BOX ELDER COUNTY

The Board of Planning Commissioners of Box Elder County met in public session at the regular meeting place at the Box Elder County Courthouse, 01 South Main Street, in Brigham City, Utah, at 7:30 p.m. on July 20, 1989.

The meeting was called to order by the Chairman, Pro Tem., with the following members present, constituting a quorum:

Jon Thompson	Chairman, Pro Tem.
Steve Grover	Member
Junior Okada	Member
Robert Valentine	County Commissioner
Allen Jensen	Ex-Officio Member

Absent:

Richard Kimber	Chairman
DeVon Breitenbeker	Member
Don Christensen	Member

Mr. Thompson presented the Minutes of June 15, 1989. Mr. Grover made the motion to approve the Minutes as prepared. Commissioner Valentine seconded. None opposed. The motion carried unanimously.

AGENDA: (ATTACHMENT 1):

Mr. Thompson presented the Agenda for adoption. Commissioner Valentine made the motion to adopt the Agenda as prepared. Mr. Grover seconded. None opposed. The motion carried unanimously.

CONDITIONAL USE PERMIT - GARY PACKER:

No one was present to represent Mr. Packer in this matter. Mr. Thompson requested a motion to table the discussion for the next meeting. Mr. Grover made the motion. Mr. Okada seconded. None opposed. The motion carried unanimously.

KEITH HANSEN - DISCUSSION ON HOW TO HANDLE A CONDITIONAL USE PERMIT:

Mr. Hansen read from a prepared script, (Attachment 2) referring to various attachments (included) and maps (not included) regarding the issuance of the Conditional Use Permit to Mr. Darrell Nielsen for a gravel pit in the Willard, Utah, area.

RUSS BROWN BILL:

Mr. Thompson requested a motion to table this discussion until a full quorum that included Chairman Kimber and Mr. Denton Beecher are available. Commissioner Valentine made the motion. Mr. Grover seconded. None opposed. The motion carried unanimously.

After Mr. Hansen's presentation, the Commissioners discussed briefly some of his issues. Commissioner Valentine stated "There were some pretty damming allegations in Mr. Hansen's presentation regarding the competency and capabilities of Mr. Beecher, that are not addressed specifically, but there is continual alluding throughout. I think it's appropriate that this body, merely as a matter of record, recognize the work that was done and the procedures that were gone through with this permit; and so requiring from the standpoint of the applicant, I really believe that based on the data, that the advice and recommendations of Mr. Beecher have been in accordance with what he felt was proper. Although this is somewhat contrary there ought to be a vote of confidence come from this body, and I move that one be made." Mr. Grover made the second, adding Mr. Beecher is very competent. The motion carried unanimously.

The discussion continued on the subject of what constitutes a dam. Mr. Grover made the motion to adjourn. Mr. Okada seconded. The motion carried unanimously. Mr. Thompson adjourned the meeting at 9:10 p.m.

Passed and adopted in regular session this 17th of August, 1989.

ATTEST:

Allen L. Jensen
County Clerk

Richard D. Kimber, Chairman

AGENDA

BOX ELDER COUNTY PLANNING COMMISSION

MEETING PLACE: COUNTY COMMISSION CHAMBERS
BOX ELDER COUNTY COURTHOUSE
BRIGHAM CITY, UTAH

I. Public agenda for Box Elder County Planning Commission meeting scheduled for July 20, 1989 at 7:30 p.m.

II. Notice given to newspaper this 19th day of July, 1989.

III. Approval of minutes of June 15, 1989.

IV. Scheduled Delegations:

1. Conditional Use Permit - Gary Packer
2. Keith Hansen - Discussion on how to handle a Conditional Use Permit (hour to hour & 15 minutes)
3.
4.
5.
6.
7.
8.
9.
10.

V. Old Business

1. Russ Brown Bill
2.
3.
4.
5.

atch no. 1

EVALUATION
OF THE
CONDITIONAL USE PERMIT

1. DUST EMMISSIONS.

The statement is all inclusive but who here knows what these emission requirements are?

May I suggest you read the permits. They are couched in a bunch of technical references that are meaningless to all of us.

This statement establishes the standards which must be complied with, it does not specify how they are to be complied with when using the "Best Available Control Technology".

2. WRITTEN APPROVAL OF THE AIR CONSERVATION COMMITTEE.

In order to understand this issue you have to acquaint yourself with the required procedures and the events as they transpired. Briefly.

February 26, 1988.

We get involved at the request of the Mayor and Council reviewing the Conditonal Use submittals. The adequacy of the data was a concern then as it is now.

March 15, 1988.

We submit our review comments to BAQ - Dave Kopta.

April 4, 1988.

Our letter to the Mayor and Council relative to BAQ's position on silicone emissions, inadequate diesel fuel consumption, exposed area at 2 acres, not 5, treatment of gravel roads, production rate, moisture content, 360 days/year operation, number of trucks, etc.

April 11, 1988.

BAQ held public hearing in Willard.

atch no. 2

May 16, 1988.

BAQ letter to Mr. Nielsen stating his incremental off-property PM_{10} will be 684 ug/m^3 and that he must reduce it to 40 ug/m^3 (17:1 times).

July 21, 1988

BAQ issues an approval order for Mr. Nielsen's operation without any modification as required by their May 16 letter.

August 18, 1988.

Willard City appealed the above permit.

October 12, 1988.

BAQ responds to the appeal in letter addressed to the ACC. You must read this response to understand confusion. ACC grants Willard 30 days to meet with BAQ and resolve differences.

November 15, 1988.

BAQ recalculates emissions. Not sent out.

December 9, 1988

BAQ meeting in Salt Lake with Mrs. Hemsley and Mr. Nielsen to go over 11/15 calculations. Production reduced to 300,000 tons, moisture requirements increased, Mr. Kopta wanted immediate approval. I refused. Subsequent checks proved calculations in error.

December 15, 1988

ACC meeting in Salt Lake where I presented our findings. ACC was not receptive and they relied on BAQ and issued 12/15/88 permit.

December 15, 1988

I meet with you to discuss ACC actions. Planning Commission discusses Proposed Permit as revised by ACC and Mr. Nielsen acknowledges revised permit was issued.

April 11, 1989

BAQ issues new permit moving crusher another 300 feet South substantiating my position that the BAQ calculations of 11/15/88 were in error.

June, 1989

Appeal to Utah Department of Health has been made with data supporting silicone emissions.

Much was said by Mr. Nielsen on December 15, 1988 and has been said by others at various times about Willard City's and Keith Hansen's interferrence with the BAQ permit. I submit that this effort, to protect the air quality of Willard City and the long-term impact it could have on Box Elder County should have been initiated by your expert/consultant. If he didn't understand the issue, he should have lent his support rather than criticize and ignore.

Regardless of the representations, BAQ did change their permit on December 15 and has subsequently changed them again on April 11, 1989. It is your obligation to incorporte these conditions in your permit.

Gentlemen, in my opinion, your approval of the Conditional Use Permit on March 3, 1989 was premature and is not based on the "Findings of Fact" required by your ordinance and as recommend by the County Attorney. Your minutes show that you've accepted the July 21, 1988 permit when the conditions of December 15, 1988 were in effect.

3. WRITTEN RECLAMATION PLAN

You have received from Mr. Bland Richardson a written plan on or about January 30, 1989.

This January 30, 1989 report states that revegetation can be accomplished for $500 to $750 per acre. Because of the wide variation between the costs previously submitted by Mr. Nielsen ($4299 v.s. $500 to $750) I called Mr. Richardson. Mr. Richardson's basic work is with the reclamation of phosphate mines where he has the authority of the U.S. Government for enforcement. After discussing the issue for sometime, Mr. Richardson recognized our enforcement limitations and asked about requiring a bond to guarantee performance. Mr. Richardson stated that his report was of a limited scope and emphasized that in order for the revegetation to be accomplished for the stated costs it had to be done concurrently with the excavation. This means that as new areas were exposed, the immediately adjacent areas had to be topsoiled and planted. The BAQ permit requires essentially the same procedure, a procedure which may not prove practical once it is analyzed by a time, motion and cost study. Mr. Richardson's report contains many factors that must be addressed in any plan, the most crucial being:

A. Vehicle site access to be limited.
B. Cut and fill slopes to graded to gentle slopes.
C. Storm water control essential to minimize erosion.
D. Topsoil to be stock piled in an area where it will not be disturbed.
E. Storm water to pass through a sediment basin.
F. Final slope shaping and revegetation to immediately follow excavation.

G. Erosion is expensive to repair and if area is left as long as a week or two after topsoiling, then new seed bed must be prepared.

H. Save enough topsoil or cost will be prohibitive.

I. Maximum slope is 2:1 with benches at 50 to 75 foot intervals.

J. Topsoil at least 6 inches deep and mixed with slope material.

K. Fertilizer to be harrowed into soils and seeds pressed tightly into soil.

L. In order to prevent erosion, there needs to be at least 90% ground cover.

M. Things to be aware of in the reclamation effort:

- Most soil erosion normally takes place after rain drops strike bare ground.
- Accelerated erosion takes place when water is channeled.
- Wind erosion always takes place on bare ground.
- Slope failures take place most oftern when left bare.
- The deterrent to all these things is good vegetable cover.

N. Where Cook Canyon drainage crosses the excavation site it must be put in a rock channel. Energy disipaters (large Rock) will be placed in the channel to reduce the velocity of the water. Any disturbed area adjacent to the channel which is not being excavated will be seeded.

Whenever a contractor or developer is responsible for completing a project, especially one with many unknowns, the guarantee must be adequate to cover the costs if the City or County had to contract the work done. Thus, in order to protect the County the reclamation costs must include adequate funds to spread the topsoil which would be, as a minimum about $3000 per acre.

Mr. Richardson's proposal does not include:

A. The detailed plans or a planting schedule as recommended by Stephen Monsen.

B. Adequate funds so that the County could spread the topsoil and complete the planting if Mr. Nielsen fails or refuses to comply.

C. What site conditions, sprinkling system, watering schedule, etc. is necessary to assure growth.

D. The excavation limitations due to the fact that all Mr. Nielsen can expose is 5 acres until adequate growth is re-established to prevent wind erosion, rain erosion and the resulting PM_{10} emissions.

4. WRITTEN PLANS, DIAGRAMS AND DRAWINGS.

The plans I reviewed in April, 1989 and again in June, 1989 are essentially the same drawings Mr. Molgard had which were dated June 1987 or thereabouts. The intent of these drawings, for any project, is that they commit the recommendations of the experts to a printed document that can be used as a reference to verify compliance. The documents you have accepted are, in my opinion, totally inadequate. I'll address only part of the issues.

A. BAQ says road to be paved for 3,000 feet.
Plan says 1,500 feet.

B. BAQ limits crusher area to the South 465 feet whch is in the retention pond.
This is not shown.

C. BAQ prohibits most if not all of Phase 3.
Drawings continue to show Phase 3.

D. Side slopes are shown 2:1 minimum.
Should be 2:1 maximum.

E. Drainage facilities inadequate such as along road to handle overflow from retention pond and debris basin.

F. Main channel from Cook Canyon mislabled.
(See the photos furnished).

G. No details on how Cook Canyon flow is to be controlled in the North channel.

H. Russ Brown, on December 29 said a low level outlet was required.
Lew Wangsgard said "categorically no."
The plans do not show an outlet.

I. No geotechnical assessment of problems that may occur as a result of the ponding as proposed by Lew Wangsgard.
Mr. Brown on December 29 stated as follows in response to Mr. Kimber's question about draining the pond.

> "Well, there isn't any detail of what's going to happen to the water. There isn't any detail if you would line it. There isn't any detail that you could tell you. I think that it would be imperative that you have a low level outlet because it's not wise to have a pond up there for a number of reasons, for very long."

> "In other words, we don't want any water stored up there on the mountain, with the possibility of water popping up in somebody's basement down below, and mosquitoes and other things you mentioned."

J. In response to a question by Mr. Kimber relative to the adequacy of the plans, Mr. Brown responded:

> "If you are going to construct something, I would think that you would want more detail."

K. The plans do not include the rock lined channel recommended by Bland Richardson even though the excavation will be in the main channel. Mr. Brown, in his testimony of December 29, 1988 denies that the excavation will be in the main channel, or any channel for that matter when he states: referring to the first stage:

> "It doesn't involve digging in the flood channel itself, in there."

Gentlemen, check your photos and read Mr. Brown's report of October 12, 1982 and determine if the main channel or any channel is to be disturbed/destroyed by the proposed Phase I excavation.

L. Where are the terraces recommended by Mr. Richardson?

M. You've approved Phase I. What is Phase I and how big is the area. When the slope distances are used to calculate the exposed area, Phase I incorporates about 13.6 acres or over 2 1/2 years of excavation if the 5 acre BAQ limit is to be enforced unless Mr. Nielsen can provide another means of controlling the dust during the intervening 2 or 3 years it takes to establish the vegetation.

N. Addendum #1 shows the excavation to include Willard City. I don't believe the County can approve excavation within the city.

O. Sheet No. 3 shows a 9.4 acre foot pond, Addendum #1 shows a 19 acre foot pond without an outlet.

What did you approve?

Gentlemen, in my opinion, a serious error has been made when you accepted/approved these drawings. You do not have an enforceable set of plans. There is to much confusion, lacking of details, no approvals, no engineers signature or seals all of which have opened the door to future attempts at interpretation, differences of opinion and litigation.

5. WRITTEN PERMISSION FROM UDOT

You have a copy of a permit but as far as I have been able to determine, no one has assessed the safety problems associated with the loaded trucks exiting down a 12 to 13% grade.

6. ACCESS ROAD

Although BAQ has required this road to be paved in its entirety, the Planning Commission has refused or failed to address the issue.

Why? What portions are to be paved? Where are the channels that are to control the overflow from the retention Pond and debris basin?

7. WRITTEN COMMENT FROM THE FLOOD DISTRICT

You have a Flood District letter that says if a permit is approved, the flood control issue could be resolved. You also have letters saying they have not approved the flood control plans. I'll not confound you with all of the technical aspects of this issue, however, I hereby submit the evidence that has caused me to question the validity of Mr. Brown's calculations.

I. Russ Brown's Calculations for Cook Canyon Using the F&F distribution (Blue)

Note:

Page 2: Precipitation is 1.65 inches from NOAA Data (White Sheet) taken from July 1981 Master Plan.

