assumed that some additional forming would be required around existing pipes to accommodate construction of the new floodwalls. It is also assumed that several flap gates would be required for various pipe diameters. A lump sum of money was included in the cost estimates of this report to account for coordinating intersecting utilities, inlets, and diversions.

## Table 5-9
## Existing Utilities, Inlets and Diversions

| Location | Type | Description |
|---|---|---|
| 150-ft± Upstream from Booth Street Bridge | Water | 24- inch welded steel under river |
| 100 ft± from Booth Street Bridge | Water | 36-inch culvert |
| Booth Street Bridge | Gas | 4-inch on bridge |
| | Telephone | Six, 3½-inch steel under river |
| Keystone Avenue Bridge | Street Lighting | Power line on bridge |
| 400-ft± downstream from Keystone | Water | 24-inch welded steel under river |
| 500-ft± downstream from Keystone | Gas | 8-inch under river |
| Bell Street | Sewage | 33-inch RCP under river |
| Arlington Avenue Bridge | Street Lighting | Power line on bridge |
| | Telephone | Nine 3½-inch steel conduits on bridge |
| Sierra Street Bridge | Water | 12-inch steel on bridge |
| | Gas | 4½-inch on bridge |
| | Power | Transmission line on bridge |
| | | Flap Gate - 24-inch |
| | | Nine pipes: 8 12-inch, no drains? |
| Viriginia Street Bridge | Water | 8-inch CIP on bridge |
| | Telephone | Three, 2-inch steel and nine, 6-inch PVC |
| | Unknown | One, 1-inch and one, 3-inch on bridge |
| | | Two, 30-inch pipes, one with flap gate (flap gate appears to be sewer) |
| | | Five total: three 12-inch, one power, one water |
| Center Street Bridge | Power | Transmission line on bridge |
| | Telephone | Twelve, 3½-inch steel conduits on bridge |
| | Unknown | One, 2-inch and two, 4-inch pipe on bridge |
| Lake Street Bridge | Telephone | Six, 3½-inch steel conduits on bridge |
| Second Street Bridge | Water | 12-inch steel, concrete encased as a unit on bridge |
| | Gas | 4½-inch steel encased as a unit on bridge |
| Kuenzli Street Bridge | Power | Transmission line on bridge |
| Park Street | Water | 12-inch steel under river |
| | Gas | 12-inch steel under river |
| Locust Street | Sewage | Pipeline suspended over river |
| Between Kietzke Lane and Giroux Street | Sewage | Pipeline suspended over river |
| Crissie Caughlin Park, N. bank, upstream end | Storm drain | Gated box |
| Sumac St. S. bank | Storm drain | 12-inch |
| Between Sumac St. and Sherwood Dr., S. bank | Storm drain | 15-inch |

Table 5-9 continued.

| Location | Type | Description |
|---|---|---|
| Sherwood Dr., S. bank | Storm drain | 48-inch |
| Allen St., S. bank | Storm drain | 12-inch |
| Ivan Sack Park | Grade control | For irrigation diversion |
| Foster Dr., S. bank | Storm drain | 48-inch |
| Riviera St., S. bank | Storm drain | 12-inch |
| Spoon Dr., N. bank | Storm drain | 48-inch± |
| Cowan Dr., N. bank | Storm drain | 36-inch |
| Cowan Dr., S. bank | Storm drain | Size unknown |
| Idlewild Park S. bank | Gated diversion | To park lake |
| Idlewild Park S. bank | Grade control | Diversion |
| Idlewild Park S. bank | Outlet | Lake drain, 24-inch CMP |
| Idlewild Park S. bank | Lake Spillway | 4-foot by 8-foot box |
| Chism St. N. bank | Storm drain | 27-inch |
| Booth St. upstream S. bank | Unknown | CMP arch |
| Vine St. N. bank | Storm drain | 21-inch |
| Washington St. N. bank | Storm drain | 12-inch |
| Between Bell & Ralston Sts., N. bank | Storm drain | 15-inch |
| Arlington Ave. N. bank | Storm drain | 6-foot by 12-foot box |
| Arlington Ave. S. bank | Storm drain | 42-inch |
| Sierra St. S. bank | Gated diversion | For Cochran Ditch |
| Center St. N. bank | Storm drain | 30-inch |
| Center St. S. bank | Storm drain | 12-inch |
| Lake St. N. bank | Storm drain | Size unknown |
| Lake St. S. bank | Storm drain | Size unknown |
| Kuenzli St. S. bank | Storm drain (2) | Size unknown |
| Kuenzli St. N. bank | Storm drain | 24-inch |
| Wells St. N. bank | Storm drain | 24-inch |
| Wells St. S. bank | Storm drain | 30-inch |
| Locust St. S. bank | Storm drain | 30-inch |
| Giroux St. S. bank | Storm drain | 12-inch |
| Between Giroux St. and Kietzke Ln. and Hwy 395 N. bank | Storm drain | 10-inch |
| Between Kietzke Ln. and Hwy 395 N. bank | Storm drain | 66-inch |
| Between Kietzke Ln. and Hwy 395 S. bank | Storm drain | 24-inch |