Page 3: Peak flow is 216 cfs with a discharge of 18 acre feet.

This F&F storm was calculated by Norm Stauffer and myself. A comparison of the results is as follows:

Calculated by:	Peak Flow/cfs	Volume/Ac Ft.
RBG	216.	18
NS	226.8	18.5
KH	222.9	18.5

The above calculations confirm that the three of us are using the same storm curve. The variations are minor and an inherent part of the respective programs.

I also used the 1.65 inches in the TR-55 graphical procedure and calculated the peak flow for the storm at 235 cfs (2nd white). Mr. Brown's 216 cfs and my 235 cfs are comparable and acceptable within the limits of the storm calculations. What it proves is that 1.65 inches of rain will generate about 216-235 cfs from either the F&F or SCS type storm.

II. Farmer & Fletcher study is "site specific" for an area in Davis County. The above storm curve was develped by analyzing numerous storms with specific rainfall intensities. These intensities are shown in Figure 3 of their report. A copy of Figure 3 is included herewith (Pink). As you will note the precipitation is in inches per hour for storms of durations varying from 2 minutes to 360 minutes. The recurrence interval is from 2 to 50 years. In order to determine the intensity for a 100 year storm the 120 minute line (2 hour) was extended to the approximate location of a 100 year ordinate. The intensity interception is 1.7 inches per hour or 3.4 inches during a 2 hour storm. The possibility exists of an error with the projectin of the storm line, therefore 3 inches was used in the subsequent calculations. The results of these calculations are:

Calculated by:	Peak Flow	Volume/Ac.Ft.
KH	621	50.2
RB	216	18

III. a. Russ Brown's calculations of the peak flow for the SCS-24 hour-100 year storm is included herewith. (White).

b. I calculated what is supposed to be the same SCS-24hr-100 year storm.

1) I (Goldenrod) used the TR-55 program developed by the SCS. I varied the rainfall depth from 2.3 inches to 3.8 inches to determine the flow variations. The peak flow for the 24 hour storm was 784 cfs when the rainfall was 3.8 inches.

2) Because of the abnormal difference between Russ Brown's discharge of 216 cfs and my 784 cfs I requested the assistance of Norm Stauffer, a State hydrologist. I furnished the basic data.

SCS-24 hour- 100 year
CN - 87
Rainfall = 3.8 inches
Lag = 0.26 inches

His calculations are included herewith on the second set of pink sheets. If you will refer to the last page and you will note:

Volume 70.85 acre feet
Peak Discharge 748.78 cfs

3) Still not being satisfied and because the Flood Control District's hesitancy to accept my figures I contacted Dr. Paul Riley at USU. He is an expert --

The findings of his class are:

Team 1	562 cfs
Team 2	742 cfs
Team 3	
Hydrograph 1	624 cfs
Hydrograph 2	711 cfs
Team 4	600 cfs

The variations in the above flows are due to the procedures used, still the flows ae substantially greater than Russ Brown's at 134 cfs.

4) The third set of calculations (Blue) used the HEC 1 program which is supposed to be the same program as used by Russ Brown. As you will note the rainfall is 3.8 inches, the duration is 24 hours and the CN is 87, all of which are identical with Russ Brown's input. The computer, with the SCS-24 hour program on the disc computed a peak volume of 70.84 acre feet with a peak flow of 747.14 cfs.

OPINION:

A. My calculations have been confirmed

B. Russ Brown's calculations have not, they have been used by by Mr. Wangsgard. Refer to Onesco's letter of July 28, 1988.

5) How do I account for the difference.

17

a) On January 30, 1989 I finally received Mr. Brown's SCS Curve data. (Grey). As you will note, Mr. Brown has relied on a curve plotted by James M. Montgomery Engineers that is part of a Provo City Master Plan. If the curve (No.3) is wrong then Mr. Brown's calculations are wrong. The small written figures on the left for percent of depth are Mr. Brown's scaled values. The time corresponding to these depths are written across the bottom. These figures are tabulated on the third page. In my opinion, a responsible engineer does not rely on the work of others, especially when it involves the scaling of factors from a drawing which is subject to plotting errors and distortion when printing.

b) I acquired from the SCS hydrologist in Boise, Idaho the incremental run-off curve data. I have summarized this data and had the comparable ordinates typed on a copy of Mr. Brown's data (Green) which has been sent to him. As you will note, they are different. Attached to this green sheet is the JMM drawing upon which I have plotted the SCS curve. The yellow line is the curve Mr. Brown used. The Blue is the corrected SCS curve. The vertical portion of the blue curve is the area where the flow increases substantially. They are different, a fact which accounts for the difference in the flow data I have generated at

about 750 cfs with that of Mr. Brown at 134 cfs.

OPINION:

Mr. Brown has relied on the work of others without verifying the accuracy and consequently he has made a serious error.

6) FLOOD VOLUME.

The SCS - 24 hour - 100 year flood calculated by Mr. Brown, Norm Stauffer and myself have confirmed the volume of run-off at 71 acre feet.

Russ Brown stated on December 29, 1988:

"A 24 hour storm in terms of volume obviously will give you a much larger volume than a two hour storm..."

QUESTIONS:

A. How is this volume of 71 acre feet to be controlled?

B. Why has it been ignored?

8. PERMISSION FROM OGDEN WATER USERS

Apparently Mr. Nielsen has received permission to cross the canal at the Southwest corner of the property. However, has Ogden River Water Users been appraised of the fact that:

A. the drainage channel from Cook Canyon in this area is to be destroyed by the excavation.

B. A retention pond of either 9.4 or 19 acre feet is to be built immediately above the canal area and a rock lined overflow is proposed?

C. That no provisions have been provided to control the flow in this channel once the excavation starts, at least not until Phase 2 or later?

D. That Mr. Nielsen proposed diverting all of the flow from Cook Canyon into the North channel that flows through the concrete chute and that no details are provided of how this water is to be diverted at the canyon mouth, controlled as it crosses the fan and controlled as it flows below the canal to the debris basin?

Phone call from Ralph Bird, manager of Ogden River Water Users on July 19, 1989:

> Mr. Nielsen has a crossing permit only, no approval of any activity that would affect or could damage their pipeline and/or property.

9. PROTECTION OF ADJACENT REAL PROPERTY

Plans should show this but they do not. Requirement of Sec. 6-6.

10. APPROVAL OF THE STATE ENGINEER

On January 5, 1989 Denny Beecher makes the following comment while addressing the 9.4 or is it the 19 acre foot retention pond.

> "They have also contacted the State Engineer's Office and the State Engineer requires permits on a dam and anything over 20 acre feet. This is not a dam. It is a depression or hole. There is no earthern dam built, and so their proposal is that they say they do not need the State Engineer's approval on this type of a structure. Well, it is not a structure, this type of a hole."

A. What is a dam?

1. The State Engineer defines a dam as:

"DAM means any artificial barrier or obstruction, together with appurtenant works, if any, which impounds or diverts water. All structures necessary to impound a single body of water shall be considered as one dam."

2. Definitions: Artificial barrier or obstruction:

Artificial: Produced by human art rather than by nature.
Barrier: Any obstacle or obstruction, natural or otherwise.
Impound: To collect (water) in a pond, reservoir, etc.
Reservoir: A basin, either natural or artificial, for collecting and containing a supply of water.

3. Logic:
   a. If the excavation did not provide a method of impounding the water, the area would be a channel.
   b. The excavation proposes to impound the storm water by excavating the natural soils leaving a barrier consisting of natural soils to confine the waters. This barrier will after, excavation have the configuration of a dam. This "artificial barrier" may or may not have the structural stability of a manmade barrier, and therefore could fail more readily.
   c. The excavation of the retention basin as proposed, will create a reservoir of 9.4 acre feet, or is it 19 acre feet. According to Mr. Wangsgard, it could be enlarged 3.4 or even 5 times.

4. The State Engineer, in his "Rules and Regulations Governing Dam Safety in Utah" states:

"Before commencing the construction of any dam or reservoir not affected by the provisions of

section 73-5-5, written notice thereof shall be given to the state engineer which shall contain the information required by the preceding paragraph."

Section 73-5-5- States:

"73-5-5 CONSTRUCTION AND REPAIR OF DAMS --SUBMISSION OF PLANS TO ENGINEER FOR APPROVAL--SUPERVISION AND INSPECTION--PAYMENT OF EXPENSES--PENALTY FOR VIOLATION--EXCEPTIONS. Duplicate plans, drawings and specifications for any impounding dam which will impound more than twenty acre feet of water, shall be submitted to the state engineer for his approval, thirty days before construction thereof shall begin.

The relevant requirements of the preceding paragraph which is 75-3-12 are:

"...reservoirs or dams used to impound any water whatsoever, shall notify the state engineer in writing of the name of such dam or reservoir, the general location thereof with reference to section, township, and range, city, town or highway or to a prominent and permanent natural object if located within two miles therefrom and approximate capacity of the reservoir, and height of the dam, and shall file with the state engineer, plans, drawings and specifications..."

OPINION:

Dams, reservoirs and impoundments are synonymous.

Enclosed herewith (cream) is a copy of the "Application to Construct a Dam Impounding less than 20 acre feet.

CONCLUSIONS:

A. The Planning Commission has been misinformed about the need for the State Engineer's approval of a pond with a capacity of less than 20 acre feet.

B. If the impoundment is to increase 3, 4 or 5 times as stated by Lew Wangsgard or if it must contain any part or all of the 71 acre feet, the applicant must comply with the provisions of 73-5-5 Construction and Repair of Dams--Submission of Plans to Engineer for Approval--Supervision and Inspection--Payment of Expenses--Penalty for Violation--Exceptions.

C. The Planning Commission was misled by Mr. Lew Wangsgard on January 5, 1989 when he stated:

> "You don't have to make application for a dam. I think it would not be difficult to obtain from the State Engineer's office a letter of approval indicating that there is no dam involved and that therefore, it is not required as a matter of requirement of the State."

I am furnishing herewith a copy of these requirements which, in my opinion, all of you should read and which should be on file in Denny Beecher's office.

10A. STATE ENGINEER APPROVAL OF CHANNEL CHANGES.

The document you have been furnished (white) "Administration Rules for Stream Channel Alterations" has several relevant paragraphs which you should be aware of:

READ FROM BLUE BOOK--HAVE THEM MARK THEIR COPIES.

11. Other's comments.

12. Other's comments.

13. Other's comments.

14. QUALIFIED ENGINEER'S ESTIMATE

May I suggest that you have Denny prepare copies of each estimate, starting in 1981 for your personal review and that you compare each one with the other. There are significant changes and decreases that are not justified.

In my opinion, your approval of $20,000 is inadequate and would be difficult to administer. What specific items are covered by the $20,000? If Mr. Nielsen spends $20,000 on the road, a culvert and the run-away truck lanes, who will pay for the flood control structures, the revegetation, etc.?

Until the plans are complete, incorporating all of the foregoing, no one can prepare a reliable estimate that will protect Box Elder County.

16. NOISE LEVELS

The acceptable limits of "noise" created by this operation are specified in your county ordinance. To you and I, the limits do not really mean

much and for Mr. Nielsen to say he will comply does not mean he can comply.

Noise is a pollution of the environment as much as dust and other emissions are. Only an expert, an accoustical engineer, qualified in assessing these noise levels can determine the noise impact. I had to use an accoustical engineer for St. Benedicts Hospital. It is included in these reports. (Show document)

In my opinion, Mr. Nielsen should be required to submit a comparable analysis for his operation. The combination of his equipment and the trucks hauling the material may exceed the noise limitations thus restricting the amount of material that can be moved. Mr. Nielsen needs to know this because it will affect the economic viability of the project and you need to know this so that the rights of the people are protected.

Once an operation begins, you are not going to "shut him down" without just cause. A threat of damages then becomes real and you may be held accountable.

RECOMMENDATIONS:

A. You have sufficient evidence of non-compliance, misleading statements and, in my opinion, you should recind the permit.

B. Require Mr. Nielsen to submit his plans, Russ Brown's calculations, Lew Wangsgard's calculations, and my calculations to the State Engineer for review. Let him be the independent third party judge.

SUMMARY

Gentlemen, much has been written in your minutes with criticisms being uttered, allegations of misrepresentations, questions of who is an

expert, concerns expressed for personal liability, accustions of selling personal and professional integrity, challenges to the Air Quality data furnished, evidence that the BAQ permit of 12/15/88 had not been read restricting the crusher location, being "chagrined" because the Planning Commission wasn't totally informed and the treating Willard City as a "foreign entity"

It really bothered me when the December 29, 1988 meeting was closed to "others" input especially since I had hand delivered this document (12/21/88) to Richard Kimber's home assuming its content would be made available to all of you. This document provides you with a lot of the technical data, RBG reports, other previous reports, calculations, maps, photos, etc., all of which you, in my opinion, should have been permited to review. The only way you could have understood this data is if I had been allowed to discuss it with you. In my opinion, you would have had a better understanding of the confusion and conflicting statements in the Rollins, Brown & Gunnell reports that start in February, 1981.

You would have known the excavation is to begin in the main channel from Cook Canyon even though you've been assured otherwise.

You would have known the Air Quality issue was still up in the air and not resolved.

You would have read Russ Brown's report of October 12, 1982 where he described the September 26, 1982 flood that initially coursed down the channel, that is to be destroyed by the excavation, across the Ogden-Brigham Canal and then changed its path, to the channel that is now being labeled the main channel, and wreaked destruction of the canal. (Show map).

You could have assesed the need for drilling, topsoiling, revegetation, maintenance and drainage channels, channel velocity as contained in previous documents that should be in the County's possession.

WHY WERE YOU DENIED THIS DOCUMENT?

On Monday, July 17, 1989 I was in Denny's office discussing the problems associated with the gravel pit. I asked Denny why he didn't come to my office when I invited him, to review the information I had in my files. I felt that if he knew what was available that he could mitigate the misunderstandings and even possibly resolve some of the issues.

Dennys' response:

> " I was advised by the County Commissioners and County Attorney not to."

Why? Since when:

A. Did our records become a contaminant? Is someone afraid that their present opinions will be dispelled and someone is going to have to rethink their position?

B. Has Willard become a foreign entity or enemy of Box Elder County?

DeVon, you expressed concern over when this circle of expert opinions would stop.

To that query I respond by saying, the circle will become a straight line when you have someone that is educated and professionally trained to assess the issues, who will work with you, talk with you and sometimes will lead you through the maze of technical jargon and data into that straight line, using facts, not allegations or personal prejudices as guide posts. You and your advisor/expert/consultant also should be ready to openly accept all of the technical data and if there

is a substantial difference of opinion you must ask for a third party to intervene and provide guidance. As a practical matter, your in house advisor/expert/consultant should fulfill this role. Reliance on personal beliefs and/or someone who is not qualified, exposes you, in my opinion, to a personal liability you can ill afford.

You also expressed concern on how to determine who is an expert.

Because a man tells you how great he is, how many reports he has written or how many agencies he's responded to or worked for does not, in and of itself qualify him as an expert, especially if another professional reviews his work and finds gross errors which the other expert refuses to address or acknowledge. In my opinion, you should wonder why this expert you've relied on, has used a curve that was prepared only 2 years ago by another consultant rather than verifying and/or having the correct SCS data in his files.

The expert is, in my opinion, the individual who by education and experience has qualified himself to act in manners beneficial to mankind. This individual becomes the real expert when he recognizes his limitations and requests the assistance of others, more qualified than he, to assist him.

I've sucessfully operated my engineering firm for over 30 years by following the above principals. I constantly use other experts to assist in my determinations.

Lets examine the facts as they now stand.

A. I stated hydro-seeding was not reclamation and was criticized for it.

   Steven Monsen and Bland Richardson have supported by contention as did the 1981 Schick report.

B. The Bureau of Air Quality has not voluntarily revised their permit conditions. This PM_{10} Off-property Summary (Purple) summarizes their actions. Please note the dates and the following:

1) 500,000 tons was going to produce 11-12 tons of PM_{10} during the period of 2/07 thru 7/20.
2) The incremental ug/m^3 varied from 342 to 684 to 36.6 to 47 for this tonnage.
3) The total impact varied from a high of 794 ug/m^3 to a low of 121.6 ug/m^3.

All of the foregoing were supposed to be based on the "Best Available Control Technology". I would not accept these calculations thus BAQ went back to the computer and come up with the new calculations which are highlighted in yellow under 11/15. Note the tonnage is now reduced to 300,000, the PM_{10} is, with this reduction 7.8 tons per year yet the total off-property impact at 136.7 ug/m^3 is greater than 7/20 which was 134 ug/m^3. The calculations are still supposed to have been made using the "Best Available Control Technology". It is this data of 11/15 that BAQ used to develop the 12/15/88 proposed permit. I was still not satisfied because of the apparent and obvious errors in their last set of calculations so I prepared my own which is in the last column. The total off-property impact became 157 ug/m^3 which exceeded the EPA allowable of 150 ug/m^3 thus the operation could not be approved.

I do not know if my calculations in the last column had an effect or not but, after a series of communications with Ken Alkema and Mark Burrell of the Health Department along with the intervention of the Lieutenant Governor, the April 11,

1989 permit was issued. We still do not hae a copy of the last calculations.

Have we, the Mayor, the City Council and I been effective in protecting the health, safety and welfare of the residents of Willard City, I'd like to think so. It's been a difficult and arduous task, but with the support of the Mayor and Council we have prevailed. The question now becomes:

> "Are you going to let our efforts go for naught-because of the prejudices evidenced in the minutes of your meetings? In my opinion, the feelings exhibited in these minutes are due to a lack of communication which has resulted in your misunderstanding. Let's not try to point a finger, because as Jon Bunderson said, "I don't think it matters who went down and complained to Utah Air Quality." The fact is that Air Quality was given the task to approve Mr. Nielsen's operation and they have issued a revised permit with conditions that must be complied with, conditions which, in my opinion, you cannot ignore or you are in violation of Section 6-6 of the County Ordinance and possibly even the State Law for approving a "non-approved" operation.
>
> Remember, Your Condition No. 2 requires the applicant to obtain the approval of the Utah Air Conservation Committee and the Utah State Board of Health which shall be submitted to the Planning Commission.

In my opinion, if Mr. Nielsen has not or did not submit the 12/15/88 Proposed Permit to you in a timely manner and prior to March 3, 1989, then he was in violation of Condition No. 2 which voids your Conditional Use Permit approval of March 3, 1989. The Planning Commissions failure to clarify the status of and/or incorporate the provisions of the 12/15/88 permit as part of the permit approval complicates the issue and will make for interesting dialogue, if this issue goes to court and you have to defend your action. The Planning Commission was made aware of the 12/15/88 proposed permit and Denny had one in his possession on January 5, 1989.

An April 11, 1989 permit, which was issued contrary to an agreement made between Ken Alkema and Willard City, is now in effect and must be complied with and should become part of the Conditional Use Permit so that the requirements for compliance are not lost.

4) RECLAMATION PLAN

In my opinion, the plan is incomplete because it does not address how the plans are to be maintained until they become established is an effective erosion mitigator, where the water is to come from, how it is to be sprinkled, the cost of sprinkling, where the top soil is to come from and what it will cost if it has to be hauled in. The major issue not resolved is how the 5 acre exposed area limit, of the BAQ permit, is to be complied with.

5) PLANS, DIAGRAMS, ETC.

In my opinion, the plans are not acceptable because they do not include the BAQ restrictions Mr. Richardson's recommendations, are misleading because the main flood channel from Cook Canyon is not identified and they do not adequately address how the flood waters are to be controlled. Please consider the following scenario:

a) The plans show a 9.4 and a 19 acre foot pond.

Question 1.

Which is correct?

b) The 10 foot deep pond is apparently to be excavated during Phase 1. This excavation is in the Main Channel of Cook Canyon as evidenced by the photos you have and by Mr. Russ Brown's reports (See Oct. 12, 1982).

The plans do not show how the water is to be controlled and erosion prevented on the North Bank as the excavation proceeds. Bland Richardson addressed the issue by recommending rocked channels and energy dissipators. Russ Brown has also addressed the issue in his review of the 1981 Schick report.

Question

What happens if the pond is incomplete and/or if it is filled with sediment anytime during Phase 1 which could prove to be a 3 to 10 year project based on BAQ limitations.

c) Assuming the total flow is diverted down the North channel as proposed. The dispersel area which currently

absorbs 50% of the flood flow will be reduced by 75 to 80%, thus the channel flow across the canal could be increased to 80% or more of the total flow that exits the canyon mouth.

Question:

How is this increased flow to be diverted into the North channel and controlled? According to the plans, the flood will not be allowed to vary its flow pattern on the alluvial fan and dissipate while reducing it's velocity and sediment transporting ability.

d) Mr. Brown, on December 29, 1988 stated that most designs are based on a 50 year flood because they can't afford the costs of controlling a 100 year flood. Roger Boisjoly, former Mayor of Willard, in a letter or memo dated August 6, 1981 states: I was told by Mr. Russell Brown of Rollin's, Brown & Gunnell, Consulting Engineers that the cost to contain a 100 year storm would perhaps exceed by many times the net worth of the whole City of Willard." Mr. Brown has not refuted this statement even though I mailed it to him on 10/18/88.

If the cost of containing a hundred year storm is prohibitive, why is this Planning Commission approving the destruction of a natural feature, the alluvial fans, that have a proven capability of disipating 50% or so of the storm flow? This natural flood mitigating feature reduces the 100 year flood crossing the canal to the equivalent of a 10-25 year flood.

Retaining these alluvial fans will reduce the costs of construction and maintenance of flood control facilities

to both Willard City and Box Elder County. If they are to be removed, the responsible party must immediately replace them with facilities equal to or better than that which exists.

Question 1:

Are you prepared to accept the responsibility if the facilities prove inadequate?

Question 2:

Can Mr. Nielsen or the residents of Box Elder County afford the costs and the risks?

e) The plans do not show the "benching" required by Mr. Richardson nor the North limit line of the BAQ permit. On December 29, 1988 minutes the following dialogue is recorded:

> "BEECHER: You know, the question was brought out out last time by Mr. Hansen that the Air Quality was going to require that the crusher remain in that area, you remember that discussion; and that he would have to transport when he got into phase 2. He would not be able to build that, according to Mr. Hansen's ideas. He would not be able to build that. Now we don't know that as a fact other than Mr. Hansen's statement. And I am not saying Mr. Hansen didn't tell us the truth, but that was just his statement. We don't have that as a fact from Air Quality. But if it were the condition, we have got a

different set of problems, here, if he is not allowed to move the crusher. I can't believe that because I have never seen an operator work that way yet. They move the crusher to the hill.

THOMPSON: I called Air Quality. Air Quality didn't say that he couldn't move his crusher. Mr. Hansen misquoted him. Folktech, or whatever his name is, says he will be able to move the crusher almost clear through that pit.

BEECHER: So, if we were misquoted on that one, how many others were we misquoted on? We better just forget that other permit until we get a copy of it."

Gentlemen, why didn't Denny ask Mr. Nielsen to produce the permit or call Air Quality for verification? The response credited to Mr. Thompson I believe was made by Mr. Grover. I didn't quote Mr. Folktech-Kopta is probably who was meant. I quoted what was written in paragraph 15 of the permit, to wit:

(15) The North edge of the unstabilized area shall not be located closer than 456 feet from the common border with the Jensen property. The plant shall not be located closer than 928 feet from the common border with the Jensen Property.

Denny's statement addressing the crusher location makes my point - you do have a different set of conditions. "These" condition have not been recognized even though the permit was in Denny's possession.

One of the major problems we have, as a culture, we don't want to read something and verify it for ourselves, we want someone to tell us, consequently we oft-times are easily misled.

f) Plans developed for future.
Based on the Planning Commission minutes there is an opinion that plans cannot be developed for the future.

This conception is wrong. Master Plans are prepared every day of the world. The purpose of this plan is to identify what is to be done now and what is intended in the future. Each year or as often as needed, the Master Plan can be updated and modified as required.

The long-term plan is essential for Mr. Nielsen's programing and for you and your predecessors to follow. Without it, someone will be going through this procedure all over again.

6. ACCESS ROAD
The details are incomplete and the plan does not comply with BAQ.

7. FLOOD CONTROL
You do not have the flood control approval and, in my opinion, your proceeding to issue the Conditional Use Permit without their blessings has placed an enormous liability on your

shoulders. As I read the State Engineers document, his approval is required for all flood facilities, including the channel changes. As long as the technical controversy exists, you should not, in my opinion, attempt to decide who is right.

8. OGDEN RIVER WATER USERS
You do not have in your possession a construction permit that allows Mr. Nielsen to change any of the features on the Ogden-Brigham Canal right-of-way.

9. PROTECTION OF ADJACENT PROPERTIES
Plans must be complete on flood control facilities. Compliance with BAQ permit must be demonstrated.

10. APPROVAL FROM STATE ENGINEER
You've been told this is not necessary. Mr. Chad Gourley of the State Engineer's Office said it was. Request written opinion and recommendations from State Engineer.

11. FLOOD CONTROL DISTRICT ACCEPTANCE
Their responsibility but until it is proven that the facilities will not increase the cost to the taxpayers or expose them to a greater liability, in my opinion, the FCD should not accept anything. It is one thing to have to contend with a natural feature and an act of God, but it becomes a personal liability if man changes this natural feature and damage or loss of life results.

12. AGENCY COMMENTS
You've apparently received these comments but have not incoporated the comments into your findings of fact. Mere receipt of a document does not a conditional use permit make. Paragraph 3 of Sec. 6-6 defines your responsibilities.

13. BLASTING

No comment.

14. ENGINEERS ESTIMATE.

There is no way that a reliable engineer's estimate can be prepared until the plans are complete. Rather than rejecting Willard City's involvement, why not accept and review their comments and recommendations? You'll be getting the assistance of a qualified engineer who has been performing similar reviews for over 30 years, and it won't cost the County anything for what has been done to date. (Show plans)

15-18

No comment from this engineer

19-20 TERMINATION OF C.U.P.

This statement reads good but any attempt to enforce it will, in my opinion, immediately subject you, the County and anyone involved with the threat of and in all probability the filing of a lawsuit.

It is better to have all conditions clearly defined, all construction shown in detail and adequate funding or escrow to prevent future misunderstandings.

In my opinion, you have not complied with Sec. 6-6 of the County Planning Ordinance, in that:

a) The Conditional Use Permit dated March 3, 1989 is a statement, listing documents that Mr. Nielsen must furnish.
b) It does not include any findings of fact.

c) No proof that that safety and welfare of the residents will not be impacted.

d) There is no itemization, description of the conditions to be imposed.

Gentlemen, as I read your Conditional Use Permit granted March 3, 1989, it is the same document originally given to Mr. Nielsen that specifies what he must furnish in order for you to determine the requirements and conditions you will impose as are necessary for the protection of adjacent properties.

Respectfully submitted,

HANSEN & ASSOCIATES, INC.

Keith A. Hansen, P.E.

KAH/dmb

enclosures

STANDARD-EXAMINER
TUESDAY, JULY 11, 1989
CITY EDITOR: 625-4220

Developer of proposed gravel pit pleads case

By MARK PETERSON
Standard-Examiner

BRIGHAM CITY — The developer of a proposed gravel pit east of Willard took one last chance to plead his case to the media with a press conference that lasted more than two hours and included tours of two gravel pits.

"All I want is what's fair," said Darrell Nielsen.

Nielsen's permit allowing the project was scheduled to be put to an appeal hearing this afternoon before the Box Elder County Commission.

The county's planning commission gave a conditional-use permit allowing Nielsen to operate the gravel pit just northeast of the Woodyatt fruit stand on U.S. 89. Willard residents have protested that permit to the county commission, which must decide whether to uphold the planners' decision or rescind it.

Residents have complained about potential noise, dust, soil erosion and reduced deer foliage if the gravel pit swings into full operation.

Nielsen, in company with his attorney, engineer and reclamation consultant, sat down with reporters to explain his position.

"There are still some major misperceptions about what Mr. Nielsen's proposal entails," said attorney Jeff R. Thorne.