## GEOTECHNICAL

A geotechnical review was performed as part of this Reconnaissance Report to evaluate the potential to store additional water behind Martis Creek Dam and to comment on soil conditions underlying the levees and floodwalls of the authorized project. This review is limited in scope to the available data identified by the COE. Data sources used in this review include:

Documentation Report, Truckee Meadows (USACE) , 1983

Section C: "Geotechnical Exploration" (Leeds, Hill and Jewett, Inc.), May 1982

Section D: "Soils and Geology Office Study" (USACE), September 1981

Water Control Manual, Truckee River Basin Reservoirs (USACE), July 1985

1995 Test Fill Report, Martis Creek Dam (USACE), October 1996

Memorandum: Martis Creek Dam - Fixed Gate Openings for Flood Control (USACE), December 6, 1995

Memorandum: Martis Creek Dam - Fixed Gate Openings for Flood Control (USACE), November 8, 1995

Memorandum: Martis Creek Dam - Fixed Gate Openings for Flood Control (USACE), November 17, 1995

### Purpose of Geotechnical Review

The purpose of this review is to:

- provide a preliminary assessment of geotechnical feasibility for increasing the minimum pool capacity at Martis Creek Reservoir by 5000 af, and

- identify soils conditions and possible constraints to construction of authorized levees and floodwalls through the Truckee Meadows.

Included in this review was a meeting with Donna Garcia and Mike Ramsbotham of the COE to discuss the Martis Creek Dam test filling. Further, more-detailed review, including other available project documents and additional discussions with COE personnel, may result in modification and/or amplification of the conclusions presented below.

### Martis Creek Reservoir

Martis Creek Dam was constructed in 1972 to provide flood control. The main structure is a zoned earthfill dam of maximum height of 113 feet, built at a crest elevation of 5858 feet. The upstream one-third of the embankment is constructed of "impervious" material and the downstream two-thirds are constructed of "random" fill.

The dam foundation is indicated to be constructed on a variety of native materials, including slope wash in the right abutment area (consisting of cobbly clayey sandy gravel of variable permeability); glacial outwash in the left abutment area (consisting of interlayered silt, sand, gravel, cobbles and boulders with high permeability); and upper Truckee formation sediments in various other sections of the dam (consisting of interbedded silt, sand and clay with gravel of variable permeability). Sediments of the upper Truckee formation are indicated to be underlain by a marker bed of "blue silt," described as predominately "firm to moderately cemented, impervious, and generally exhibits high plasticity."

The majority of the dam foundation appears to have been constructed within relatively pervious sediments overlying the "blue silt" marker bed; therefore, effective underseepage cutoff does not appear to have been achieved. Full underseepage cutoff may not have been a major consideration in design because the primary purpose was flood control and not water storage. Seepage control measures that were incorporated into the original construction included an upstream impervious blanket; right and left abutment toe drains; internal vertical and horizontal drains; drainage shaft; drainage and stability berm; left abutment drainage blanket; internal spring drains; and relief wells.

In the years following completion of construction, significantly greater seepage occurred through the foundation of the dam than was anticipated. Additional seepage control measures were implemented in response to the observed seepage and distress; they included (among other measures) seepage collection boxes, surface drainage modifications, rebuilding of drain blankets, redevelopment of relief wells, installation of observation wells, and construction of new drainage blankets.

The maximum pool elevations between 1972 and 1995 have varied from 5780 to 5833. Pool elevations were typically between 5780 and 5810; in only three years did the maximum pool elevation exceed 5810 (1980, 1986 and 1995), and only in 1995 (when it reached an elevation 5833) did the elevation significantly exceed elevation 5815. Discussions with COE personnel indicate that the 1997 level reached 5815 for a short period of time, without major distress observed.

Test filling, included monitoring of extensive piezometers, observation wells and other instrumentation, was performed in 1973, 1974, 1978, 1980, 1986, and 1995 in evaluation of seepage behavior. No major distress was reported to the facility during these tests, although the 1995 test was terminated at elevation 5833 because of observed sand boils along the lower dam access road and uncontrolled seepage in the spillway cut.

Slope stability analyses were also performed for the embankment, drainage berm, spillway, and left abutment slopes at various times from design through 1995. Results of the stability analyses indicate that minimum factors of safety vary from 0.8 to 1.1 under a seismic loading of 0.1g and at a maximum reservoir level of 5838.