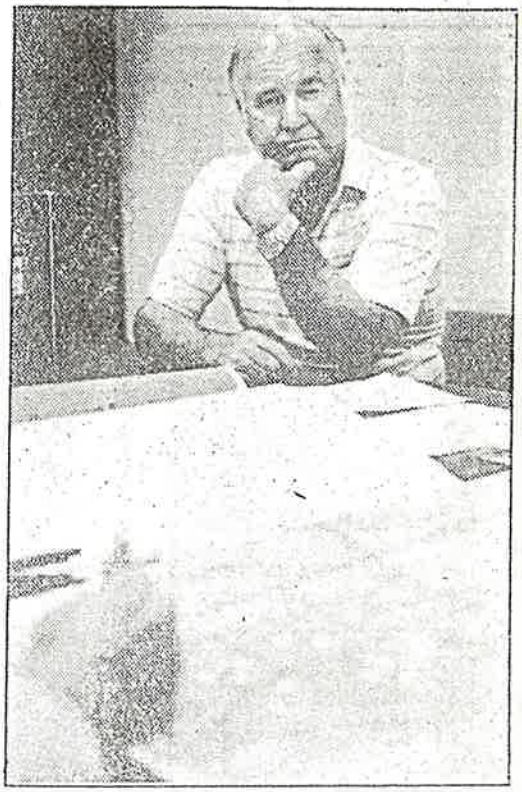
Thorne said although the entire scope of the gravel pit project encompasses 160 acres, only five acres at a time will be allowed to be mined and the used portion of the pit will be reclaimed as new portions open.

"The reclamation plan is designed primarily to prevent erosion by both wind and water," said Bland Richardson, a retired research forester and consultant on the gravel pit project.

Richardson said that within three years of reclaiming the first five acres of gravel pit, there should be 90 percent ground cover with new plants and that the new plants will provide better forage for the deer in the area.

"I think some people underestimate the

See GRAVEL on 2C



Steve Wewerka/Standard-Examiner

Darrell Nielsen looks over blueprint of his gravel pit proposal Monday during a 2-hour press conference.

Gravel

From 1C

value of new shrubs and forbs," Richardson said.

Engineer Lew Wangsgard said in addition to enlarging an existing detention basin, the gravel pit itself will provide flood control for Cook Canyon.

"This particular excavation would provide ultimate protection for the people of Willard," Wangsgard said.

The engineer said Nielsen agreed to more than double the size of the existing basin, but the excavation will provide three times more protection than the basin itself — enough, Wangsgard said, to handle a hundred-year storm.

Thorne said Nielsen is just as worried about property values as are the Willard residents, because Nielsen owns not only the gravel pit, but adjoining lands that eventually may be turned into subdivisions.

The attorney also said air quality would be monitored by inspectors and the permit could be canceled if terms are not met.

Nielsen said he had already spent more than $1 million on the project and has nearly completed the road to the excavation site.

Asked if he planned court action if the county commission turned down the project, he said, "We'll cross that bridge when we come to it."

```
                                    ****
                FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY [illegible] OF EN[illegible]ERS, THE HYDROLOGIC ENGINEERING CENTER, 609 [illegible]ND STREET [illegible], CA. 95616
                                    ****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

1                                   HEC-1 INPUT                                                    PAGE  1

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

*** FREE ***
*** LIST ***
          1           ID        WILLARD - COOK'S CANYON HYDROLOGY
          2           ID        100 YEAR - 2 HOUR DISCHARGE - F&F DISTRIBUTION
          3           ID        ROLLINS, BROWN & GUNNELL, INC.
          4           IT        5       0       0      50       0       0
          5           IN       12
          6           IO        1       1

          7           KK    COOK  FLOOD DISCHARGE AT MOUTH OF COOK'S CANYON - ELEV. 4900
          8           BA    0.54
          9           PB    1.65
         10           PC       34      58      74      82      88      92      94      96      98     100
         11           LS        0      87
         12           UD    0.26

         13           KK   FRONT FLOOD DISCHARGE FROM FRONTAL AREA - ELEV. 4900
         14           BA    0.12
         15           LS        0      80
         16           UD    0.10
         17           ZZ
1
                                    ****
                FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                    ****

                WILLARD - COOK'S CANYON HYDROLOGY
                100 YEAR - 2 HOUR DISCHARGE - F&F DISTRIBUTION
                ROLLINS, BROWN & GUNNELL, INC.

6 IO          OUTPUT CONTROL VARIABLES
                IPRNT          1  PRINT CONTROL
                IPLOT          1  PLOT CONTROL
                QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                NMIN           5  MINUTES IN COMPUTATION INTERVAL
               IDATE     1     0  STARTING DATE
               ITIME        0000  STARTING TIME
                  NQ          50  NUMBER OF HYDROGRAPH ORDINATES
              NQDATE     1     0  ENDING DATE
              NQTIME        0405  ENDING TIME
```

37

```
                COMPUTATION INTERVAL      .08 HOURS
                  TOTAL TIME BASE    4.08 HOURS

        ENGLISH UNITS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  7 KK    *     COOK   *      FLOOD DISCHARGE AT MOUTH OF COOK'S CANYON - ELEV. 4900
          *            *
          **************

  5 IN        TIME DATA FOR INPUT TIME SERIES
                  JXMIN          12  TIME INTERVAL IN MINUTES
                 JXDATE      1    0  STARTING DATE
                 JXTIME           0  STARTING TIME

            SUBBASIN RUNOFF DATA

  8 BA        SUBBASIN CHARACTERISTICS
                  TAREA         .54  SUBBASIN AREA

              PRECIPITATION DATA

  9 PB            STORM        1.65  BASIN TOTAL PRECIPITATION

 10 PI        INCREMENTAL PRECIPITATION PATTERN
                10.00     10.00      8.00      6.67      6.00      3.33      3.33      2.67      2.50      2.17
                 1.67      1.67       .83       .83       .83       .83       .83       .83       .83       .83
                  .83       .50

 11 LS        SCS LOSS RATE
                  STRTL         .30  INITIAL ABSTRACTION
                 CRVNBR       87.00  CURVE NUMBER
                  RTIMP         .00  PERCENT IMPERVIOUS AREA

 12 UD        SCS DIMENSIONLESS UNITGRAPH
                  TLAG         .26  LAG

                                                    ***

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

                                          UNIT HYDROGRAPH
                                      18 END-OF-PERIOD ORDINATES
          146.      492.      819.      853.      687.      434.      271.      176.      112.       71.
           45.       29.       18.       12.        8.        5.        3.        0.

*****************************************************************************************************************

                                        HYDROGRAPH AT STATION     COOK

*****************************************************************************************************************
                                                                  *
   DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q            *    DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q
                                                                  *
    1    0000    1     .00     .00     .00         0.            *     1    0205   26     .00     .00     .00        36.
    1    0005    2     .25     .25     .00         0.            *     1    0210   27     .00     .00     .00        24.
    1    0010    3     .25     .23     .02         3.            *     1    0215   28     .00     .00     .00        15.
    1    0015    4     .20     .14     .06        21.            *     1    0220   29     .00     .00     .00        10.
    1    0020    5     [illegible]                                *     1    [illegible]
```

38

1	0035	8	.08	.03	.05	206.	*	1	0240	33	.00	.00	.00	2.
1	0040	9	.03	.03	.04	216.	*	1	0245	34	.00	.00	.00	1.
1	0045	10	.03	.03	.04	211.	*	1	0250		.00	.00	.00	1.
1	0050	11	.03	.02	.04	198.	*	1	0255	36	.00	.00	.00	0.
1	0055	12	.04	.01	.03	185.	*	1	0300	37	.00	.00	.00	0.
1	0100	13	.04	.01	.03	170.	*	1	0305	38	.00	.00	.00	0.
1	0105	14	.02	.01	.01	153.	*	1	0310	39	.00	.00	.00	0.
1	0110	15	.02	.01	.01	133.	*	1	0315	40	.00	.00	.00	0.
1	0115	16	.02	.01	.01	113.	*	1	0320	41	.00	.00	.00	0.
1	0120	17	.02	.01	.01	96.	*	1	0325	42	.00	.00	.00	0.
1	0125	18	.02	.01	.01	83.	*	1	0330	43	.00	.00	.00	0.
1	0130	19	.02	.01	.01	75.	*	1	0335	44	.00	.00	.00	0.
1	0135	20	.02	.01	.01	70.	*	1	0340	45	.00	.00	.00	0.
1	0140	21	.02	.01	.01	67.	*	1	0345	46	.00	.00	.00	0.
1	0145	22	.02	.01	.01	65.	*	1	0350	47	.00	.00	.00	0.
1	0150	23	.01	.00	.01	63.	*	1	0355	48	.00	.00	.00	0.
1	0155	24	.00	.00	.00	58.	*	1	0400	49	.00	.00	.00	0.
1	0200	25	.00	.00	.00	49.	*	1	0405	50	.00	.00	.00	0.

****

TOTAL RAINFALL = 1.65, TOTAL LOSS = 1.01, TOTAL EXCESS = .64

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	4.08-HR
+ (CFS)	(HR)				
		(CFS)			
+ 216.	.67	55.	55.	55.	55.
		(INCHES) .642	.642	.642	.642
		(AC-FT) 18.	18.	18.	18.

CUMULATIVE AREA = .54 SQ MI

*** ***

****
* *
13 KK * FRONT * FLOOD DISCHARGE FROM FRONTAL AREA - ELEV. 4900
* *
****

SUBBASIN RUNOFF DATA

14 BA SUBBASIN CHARACTERISTICS
TAREA .12 SUBBASIN AREA

PRECIPITATION DATA

9 PB STORM 1.65 BASIN TOTAL PRECIPITATION

10 PI INCREMENTAL PRECIPITATION PATTERN
10.00 10.00 8.00 6.67 6.00 3.33 3.33 2.67 2.50 2.17
1.67 1.67 .83 .83 .83 .83 .83 .83 .83 .83
.83 .50

15 LS SCS LOSS RATE
STRTL .50 INITIAL ABSTRACTION
CRVNBR 80.00 CURVE NUMBER
RTIMP .00 PERCENT IMPERVIOUS AREA

Rainfall Estimates

The U.S. Weather Bureau maintains rainfall recording stations throughout Utah. However, there is not a station located within the study watershed. The closest stations are located in Brigham City and Ogden. They also maintain recording stations on the mountain in Davis County about 30 miles south of Willard. Because of the elevation and locations of these stations, the typical storm on Willard Mountain would be similar in nature to those recorded by the Davis County Station. The Davis County Experimental Watershed Stations recorded on July 10, 1936, (just prior to the Willard Flood on July 29, of that same year) 1.05 inches or rainfall in 30 minutes. In 5 minutes during that storm, 0.42 inches fell. In 1938, a July storm measured 0.61 inches in 15 minutes .

The following depths for storms was obtained from the U.S. Department of Commerce National Oceanic and Atmosphere Administrator (NOAA) "Precipitation-Frequency Atlas of the Western United States" published in 1973.

TABLE 2

Storm Depth from NOAA Atlas May - October

	2 yr.	5 yr.	10 yr.	25 yr.	50 yr.	100 yr.
* 1 hr.	0.58	0.75	0.85	1.00	1.25	1.31
* 2 hrs.	0.70	0.80	1.00	1.25	1.45	1.65
* 3 hrs.	0.80	1.00	1.10	1.40	1.60	1.80
** 6 hrs.	1.10	1.40	1.60	2.00	2.20	2.40
**24 hrs.	1.80	2.25	2.60	3.20	3.60	6.40

* = Values calculated by NOAA method

** = Values from Isopluval Maps

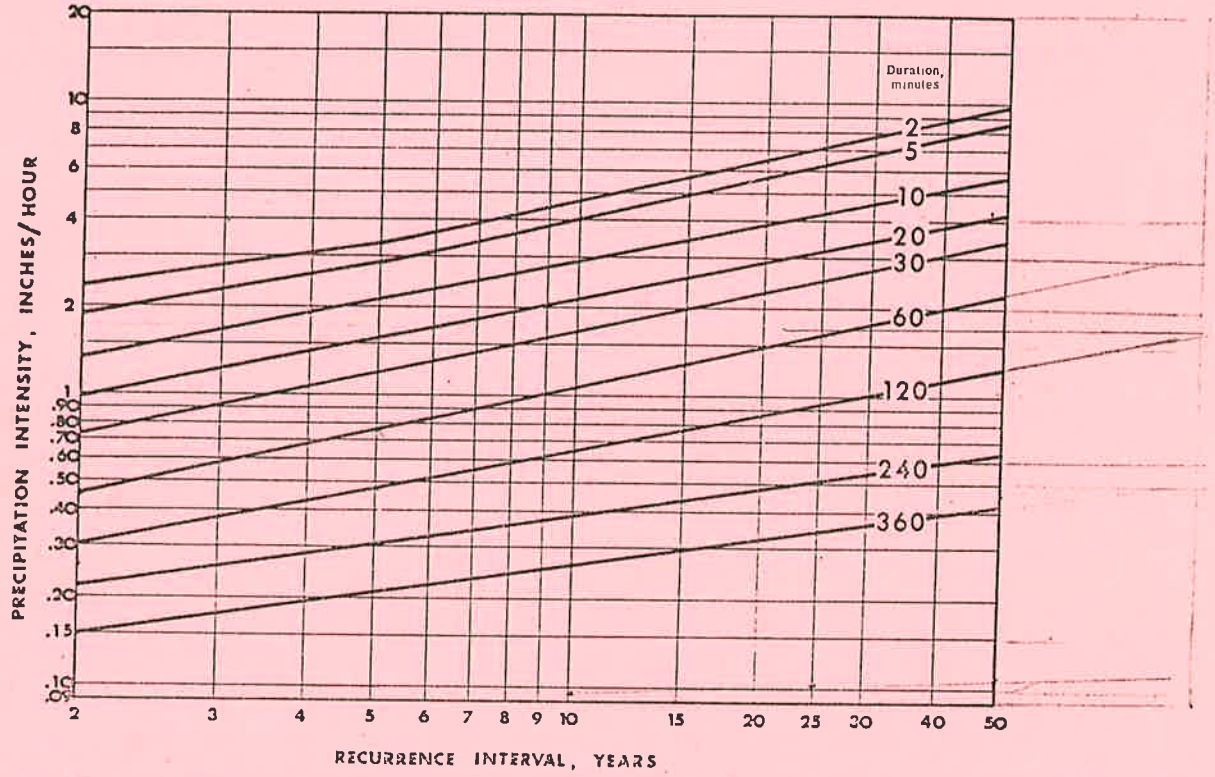
Project : WILLARD GRAPHICAL User: KAH Date: 10-06-88
County : BOX ELDER State: UT Checked: ____ Date: _____
Subtitle: COOK CANYON

Data: Drainage Area : .54 Sq Mi
Runoff Curve Number : 87
Time of Concentration: 0.26 Hours
Rainfall Type : II
Pond and Swamp Area : NONE

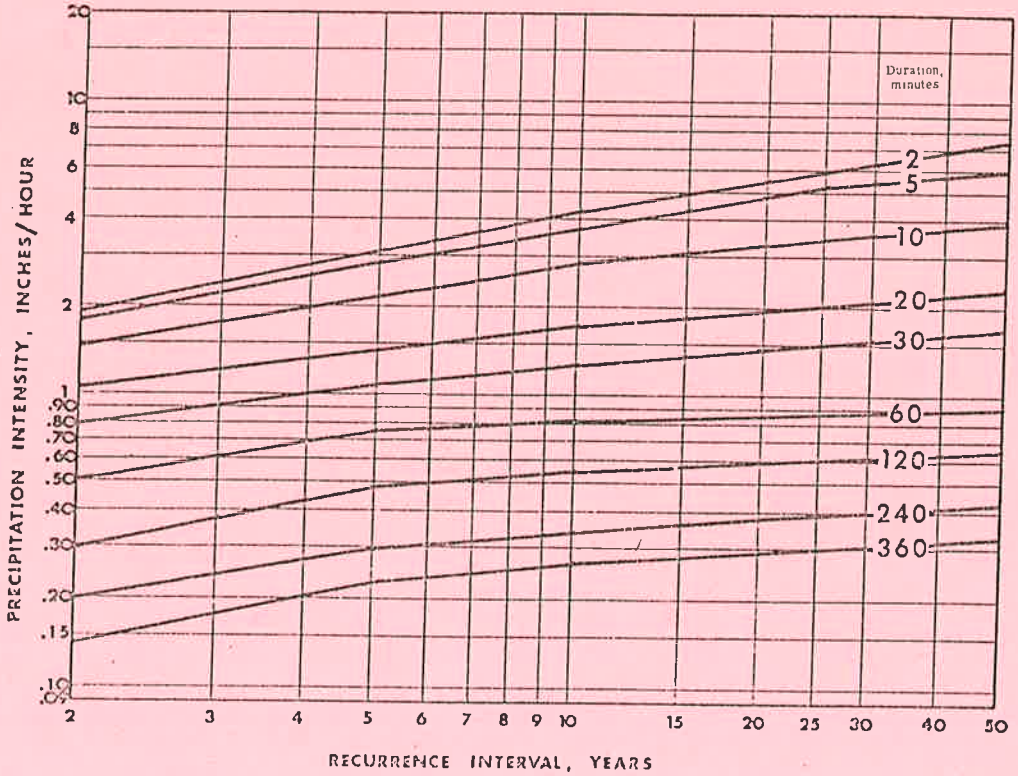
Storm Number	1	2	3	4	5
Frequency (yrs)	100	50	25	10	100
24-Hr Rainfall (in)	1.65	1.45	1.25	1.00	3.8
Ia/P Ratio	0.18	0.21	0.24	0.30	0.08
Used	0.18	0.21	0.24	0.30	0.10
Runoff (in)	0.64	0.50	0.37	0.22	2.45
Unit Peak Discharge (cfs/sqmi/in)	677	665	648	617	719
Pond and Swamp Factor 0.0% Ponds Used	1.00	1.00	1.00	1.00	1.00
Peak Discharge (cfs)	235	180	129	75	953

Figure 3.--Intensity-duration-frequency curves for recurrence intervals of 2 to 50 years and durations of 2 minutes to 6 hours for the Davis County Experimental Watershed. Curves for precipitation Zone 1 are shown in 3a, Zone 2 in 3b, Zone 3 in 3c, and Zone 4 in 3d. (Log-extreme distribution)

A



B



THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3


```
      LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
*** LIST ***
          1          ID    WILLARD - COOK'S CANYON HYDROLOGY
          2          ID    100 YEAR - 24 HOUR DISCHARGE - SCS 24 HOUR DISTRIBUTION
          3          ID    ROLLINS, BROWN & GUNNELL, INC.
          4          IT    15      0       0     100       0       0
          5          IN    60
          6          ID     1      1

          7          KK    COOK  FLOOD DISCHARGE AT MOUTH OF COOK'S CANYON - ELEV. 4900
          8          BA    0.54
          9          PB    3.80
         10          PI     1.8     2.1     2.1     2.1     2.1     2.4     4.7     5.9    13.9    13.7
         11          PI    10.2     6.7     4.8     4.5     3.3     3.0     2.6     2.5     2.4     2.2
         12          PI     2.0     2.0     1.8     1.2
         13          LS       0      87
         14          UD    0.26

         15          KK   FRONT FLOOD DISCHARGE FROM FRONTAL AREA - ELEV. 4900
         16          BA    0.12
         17          LS       0      80
         18          UD    0.10
         19          ZZ
```

****
FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
****

WILLARD - COOK'S CANYON HYDROLOGY
100 YEAR - 24 HOUR DISCHARGE - SCS 24 HOUR DISTRIBUTION
ROLLINS, BROWN & GUNNELL, INC.

6 IO OUTPUT CONTROL VARIABLES

IPRNT	1	PRINT CONTROL
IPLOT	1	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	15	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	100	NUMBER OF HYDROGRAPH ORDINATES

43

```
                NDTIME        0045  ENDING TIME

            COMPUTATION I          .25 HOURS
                TOTAL TI...E    24.75 HOURS

      ENGLISH UNITS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  7 KK    *     COOK   *      FLOOD DISCHARGE AT MOUTH OF COOK'S CANYON - ELEV. 4900
          *            *
          **************

  5 IN        TIME DATA FOR INPUT TIME SERIES
                  JXMIN          60  TIME INTERVAL IN MINUTES
                 JXDATE      1    0  STARTING DATE
                 JXTIME           0  STARTING TIME

            SUBBASIN RUNOFF DATA

  8 BA        SUBBASIN CHARACTERISTICS
                  TAREA         .54  SUBBASIN AREA

              PRECIPITATION DATA

  9 PB            STORM        3.80  BASIN TOTAL PRECIPITATION

 10 PI          INCREMENTAL PRECIPITATION PATTERN
                   .45       .45       .45       .45       .53       .52       .53       .52       .52       .53
                   .53       .53       .53       .53       .53       .53       .53       .52       .53       .52
                   .60       .60       .60       .60      1.18      1.17      1.18      1.17      1.48      1.48
                  1.47      1.48      3.48      3.48      3.48      3.47      3.42      3.43      3.42      3.42
                  2.55      2.55      2.55      2.55      1.67      1.67      1.68      1.67      1.20      1.20
                  1.20      1.20      1.13      1.13      1.13      1.13       .83       .82       .83       .82
                   .75       .75       .75       .75       .65       .65       .65       .65       .63       .63
                   .63       .63       .60       .60       .60       .60       .55       .55       .55       .55
                   .50       .50       .50       .50       .50       .50       .50       .50       .45       .45
                   .45       .45       .30       .30       .30       .30

 13 LS        SCS LOSS RATE
                  STRTL         .30  INITIAL ABSTRACTION
                 CRVNBR       87.00  CURVE NUMBER
                  RTIMP         .00  PERCENT IMPERVIOUS AREA

 14 UD        SCS DIMENSIONLESS UNITGRAPH
                  TLAG         .26  LAG

                                                    ***

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

                                                UNIT HYDROGRAPH
                                             7 END-OF-PERIOD ORDINATES
          498.      580.      206.       72.       25.        9.        3.

*****************************************************************************************************************************

44                                    HYDROGRAPH AT STATION     COOK

*****************************************************************************************************************************
```

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
								*								
1		0000	1	.00	.00	.00	0.	*	1		1230	51	.05	.01	.04	59.
1		0015	2	.02	.02	.00	0.	*	1		1245	52	.05	.01	.04	58.
1		0030	3	.02	.02	.00	0.	*	1		1300	53	.05	.01	.04	55.
1		0045	4	.02	.02	.00	0.	*	1		1315	54	.04	.01	.04	53.
1		0100	5	.02	.02	.00	0.	*	1		1330	55	.04	.01	.04	52.
1		0115	6	.02	.02	.00	0.	*	1		1345	56	.04	.01	.04	52.
1		0130	7	.02	.02	.00	0.	*	1		1400	57	.04	.01	.04	52.
1		0145	8	.02	.02	.00	0.	*	1		1415	58	.03	.00	.03	47.
1		0200	9	.02	.02	.00	0.	*	1		1430	59	.03	.00	.03	41.
1		0215	10	.02	.02	.00	0.	*	1		1445	60	.03	.00	.03	39.
1		0230	11	.02	.02	.00	0.	*	1		1500	61	.03	.00	.03	39.
1		0245	12	.02	.02	.00	0.	*	1		1515	62	.03	.00	.02	37.
1		0300	13	.02	.02	.00	0.	*	1		1530	63	.03	.00	.03	36.
1		0315	14	.02	.02	.00	0.	*	1		1545	64	.03	.00	.03	35.
1		0330	15	.02	.02	.00	0.	*	1		1600	65	.03	.00	.03	35.
1		0345	16	.02	.02	.00	0.	*	1		1615	66	.02	.00	.02	33.
1		0400	17	.02	.02	.00	0.	*	1		1630	67	.02	.00	.02	31.
1		0415	18	.02	.02	.00	0.	*	1		1645	68	.02	.00	.02	31.
1		0430	19	.02	.02	.00	1.	*	1		1700	69	.02	.00	.02	31.
1		0445	20	.02	.02	.00	1.	*	1		1715	70	.02	.00	.02	30.
1		0500	21	.02	.02	.00	2.	*	1		1730	71	.02	.00	.02	30.
1		0515	22	.02	.02	.00	3.	*	1		1745	72	.02	.00	.02	30.
1		0530	23	.02	.02	.00	4.	*	1		1800	73	.02	.00	.02	30.
1		0545	24	.02	.02	.00	5.	*	1		1815	74	.02	.00	.02	29.
1		0600	25	.02	.02	.00	5.	*	1		1830	75	.02	.00	.02	29.
1		0615	26	.04	.03	.01	9.	*	1		1845	76	.02	.00	.02	29.
1		0630	27	.04	.03	.01	13.	*	1		1900	77	.02	.00	.02	28.
1		0645	28	.04	.03	.01	16.	*	1		1915	78	.02	.00	.02	28.
1		0700	29	.04	.03	.01	18.	*	1		1930	79	.02	.00	.02	27.
1		0715	30	.06	.04	.02	23.	*	1		1945	80	.02	.00	.02	26.
1		0730	31	.06	.03	.02	28.	*	1		2000	81	.02	.00	.02	26.
1		0745	32	.06	.03	.02	31.	*	1		2015	82	.02	.00	.02	25.
1		0800	33	.06	.03	.03	34.	*	1		2030	83	.02	.00	.02	24.
1		0815	34	.13	.06	.07	56.	*	1		2045	84	.02	.00	.02	24.
1		0830	35	.13	.06	.08	85.	*	1		2100	85	.02	.00	.02	24.
1		0845	36	.13	.05	.08	101.	*	1		2115	86	.02	.00	.02	24.
1		0900	37	.13	.05	.09	111.	*	1		2130	87	.02	.00	.02	24.
1		0915	38	.13	.04	.09	119.	*	1		2145	88	.02	.00	.02	24.
1		0930	39	.13	.04	.09	124.	*	1		2200	89	.02	.00	.02	24.
1		0945	40	.13	.03	.10	130.	*	1		2215	90	.02	.00	.02	23.
1		1000	41	.13	.03	.10	134.	*	1		2230	91	.02	.00	.02	22.
1		1015	42	.10	.02	.08	125.	*	1		2245	92	.02	.00	.02	22.
1		1030	43	.10	.02	.08	113.	*	1		2300	93	.02	.00	.02	22.
1		1045	44	.10	.02	.08	109.	*	1		2315	94	.01	.00	.01	19.
1		1100	45	.10	.02	.08	109.	*	1		2330	95	.01	.00	.01	16.
1		1115	46	.06	.01	.05	97.	*	1		2345	96	.01	.00	.01	15.
1		1130	47	.06	.01	.05	81.	*	2		0000	97	.01	.00	.01	15.
1		1145	48	.06	.01	.05	76.	*	2		0015	98	.00	.00	.00	9.
1		1200	49	.06	.01	.05	75.	*	2		0030	99	.00	.00	.00	3.
1		1215	50	.05	.01	.04	67.	*	2		0045	100	.00	.00	.00	1.
								*								

****

TOTAL RAINFALL = 3.80, TOTAL LOSS = 1.35, TOTAL EXCESS = 2.45

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.75-HR
(CFS)	(HR)					
		(CFS)				
134.	10.00		87.	36.	35.	35.
		(INCHES)	1.496	2.453	2.453	2.453
		(AC-FT)	43.	71.	71.	71.