The 1995 Test Fill report concluded that:

- the majority of seepage is occurring through the foundation (particularly in the right and left abutment areas) and not through the embankment;
- the seepage is not satisfactorily controlled at high reservoir levels and, to assure dam safety, additional measures must be constructed to minimize, control and measure foundation seepage; and
- slopes are marginally stable or unstable under seismic (0.1g) loading, particularly at high reservoir levels.

Recommendations in the 1995 Test Fill report included:

- maintain a maximum pool elevation of 5810 and, in the event that it should exceed this level, implement a specific schedule of inspection, monitoring, and notification;
- perform additional subsurface exploration, engineering study, and geological evaluation;
- perform additional static and seismic stability analyses of the dam; and
- construct a positive seepage barrier (e.g., a slurry cutoff wall constructed along the upstream toe of the dam penetrating the "blue silt" marker bed of the underlying Truckee formation).

## Proposed Storage Increase

Martis Creek Dam is a potential source of storage for floodwater that eventually enters the Truckee Meadows. The COE is examining storing an additional 5000 af behind Martis Creek Dam.

At the present maximum elevation of 5810, a capacity of approximately 6000 af is indicated by the area/capacity curve for this dam. An increase of 5000 af (to 11,000 af) would raise the maximum pool elevation to approximately 5823.

Based on review of these storage data and the test fill report, the following concerns are presented with respect to the proposed increase in storage of 5,000 af.

- The observed and measured seepage through the foundation appears variable and largely uncontrolled, with lesser control (and lesser understanding) at higher reservoir levels. Additional study on seepage occurrences and control should be made prior to allowing levels above the currently recommended maximum of 5810;

- The influence of seepage forces through the pervious foundation deserves further attention, especially with respect to possible heaving at the toe (from upward seepage forces) and the potential for piping failure;

- Further slope stability analyses should include conditions at pool elevation 5823 and should consider potential seepage forces along the foundation and rapid draw-down conditions; and

- Site seismicity should be reviewed in light of present standards and recent data. A recent "California Seismic Hazard Map" published by Caltrans (1996) shows a maximum credible rock acceleration at the site to be on the order of 0.4-0.5g, associated with an event of magnitude 6.5 on the Stampede Valley fault. Appropriate force for pseudostatic analyses (where the maximum credible earthquake is converted to a gravitational force acting in the horizontal direction) may be 0.2g or greater, and almost certainly would be greater than 0.1g.

### Preliminary Conclusions

Based on review of the above data and the issues and concerns raised from these data, it is concluded that further study is necessary as a basis for increasing the pool elevation for added flood control purposes. Implementation of the remedial work as recommended in the 1995 Test Fill Report, and especially construction of a seepage barrier extended to the "blue silt" layer for seepage control, is likely to

be the most effective method of controlling the amount of seepage and satisfying the concerns of piping through the foundation and uplift pressures at the downstream toe. Further stability analyses, including current seismicity standards, would be essential prior to allowing higher reservoir levels.

## Truckee Meadows Soil Conditions

### Background

Geotechnical exploration in the Truckee Meadows was performed for the Feasibility Report and is discussed in the 1983 Documentation Report (Section C). The exploration included 16 test borings to a depth of 20 feet (COE, 1982). "Undisturbed" and bulk samples were obtained from the boreholes and were submitted for laboratory testing. Testing included natural moisture content, in-situ density, Atterberg Limits, gradation, direct and triaxial shear strength, consolidation, maximum dry density, and specific gravity tests. Logs of the test borings and results of laboratory tests are referred to in the text, but were not included with the report.

In addition to these borings, Section D of the Documentation Report (Soils and Geology) discusses subsurface exploration performed by others in the project area, along with generalized engineering properties of area soils.

The Truckee River area through the Reno-Sparks vicinity is indicated to be underlain by stream alluvium and glacial outwash deposits. These materials are typically at/or near ground surface in the western portion of the project area (generally west of the Reno International Airport). East of the airport, the glacial outwash deposits are indicated to be overlain by a variable thickness of floodplain and lake deposits.

The alluvium and glacial outwash sediments in the western portion of the project area are shown to be characterized by medium to high permeability, low compressibility, low shrink-swell potential, good drainage and low plasticity. Laboratory testing was limited in these materials because of their coarse nature. Boulders to several feet in dimension are not uncommon and these materials are unconsolidated but are relatively firm. Standard penetration counts are indicated to vary from 10 to 100, although the coarse fraction may distort these values. Artificial fill up to 8 feet deep was encountered near the river and can be expected to be loose and generally weak.