45

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : WILLARD User: KH Date: 10-08-88
County : BOX ELDER State: UT Checked: ____ Date: ________
Subtitle: COOK CANYON

Continuation of subarea information

	Subareas				
	6	7	8	9	10
Area(sq mi)	0.54	0.54	0.54	0.54	0.54
Rainfall(in)	2.3	2.6	3.2	3.6	3.8
Curve number	87	87	87	87	87
Runoff(in)	1.10	1.40	1.91	2.27	2.45
Tc (hrs)	0.43	0.43	0.43	0.43	0.43
(Used)	0.40	0.40	0.40	0.40	0.40
TimeToOutlet	0.00	0.00	0.00	0.00	0.00
Ia/P	0.13	0.11	0.09	0.08	0.08
(Used)	0.13	0.11	0.10	0.10	0.10

Time	Subarea Contribution to Total Flow (cfs)				
(hr)	6	7	8	9	10
11.0	9	13	19	22	24
11.3	13	17	26	31	33
11.6	18	25	37	44	48
11.9	39	54	80	94	102
12.0	73	99	146	173	187
12.1	146	195	280	333	359
12.2	263	343	484	574	620
12.3	342P	440P	612P	726P	784P
12.4	335	428	594	704	761
12.5	255	324	446	529	571
12.6	178	225	308	366	395
12.7	131	163	223	265	286
12.8	100	124	169	200	216
13.0	64	80	108	128	138
13.2	48	60	80	94	102
13.4	39	49	65	77	83
13.6	35	42	57	67	73
13.8	31	38	51	60	65
14.0	28	34	45	54	58
14.3	24	29	39	47	50
14.6	21	26	35	42	45
15.0	20	24	32	38	41
15.5	18	22	29	34	37
16.0	16	20	26	31	33
16.5	14	17	23	27	29
17.0	14	17	22	26	28
17.5	13	16	21	25	27
18.0	12	14	19	22	24
19.0	10	13	17	20	21
20.0	9	11	14	17	19
22.0	8	10	12	15	16
26.0	0	0	0	0	0

P = Peak Flow

46

WILLARD - COOK'S CANYON HYDROLOGY 100-YEAR 24-HOUR STORM
STORM HYDROGRAPH RAIN = 3.800 DURATION = 24.0 RUNOFF = 2.454
STORM DISTRIBUTION 24-HR
CURVE NUMBER METHOD =87.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
.000	.0000	.0000	.00
.083	.0038	.0000	.00
.167	.0038	.0000	.00
.250	.0038	.0000	.00
.333	.0038	.0000	.00
.417	.0038	.0000	.00
.500	.0038	.0000	.00
.583	.0038	.0000	.00
.667	.0038	.0000	.00
.750	.0038	.0000	.00
.833	.0038	.0000	.00
.917	.0038	.0000	.00
1.000	.0038	.0000	.00
1.083	.0038	.0000	.00
1.167	.0038	.0000	.00
1.250	.0038	.0000	.00
1.333	.0038	.0000	.00
1.417	.0038	.0000	.00
1.500	.0038	.0000	.00
1.583	.0038	.0000	.00
1.667	.0038	.0000	.00
1.750	.0038	.0000	.00
1.833	.0038	.0000	.00
1.917	.0038	.0000	.00
2.000	.0038	.0000	.00
2.083	.0038	.0000	.00
2.167	.0038	.0000	.00
2.250	.0038	.0000	.00
2.333	.0038	.0000	.00
2.417	.0038	.0000	.00
2.500	.0038	.0000	.00
2.583	.0038	.0000	.00
2.667	.0038	.0000	.00
2.750	.0038	.0000	.00
2.833	.0038	.0000	.00
2.917	.0038	.0000	.00
3.000	.0038	.0000	.00
3.083	.0038	.0000	.00
3.167	.0038	.0000	.00
3.250	.0038	.0000	.00
3.333	.0038	.0000	.00
3.417	.0038	.0000	.00
3.500	.0038	.0000	.00
3.583	.0038	.0000	.00
3.667	.0038	.0000	.00
3.750	.0038	.0000	.00

WILLARD - COOK'S CANYON HYGROLOGY 100-YEAR 24-HOUR STORM
STORM HYDROGRAPH RA[illegible].800 DURATION = 24.0 RUNOFF = 2.454
STORM DISTRIBUTION [illegible]24-HR
CURVE NUMBER METHOD CN =87.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
3.833	.0038	.0000	.00
3.917	.0038	.0000	.00
4.000	.0038	.0000	.00
4.083	.0051	.0000	.00
4.167	.0051	.0000	.00
4.250	.0051	.0000	.00
4.333	.0051	.0000	.00
4.417	.0051	.0000	.00
4.500	.0051	.0000	.00
4.583	.0051	.0000	.00
4.667	.0051	.0000	.00
4.750	.0051	.0000	.00
4.833	.0051	.0000	.00
4.917	.0051	.0000	.00
5.000	.0051	.0000	.00
5.083	.0051	.0000	.00
5.167	.0051	.0000	.00
5.250	.0051	.0000	.00
5.333	.0051	.0000	.00
5.417	.0051	.0000	.00
5.500	.0051	.0000	.00
5.583	.0051	.0000	.00
5.667	.0051	.0000	.00
5.750	.0051	.0000	.00
5.833	.0051	.0000	.00
5.917	.0051	.0000	.00
6.000	.0051	.0000	.00
6.083	.0063	.0001	.00
6.167	.0063	.0001	.02
6.250	.0063	.0002	.07
6.333	.0063	.0002	.16
6.417	.0063	.0003	.29
6.500	.0063	.0003	.45
6.583	.0063	.0004	.64
6.667	.0063	.0004	.84
6.750	.0063	.0005	1.03
6.833	.0063	.0005	1.24
6.917	.0063	.0006	1.44
7.000	.0063	.0006	1.64
7.083	.0063	.0007	1.85
7.167	.0063	.0007	2.05
7.250	.0063	.0007	2.24
7.333	.0063	.0008	2.44
7.417	.0063	.0008	2.63
7.500	.0063	.0009	2.82
7.583	.0063	.0009	3.01

WILLARD - COOK'S CANYON [illegible] - 24-HOUR STORM
STORM HYDROGRAPH RA[illegible].200 DURATION = 24.0 RUNOFF = 2.464
STORM DISTRIBUTION [illegible]-HR
CURVE NUMBER METHOD CN =87.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
7.667	.0063	.0010	3.20
7.750	.0063	.0010	3.39
7.833	.0063	.0010	3.57
7.917	.0063	.0011	3.75
8.000	.0063	.0011	3.93
8.083	.0065	.0012	4.10
8.167	.0065	.0012	4.34
8.250	.0065	.0012	4.72
8.333	.0065	.0013	5.26
8.417	.0065	.0019	5.84
8.500	.0065	.0013	6.38
8.583	.0085	.0020	6.50
8.667	.0085	.0021	7.18
8.750	.0085	.0021	7.53
8.833	.0085	.0022	7.85
8.917	.0086	.0023	8.15
9.000	.0085	.0023	8.45
9.083	.0101	.0023	8.73
9.167	.0101	.0029	9.07
9.250	.0101	.0030	9.57
9.333	.0101	.0031	10.21
9.417	.0101	.0031	10.88
9.500	.0101	.0032	11.50
9.583	.0114	.0037	12.01
9.667	.0114	.0038	12.51
9.750	.0114	.0039	13.13
9.833	.0114	.0040	13.86
9.917	.0114	.0041	14.60
10.000	.0114	.0042	15.28
10.083	.0146	.0055	15.84
10.167	.0146	.0056	16.51
10.250	.0146	.0057	17.57
10.333	.0146	.0059	19.02
10.417	.0146	.0060	20.52
10.500	.0146	.0061	21.85
10.583	.0196	.0085	22.83
10.667	.0196	.0087	24.06
10.750	.0196	.0089	25.92
10.833	.0196	.0091	28.46
10.917	.0196	.0093	31.10
11.000	.0196	.0095	33.41
11.083	.0304	.0151	35.17
11.167	.0304	.0155	37.38
11.250	.0304	.0159	41.32
11.333	.0304	.0163	46.99
11.417	.0304	.0167	52.92

WILLARD - COOK'S [illegible] HYDROLOGY [illegible] EAR [illegible] STORM
STORM HYDROGRAPH [illegible] DURATION = [illegible] RUNOFF = 2.454
STORM DISTRIBUTION [illegible] 24-HR
CURVE NUMBER METHOD [illegible] =87.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
11.500	.0304	.0171	58.07
11.583	.1317	.0779	61.91
11.667	.1317	.0834	73.87
11.750	.1317	.0852	107.49
11.833	.3495	.2524	162.97
11.917	.3496	.2727	247.57
12.000	.3495	.2872	384.40
12.083	.0456	.0383	567.24
12.167	.0456	.0385	717.43
12.250	.0456	.0387	748.78
12.333	.0456	.0387	648.39
12.417	.0456	.0390	504.06
12.500	.0456	.0391	377.62
12.583	.0234	.0202	300.00
12.667	.0234	.0202	249.94
12.750	.0234	.0202	210.04
12.833	.0234	.0203	175.26
12.917	.0234	.0203	144.94
13.000	.0234	.0203	120.50
13.083	.0171	.0149	104.33
13.167	.0171	.0149	94.12
13.250	.0171	.0149	87.06
13.333	.0171	.0149	80.56
13.417	.0171	.0149	74.53
13.500	.0171	.0150	69.84
13.583	.0133	.0116	66.92
13.667	.0133	.0117	64.69
13.750	.0133	.0117	62.05
13.833	.0133	.0117	58.75
13.917	.0133	.0117	55.55
14.000	.0133	.0117	53.02
14.083	.0095	.0084	51.46
14.167	.0095	.0084	50.02
14.250	.0095	.0084	47.77
14.333	.0095	.0084	44.67
14.417	.0095	.0084	41.59
14.500	.0095	.0084	39.14
14.583	.0095	.0084	37.62
14.667	.0095	.0084	36.69
14.750	.0095	.0084	36.11
14.833	.0095	.0084	35.77
14.917	.0095	.0084	35.53
15.000	.0095	.0084	35.38
15.083	.0095	.0084	35.28
15.167	.0095	.0084	35.24
15.250	.0095	.0084	35.24

50

WILLARD - COCK'S [illegible] 100-YEAR 24-HOUR STORM
STORM HYDROGRAPH [illegible]
STORM DISTRIBUTION 19 SCS 24-HR
CURVE NUMBER METHOD CN =97.0

TIME (HOURS)	RAINFALL INCHES	NET RAIN (INCHES)	DISCHARGE (CFS)
15.333	.0055	.0024	35.26
15.417	.0055	.0024	35.28
15.500	.0055	.0024	35.30
15.583	.0055	.0024	35.32
15.667	.0055	.0024	35.34
15.750	.0055	.0024	35.36
15.833	.0055	.0024	35.38
15.917	.0055	.0024	35.40
16.000	.0055	.0024	35.42
16.083	.0057	.0051	32.40
16.167	.0057	.0051	34.35
16.250	.0057	.0051	33.26
16.333	.0057	.0051	30.47
16.417	.0057	.0051	27.58
16.500	.0057	.0051	25.26
16.583	.0057	.0051	23.62
16.667	.0057	.0051	22.92
16.750	.0057	.0051	22.34
16.833	.0057	.0051	21.97
16.917	.0057	.0051	21.72
17.000	.0057	.0051	21.55
17.083	.0057	.0051	21.43
17.167	.0057	.0051	21.38
17.250	.0057	.0051	21.37
17.333	.0057	.0051	21.37
17.417	.0057	.0051	21.38
17.500	.0057	.0051	21.39
17.583	.0057	.0051	21.39
17.667	.0057	.0051	21.40
17.750	.0057	.0051	21.41
17.833	.0057	.0051	21.41
17.917	.0057	.0051	21.42
18.000	.0057	.0051	21.42
18.083	.0057	.0051	21.43
18.167	.0057	.0051	21.44
18.250	.0057	.0051	21.44
18.333	.0057	.0051	21.45
18.417	.0057	.0051	21.45
18.500	.0057	.0051	21.46
18.583	.0057	.0051	21.47
18.667	.0057	.0051	21.47
18.750	.0057	.0051	21.48
18.833	.0057	.0051	21.48
18.917	.0057	.0051	21.49
19.000	.0057	.0051	21.50
19.083	.0057	.0051	21.50

MILLARD - COCK'S CR... HYDROLOGY ...0-YEAR 24-HOUR STORM
STORM HYDROGRAPH R... 500 DURATION = 24.0 RUNOFF = 2.454
STORM DISTRIBUTION IS ... 24-HR
CURVE NUMBER METHOD CN =87.)

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
19.167	.0057	.0051	21.51
19.250	.0057	.0051	21.51
19.333	.0057	.0051	21.52
19.417	.0057	.0051	21.52
19.500	.0057	.0051	21.53
19.583	.0057	.0051	21.54
19.667	.0057	.0051	21.54
19.750	.0057	.0051	21.55
19.833	.0057	.0051	21.55
19.917	.0057	.0051	21.56
20.000	.0057	.0051	21.56
20.083	.0038	.0034	21.57
20.167	.0038	.0034	21.32
20.250	.0038	.0034	20.46
20.333	.0038	.0034	19.84
20.417	.0038	.0034	17.58
20.500	.0038	.0034	16.40
20.583	.0038	.0034	15.67
20.667	.0038	.0034	15.21
20.750	.0038	.0034	14.91
20.833	.0038	.0034	14.73
20.917	.0038	.0034	14.60
21.000	.0038	.0034	14.51
21.083	.0038	.0034	14.45
21.167	.0038	.0034	14.42
21.250	.0038	.0034	14.42
21.333	.0038	.0034	14.42
21.417	.0038	.0034	14.42
21.500	.0038	.0034	14.43
21.583	.0038	.0034	14.43
21.667	.0038	.0034	14.43
21.750	.0038	.0034	14.43
21.833	.0038	.0034	14.43
21.917	.0038	.0034	14.44
22.000	.0038	.0034	14.44
22.083	.0038	.0034	14.44
22.167	.0038	.0034	14.44
22.250	.0038	.0034	14.45
22.333	.0038	.0034	14.45
22.417	.0038	.0034	14.45
22.500	.0038	.0034	14.45
22.583	.0038	.0035	14.46
22.667	.0038	.0035	14.46
22.750	.0038	.0035	14.46
22.833	.0038	.0035	14.46
22.917	.0038	.0035	14.46

5N

WILLIAMS - GOODING CANYON HYDROLOGY 100-YEAR 24-HOUR STORM
STORM HYDROGRAPH FOR AREA 206 DURATION = 24.0 RUNOFF = 2.454
[illegible]
CURVE NUMBER METHOD CN =87.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
23.000	.0038	.0035	14.47
23.083	.0038	.0035	14.47
23.166	.0038	.0035	14.47
23.250	.0038	.0035	14.47
23.333	.0038	.0035	14.46
23.416	.0038	.0035	14.45
23.500	.0038	.0035	14.45
23.583	.0038	.0035	14.45
23.666	.0038	.0035	14.45
23.750	.0038	.0035	14.45
23.833	.0038	.0035	14.45
23.916	.0038	.0035	14.45
24.000	.0038	.0035	14.49
24.083	.0000	.0000	14.50
24.166	.0000	.0000	13.98
24.250	.0000	.0000	12.25
24.333	.0000	.0000	9.36
24.416	.0000	.0000	6.41
24.500	.0000	.0000	4.04
24.583	.0000	.0000	2.56
24.666	.0000	.0000	1.63
24.750	.0000	.0000	1.03
24.833	.0000	.0000	.65
24.916	.0000	.0000	.38
25.000	.0000	.0000	.20
25.083	.0000	.0000	.08
25.166	.0000	.0000	.02
25.250	.0000	.0000	.00
TOTALS	3.900	2.4539	10286.95

STORM HYDROGRAPH VOLUME = 70.85 ACRE-FEET
MAXIMUN STORM DISCHARGE = 743.78 CFS

22.658	.0038	.0034	14.46
22.741	.0038	.0035	14.46
22.824	.0038	.0035	14.46
22.907	.0038	.0035	14.46

1

WILLARD-24 HOUR-100YEAR-RBG DUPLICATE
STORM HYDROGRAPH RAIN = 3.800 DURATION = 24.0 RUNOFF = 2.453
STORM DISTRIBUTION IS SCS 24-HR
CURVE NUMBER METHOD CN =87.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
22.991	.0038	.0035	14.47
23.074	.0038	.0035	14.47
23.157	.0038	.0035	14.47
23.241	.0038	.0035	14.47
23.324	.0038	.0035	14.48
23.407	.0038	.0035	14.48
23.491	.0038	.0035	14.48
23.574	.0038	.0035	14.48
23.657	.0038	.0035	14.48
23.740	.0038	.0035	14.49
23.824	.0038	.0035	14.49
23.907	.0038	.0035	14.49
23.990	.0038	.0035	14.49
24.074	.0000	.0000	14.50
24.157	.0000	.0000	13.98
24.240	.0000	.0000	12.25
24.324	.0000	.0000	9.38
24.407	.0000	.0000	6.42
24.490	.0000	.0000	4.04
24.573	.0000	.0000	2.56
24.657	.0000	.0000	1.63
24.740	.0000	.0000	1.03
24.823	.0000	.0000	.65
24.907	.0000	.0000	.39
24.990	.0000	.0000	.20
25.073	.0000	.0000	.08
25.157	.0000	.0000	.02
25.240	.0000	.0000	.00
TOTALS	3.800	2.4535	10289.51

STORM HYDROGRAPH VOLUME = 70.84 ACRE-FEET
MAXIMUN STORM DISCHARGE = 747.14 CFS

A>HS

A>STORM

ROLLINS, BROWN and GUNNELL, INC. professional engineers

January 30, 1989

Mr. Keith Hansen
Hansen & Associates
538 North Main Street
Brigham City, Utah 84302

Dear Mr. Hansen:

In response to your letter of December 30, 1988, please find attached the SCS storm distribution used for the 24-hour, 100 year analysis of the Cook's Canyon drainage area. This figure was obtained from the Provo City Storm Drainage Master Plan prepared by James M. Montgomery Engineers in 1986.

Sincerely,

ROLLINS, BROWN AND GUNNELL, INC.

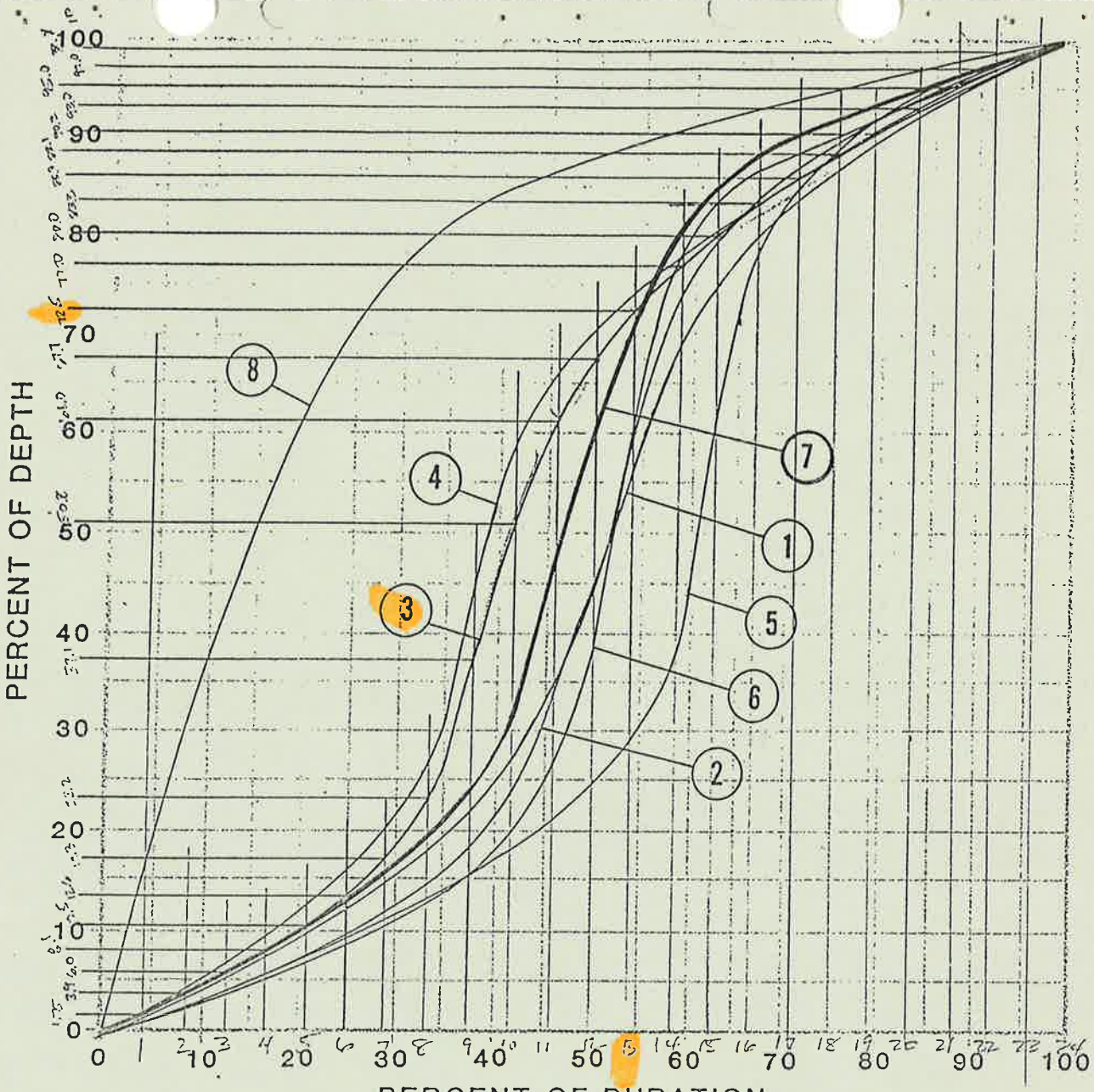
Russell O. Brown, P.E.

CLC/cak
Encl.

RECEIVED
[illegible] 1989
Hansen & Associates Inc

1435 WEST 820 NORTH
POST OFFICE BOX 711
PROVO, UTAH 84603

PROVO 374-5771
SALT LAKE CITY 521-5771
AREA CODE 801



1. COE SPF 1-hour
2. COE SFP 6-hour
3. SCS 24-hour
4. SCS Emergency Spillway
5. Tettemer 6-hour
6. Historical Depths via COE Ranking
7. JMM 3-hour
8. Farmer/Fletcher 1 hour

PROVO CITY
STORM DRAINAGE MASTER PLAN

SELECTED CUMULATIVE
TEMPORAL RAINFALL DISTRIBUTIONS

FIGURE NO. 4-5

Project _____ Sheet _____ of _____

By _____ Date _____ Job no. _____

SCS 24 Hour Distribution

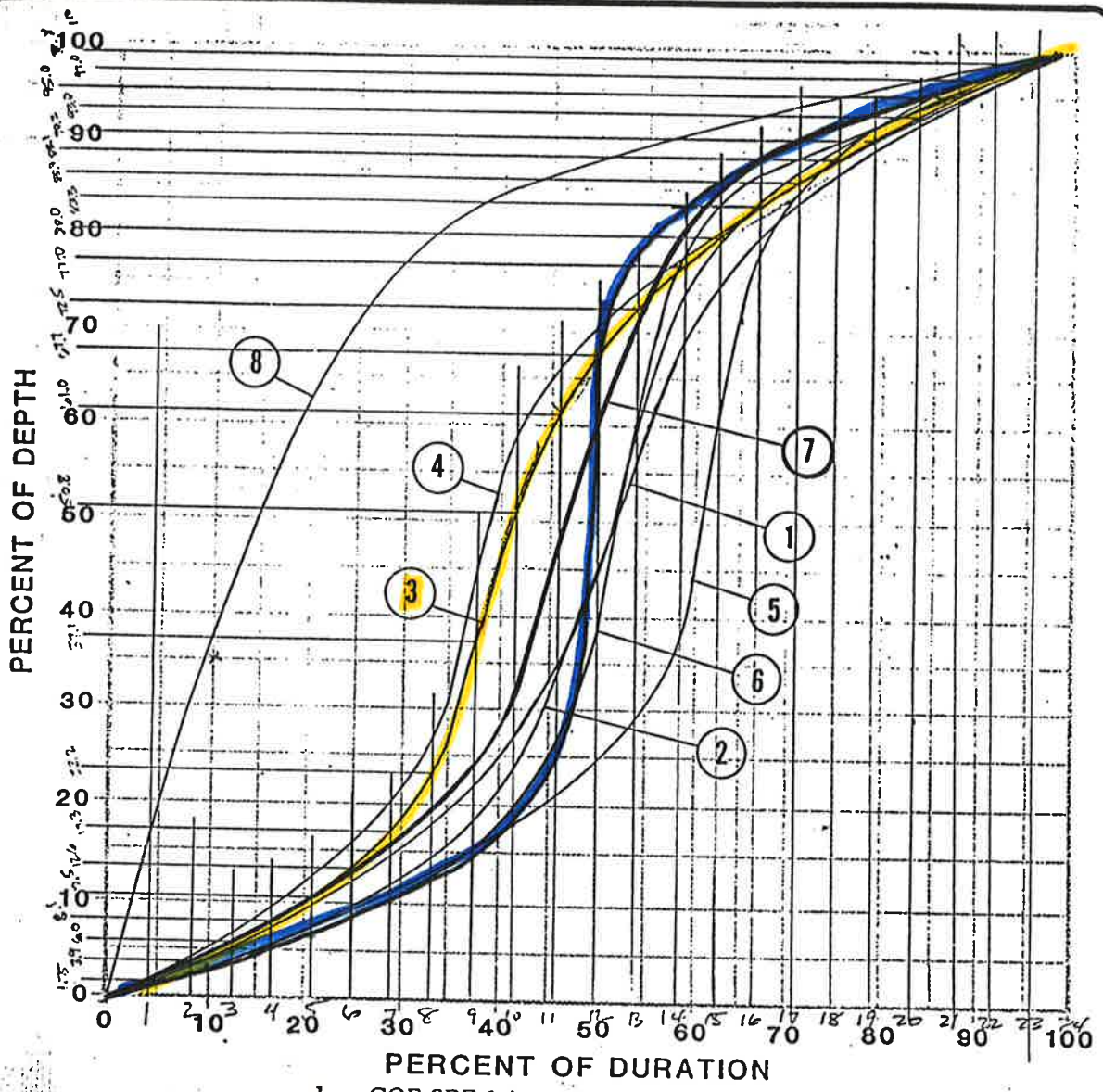
Time	Cumulative %	Increment	Rearranged
1	1.8	1.8	1.8
2	3.9	2.1	2.1
3	6.0	2.1	2.1
4	8.1	2.1	2.1
5	10.5	2.4	2.1
6	12.6	2.1	2.1
7	17.3	4.7	4.7
8	23.2	5.9	5.9
9	37.1	13.9	13.9
10	50.8	13.7	13.7
11	61.0	10.2	10.2
12	67.7	6.7	6.7
13	72.5	4.8	4.8
14	77.0	4.5	4.5
15	80.0	3.0	3.3
16	83.3	3.3	3.0
17	85.9	2.6	2.6
18	88.1	2.2	2.5
19	90.5	2.4	2.4
20	93.0	2.5	2.2
21	95.0	2.0	2.0
22	97.0	2.0	2.0
23	98.8	1.8	1.8
24	100.0	1.2	1.2

Project _____ Sheet _____ of _____

By _____ Date _____ Job no. _____

SCS 24-Hour Distribution

Time	Cumulative % SCS	Increment	Rearranged
1	1.8	1.1	1.8
2	3.9	2.3	2.1
3	6.0	3.5	2.1
4	8.1	4.8	2.1
5	10.5	6.4	2.4
6	12.6	8.0	2.1
7	17.3	10.0	4.7
8	23.2	12.0	5.9
9	37.1	14.7	13.9
10	50.8	18.1	13.7
11	61.0	23.6	10.2
12	67.7	66.3	6.7
13	72.5	77.6	4.8
14	77.0	82.5	4.5
15	80.0	85.6	3.0
16	83.3	88.1	3.3
17	85.9	90.3	2.6
18	88.1	92.2	2.2
19	90.5	93.8	2.4
20	93.0	95.3	2.5
21	95.0	96.5	2.0
22	97.0	97.7	2.0
23	98.8	98.9	1.8
24	100.0	100.0	1.2



1. COE SPF 1-hour
2. COE SFP 6-hour
3. SCS 24-hour
4. SCS Emergency Spillway
5. Tettemer 6-hour
6. Historical Depths via COE Ranking
7. JMM 3-hour
8. Farmer/Fletcher 1 hour

PROVO CITY
STORM DRAINAGE MASTER PLAN

SELECTED CUMULATIVE TEMPORAL RAINFALL DISTRIBUTIONS

FIGURE NO. 4-5

Form R-69
6/88

APPLICATION TO CONSTRUCT A DAM IMPOUNDING LESS THAN 20 ACRE-FEET

STATE OF UTAH

Application No. _____
Received _____
Entered _____

The following application is submitted, pursuant to Section 73-5-12 of the Utah Code Annotated 1953, to obtain the authority to build a dam which will create a reservoir impounding less than 20 acre-feet.