The floodplain and lake deposits in the eastern portion of the project area are shown to be characterized by low permeability, moderate to high compressibility, low to medium shrink-swell potential, poor to fair drainage and low to high plasticity. Materials descriptions include clayey silty sand, plastic

clay, sandy silt and sandy silty clay. Laboratory testing of these materials indicates the following range of soil properties:

| | |
|---|---|
| Moisture: | 29-44 percent |
| Dry Density (in-situ): | 70-88 pounds per cubic foot (pcf) |
| Maximum Dry Density | 105-121 pcf |
| Optimum Moisture | 17-20 percent |
| Liquid Limit | 39-106 percent |
| Plasticity Index | 10-69 percent |
| % Fines | 31-94 percent |
| Specific Gravity | 2.56-2.63 |
| Total Strength | c=0.2-0.6 tons per square foot (tsf) |
| | Ø=8-31° |
| Effective Strength | c=0.2-0.3 tsf |
| | Ø=27-32° |
| Compression Index | 0.28-0.35 |

The description of these materials indicates that they are consistently loose/soft and locally contain a high percentage of organics. The clays appear to be normally consolidated. Standard penetration counts are indicated to be relatively low (typically 5 to 10).

Groundwater is indicated to be relatively shallow throughout the project area (generally less than 20 feet and commonly less than 10 feet). Scour along the Truckee River is documented at several locations, including 2 feet near several bridge footings and up to 4 to 6 feet at other locations. Undercutting around area floodwalls is also reported, along with damaged walls from progressive failure and tilting.

**Preliminary Conclusions**

Foundation support for flood control elements such as levees, new floodwalls, channel modifications and bank slope protection appears to be available within the project limits, provided that appropriate engineering design is implemented.

Along the western section (underlain by generally coarse alluvial and outwash deposits), bearing support is considered likely available within firm intact sediments at relatively shallow depths. Footing support for new wall structures is anticipated to be appropriate, with bearing pressures of 1 to 2 tons per square foot likely available. Security, scour, and the presence of local large boulders must be considered. Groundwater inflow at levels below adjacent river levels may require special consideration for construction (e.g.,

diking/diversion/pumping). Liquefaction under seismic shaking may also be a design consideration in areas of loose, saturated granular soils; subdrainage may be necessary as a mitigating measure.

Along the eastern section (underlain by generally fine-grained floodplain and lake deposits), available bearing support is relatively low and some facilities (e.g., higher walls) may require deep foundation support (e.g., drilled piers or driven piles). Support for new levees is generally available, but will require consideration with respect to settlement, slope stability and erosion. Foundation support can likely be achieved for levees of height of 10 feet or less with "typical" foundation preparation, including subexcavation of weak material and recompaction (generally to 90 percent relative compaction). Higher levees may require an additional level of preparation. Subdrainage may be necessary for base stability in some areas. High groundwater should be anticipated and will require consideration in design and construction. The potential effects of seismic shaking (liquefaction, lateral spreading, rapid compaction, etc.) may also require consideration and is expected to be mitigated by typical engineering design (subdrainage, compaction, etc.).

## POTENTIAL FOR HAZARDOUS ,TOXIC, OR RADIOLOGICAL WASTE

Hazardous, toxic, and radiological waste (HTRW) may be encountered within the project area during construction of proposed facilities. Locations of possible concern are identified in this section.

Various hazardous materials have been detected in the downtown Reno area. The most common contaminant found was perchloroethylene. Other contaminants included benzene, ethylbenzene, toluene, xylenes, and chloroform (WESTEC, 1994). Contamination levels ranged from non-detectable to a high of 480 parts per billion (ppb) in the tested sites. Areas of potential contamination in the downtown Reno area are mainly north of the Truckee River between Keystone Street and Wells Avenue. The area south of the river, near the County Courthouse may also be contaminated.

Hazardous material may also be encountered in the region around the Reno Airport. Tanks associated with the airport expansion may have caused soil contamination in the vicinity.

Areas of potential contamination have been identified in the Sparks area, as well. There is soil and groundwater contamination at the tank farm located at the intersection of Pyramid and Interstate 80. Currently, a plume of petroleum is floating on the groundwater surface. The hazardous material is being cleaned up as mandated by a court order.

Most of the remaining project study area, is historically agricultural. Hazardous material is not expected to be present in these regions. Specifically, no hazardous material has been detected in the Huffaker Hills and Steamboat Creek areas. For the Truckee River area west of Reno, there is no hazardous material study currently available. Areas of contamination in this region are unknown.

Hazardous waste could be disturbed if any earthwork is performed to construct project facilities. Disturbance of contaminated soil could cause river and groundwater contamination, and could present a health hazard to workers. Detailed site investigations and HTRW inventory are necessary before any construction or disturbance of soil takes place in these areas.

# Section 6
# Citations

# SECTION 6
# CITATIONS

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