1. **APPLICANT INFORMATION**
   Name(s): _____
   Address: _____
   City: _____ State: _____ Zip Code: _____

2. **PURPOSE OF DAM**
   Stock Pond _____ Regulating Res. _____ Diversion Dam _____
   Irrigation _____ Debris Basin _____ Flood Control _____
   Sedimentation _____ Tailings Pond _____ Recreation _____
   Other (describe) _____

3. **LOCATION OF DAM**
   County _____ Quarter/Quarter (i.e. NESW) _____ Section _____
   Township _____ Range _____ Base & Meridian _____

4. **PROPOSED DAM**
   Dam Height (vertical distance) _____ feet
   Crest Length (length of top of dam) _____ feet
   Crest Width (width of top of dam) _____ feet
   Upstream slope _____ vertical on _____ horizontal
   Downstream slope _____ vertical on _____ horizontal
   Water surface area at spillway crest _____ acres
   Reservoir capacity at spillway crest _____ ac.ft.
   Type of dam (i.e. earthfill, concrete, etc.) _____
   _____

5. **PROPOSED OUTLET**
   Inside diameter _____ inches Length _____ feet
   Type of pipe (i.e. concrete, steel, etc.) _____
   Type of gate or valve _____
   Location of gate (upstream, downstream, center, etc.) _____
   _____

6. **PROPOSED SPILLWAY**
   Crest Length (width of bottom of spillway) _____ feet
   Depth (from bottom of spillway to top of dam) _____ feet
   Type (i.e. earth channel, pipe, etc.) _____
   _____
   Control (i.e. gates, flashboards, etc.) _____
   _____

60

Form R-69
6/88

INSTRUCTIONS FOR APPLICATION TO CONSTRUCT A DAM IMPOUNDING LESS THAN 20 ACRE-FEET

Section 73-5-12 of the Utah Code Annotated 1953, as amended, requires persons proposing to construct reservoirs, which have the capability of holding less than 20 acre-feet, to provide the State Engineer with pertinent data on the proposed dam and reservoir. The accompanying "Application to Construct a Dam Impounding Less Than 20 Acre-Feet" lists the information required.

In reviewing the application, the State Engineer will make a determination as to the proposal's potential to cause significant property damage or loss of human life in the event of a failure. If the potential for loss of human life or significant property damage exists, the State Engineer may require plans and specifications be submitted pursuant to Section 73-5-5 of the Utah Code Annotated 1953, as amended.

If the proposed reservoir and dam will alter a natural stream, the State Engineer may require the applicant to file an "Application to Alter a Natural Stream" pursuant to Section 73-3-29 of the Utah Code Annotated 1953, as amended.

Before approval of the accompanying application can be given, it is mandatory that the water rights for the proposed structure are in order. Reservoirs used to store irrigation water, stock ponds, and ponds used for recreation including aquatic habitat must have a water right to satisfy the uses and/or the increased evaporation. New diversion dams will normally require a new water right or a change in point of diversion of an existing right. If it is proposed to build a regulating reservoir based on ownership of stock in a water company, it will be necessary to attach a letter from the water company involved, stating they have no objection to construction of the regulating reservoir, and referencing the stock owned by the applicant.

It is important that in identifying the water right involved that it be referenced by a number on record in the State Engineer's office. This number may be a Diligence Claim Number, an Underground Water Claim Number, an Approved Application Number, a Certificate Number, a Water Users Claim Number, or a Case Number and Title of a Decree in a District Court.

It is imperative the accompanying form be complete and accurate. If assistance is needed to complete the form, contact the Utah Division of Water Rights at (801) 538-7240.

STATE of UTAH

ADMINISTRATIVE RULES for STREAM CHANNEL ALTERATIONS

STATE of UTAH

DIVISION of WATER RIGHTS

ROBERT L. MORGAN, P.E.

State Engineer

19

R625-5 ADMINISTRATIVE RULES FOR STREAM ALTERATIONS

R625-5-1 PURPOSE

1.1 The following administrative rules are compiled pursuant to section 73-3-29 of the Utah Code. The purpose of these rules is to provide an orderly process to review the stream channel alterations in the state and evaluate input from federal, state and local entities, as well as private individuals. The overall objective is to protect Utah's resources by regulating the activities in the state's natural streams. Compliance to these administrative rules is required in addition to any other federal, state, and local approvals.

1.2 Any federal or state agency, county, city, corporation or person desiring to change the course, current or cross-section of a stream channel shall abide by these rules and file a written application with the State Engineer prior to construction.

1.3 The intention of the suggested guidelines presented in this document is to provide the applicant with general guidelines to be followed in undertaking a stream channel alteration affecting the course, current, or cross-section of a natural stream.

2.1 AGGRADATION (BED): A progressive buildup or raising of the channel bed due to sediment deposition. Aggradation is an indicator that a change in the stream's velocity and sediment load is taking place.

2.2 ANGLE OF REPOSE: The maximum angle (as measured from the horizontal) at which loose gravel, sand, or rock particles will stand without deformation.

2.3 ANNUAL MAINTENANCE PERMIT: A permit issued by the State Engineer for an alteration of a stream channel for work that is done on an annual basis. This permit is issued in response to an application filed for the intended purposes and may be renewed by written request each year to authorize work to be done under its authority.

2.4 APPLICANT: Any individual, partnership, company, corporation, municipality, county, state or federal agency, or any other entity proposing to alter a stream channel or engage in constructing a channel alteration.

2.5 AQUATIC WILDLIFE & HABITAT: The aquatic environment including those fish, wildlife, macroinvertebrates and plant species dependent upon an environment created and supported by the waters of the State of Utah. Aquatic life includes communities and species populations that are adapted to aquatic habitats for at least a portion of their life.

2.6 BACKWATER: The upstream increase in water surface elevation relative to the elevation occurring under natural channel and floodplain conditions, induced from a bridge or other structure that obstructs or constricts a channel.

2.7 BANK: The side slopes of a channel between which the streamflow is normally confined.

2.8 BANK PROTECTION: Defined as riprap, gabions, clean concrete or other approved materials placed within a natural stream channel or on the channel banks for the purpose of protecting the natural soils from the erosive action of flowing water.

2.9 BED LOAD: Sediment that is transported in a stream by rolling, sliding, or skipping along the bed or very close to it.

2.10 CHANNELIZATION: Straightening or deepening of a stream channel by artificial cutoffs, grading, flow-control measures, or diversion.

2.11 CHECK DAM: A low dam or weir across a channel for the control of water stage or velocity.

2.12 CONFLUENCE: The junction of two or more streams.

2.13 CROSS-SECTION: A diagram or drawing creating a view of the channel illustrating the banks, bed, water surface and other pertinent information.

2.14 CUTOFF: A natural or artificial channel that shortens the length of a stream; natural cutoffs may occur either across the neck of a meander loop (neck cutoffs) or across a point bar (chute cutoffs).

2.15 DEBRIS: Material transported by the stream, either floating or submerged, such as logs or trash.

2.16 DEGRADATION (BED): A progressive lowering of the channel bed due to scour. Degradation is an indicator that a change in the stream's sediment load is taking place.

2.17 DISCHARGE: Volume of water passing through a channel during a given time, usually measured in cubic feet per second.

2.18 DROP STRUCTURE: An energy dissipation device placed across a channel which impedes the flow and causes a significant water surface change. The structure may be constructed with a variety of materials which are compatible with the stream environment.

2.19 EMERGENCY: Any unforeseen circumstance which presents an immediate and direct threat to the public's health, safety, welfare or property.

2.20 EPHEMERAL STREAM: A stream or reach of stream that flows for only a small portion of the year. The flow in ephemeral streams is usually short duration, high intensity flow.

2.21 EROSION: Removal of soil particles from the land surface due to water or wind action.

2.22 FILTER BLANKET: A layer of intermediate-size sand & gravel placed between fine-grained material and riprap to prevent wash-out of the finer material.

2.23 GABION: A basket or compartmented container made of steel wire mesh. When filled with cobbles or other rock of suitable size, the gabion becomes a flexible and permeable block with which channel banks can be protected and flow-control structures can be built.

2.24 GENERAL SCOUR: Scour in a channel or on a floodplain that is not localized at a pier, abutment, or other obstruction to flow. In a channel, general scour usually affects all or most of the channel width.

2.25 HEAD-CUTTING: Channel bottom erosion moving upstream through a basin indicating that a readjustment of the stream's slope, velocity and sediment load is taking place. Headcutting is evidenced by the presence of waterfalls or rapidly moving water through an otherwise placid stream. Head-cutting often leaves stream banks in an unstable condition as it progresses through a reach.

2.26 INTERMITTENT STREAM: A stream or reach of a stream that does not flow for parts of the year. As used here, the term intermittent means a stream whose flow is less than perennial but more than ephemeral.

2.27 JETTY: A permeable or impermeable structure that projects into a channel from the bank to alter flow direction, induce deposition, or reduce flow velocity along the bank.

2.28 LOCAL SCOUR: Scour in a channel or on a floodplain that is localized at a pier, abutment, or other obstruction to flow.

2.29 NATURAL STREAM: Any natural watercourse flowing in the state which has an average annual flow of 5.0 cubic feet per second (cfs) or greater. Other streams with average annual flows less than the 5.0 cfs may also be classed as natural streams depending upon their impact to the surrounding environment. The State Engineer will have the responsibility for determining if a channel is a natural stream. Natural streams include the stream channel as described in 2.39.

2.30 NORMAL HIGH WATER LINE: Line on the bank established by the fluctuation of water evidenced by physical conditions such as a clear, natural line impressed on the bank; destruction of terrestrial vegetation; presence of litter or debris; or other appropriate means that consider the characteristics of the surrounding area.

2.31 PERENNIAL STREAM: A stream or reach of a stream that flows continuously for all or most of the year.

2.32 PLANS: Descriptive drawing showing details of the proposed construction.

2.33 REVETMENT: Rigid or flexible armor placed on a bank or embankment as protection against scour and erosion.

2.34 RIPARIAN: Relating to, living or located on the banks of streams, rivers or lakes.

2.35 RIPRAP: Broken, angular rock or concrete dumped or placed to protect a structure or embankment from erosion. The term riprap has also been applied to almost all kinds of armor, including wire-enclosed riprap, grouted riprap, sacked concrete and concrete slabs. Broken asphalt or other toxic materials are not acceptable.

2.36 SLOPE (OF CHANNEL OR RIVER): Fall per unit length along the channel centerline.

2.37 STABLE CHANNEL: A condition that exists when a stream has developed the ideal bed slope and cross-section for its channel to transport the water and sediment delivered from the upstream watershed without sediment being deposited or soil particles being removed from the bed or banks.

2.38 STATE ENGINEER: The Director of the Utah Division of Water Rights, whose duties and qualifications are defined in section 73-2-1 of the Utah Code Annotated, 1953.

2.39 STREAM CHANNEL (CHANNEL): A natural stream water course with definite beds and banks which confines and conducts flowing water. The channel referred to is that which exists at the present time, regardless of where the channel may have been located at any time in the past and extends from the channel bottom to the normal high-water line. Beds of lakes and reservoirs are not considered to be stream channels.

2.40 STREAM CHANNEL ALTERATION: Any activity that affects the course, current, or cross-section of a natural channel. It includes the removal or placement of materials or structures in the stream channel.

2.41 STREAM CHANNEL CLASSIFICATION: A system of ranking individual streams in relationship to their benefit to fisheries and other aquatic wildlife. For further detail, refer to Appendix I.

2.42 WATER QUALITY CERTIFICATION: The process of review of federal and state actions for compliance with state water quality standards. Certification shall be issued by the Water Pollution Control Committee prior to project authorization.

2.43 WATER QUALITY CLASSIFICATION: A system of classifying the waters of the state according to beneficial use as defined by the Water Pollution Control Committee in Part II of the Waste Water Disposal Regulations.

2.44 WATER QUALITY: Narrative and numeric criteria developed and promulgated by the Water Pollution Control Committee for the protection of beneficial uses according to the water use classification of the state's waters.

2.45 WATER RIGHTS: The right to the use of water from the surface flow or underground storage recognized by the State Engineer. These rights may indicate points of diversion and uses that must be protected when altering a natural stream.

2.46 WETLANDS: Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs and similar areas.

R625-5-3 APPLICATION FOR STREAM CHANNEL ALTERATION

3.1 Each person requiring a permit to alter a natural stream shall file a written application on forms provided and approved by the State Engineer prior to construction. (See Appendix II for instructions and sample drawings).

3.2 Each application shall supply the applicant's name, address, and telephone number and be accompanied by a map showing the project site with sufficient accuracy to permit easy location.

3.3 Each application shall include plans of suitable scale showing the project site and proposed alterations and shall indicate proposed dates of construction. Both plan and cross-section views should be included.

3.4 For smaller alterations, a sketch of the proposed work will be acceptable, but if major changes are proposed, the State Engineer will require detailed plans, specifications, and calculations. Depending on the extent of the project, Environmental Impact Statements (EIS) or Environmental Assessments (EA) may be required for the project.

3.5 The State Engineer may require other pertinent information necessary to make an informed decision.

3.6 Applications received by the State Engineer which are incomplete or do not provide adequate information will be returned to the applicant without any action.

3.7 Applications may be filed for annual stream maintenance, and the State Engineer may require that these applications include a long-range (5-10 years) plan showing:

a) Estimated amount of material to be removed annually.
b) Location and capacity of disposal sites.
c) Location of structures that may require annual maintenance.
d) Alternatives to reduce maintenance.

3.8 Any alteration of a natural stream without a permit constitutes a violation of Utah law.

R625-5-4 REVIEW

4.1 In reviewing an application, the State Engineer shall consult with appropriate local, state and federal agencies, as well as individuals and conduct necessary investigations to develop a factual basis for a decision.

4.2 Upon receipt of the application, the State Engineer shall forward a copy to the U. S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish & Wildlife Service, and other federal agencies as appropriate for review and comment. Under the stream channel alteration program, the State Engineer does not have jurisdiction over wetlands. Issues involving wetlands will require a separate application to be filed with the U.S. Army Corps of Engineers pursuant to section 404 of the Clean Water Act.

4.3 Notices will be mailed to the Utah Bureau of Water Pollution Control for Water Quality Certification and the Division of Wildlife Resources for review and comments. Notices will also be mailed to other appropriate government agencies and individuals. At the discretion of the State Engineer, public notices shall be given or notification shall be mailed to adjacent landowners and other interested parties. Comments shall be submitted to the State Engineer in writing within 20 calendar days from the date mailed by the division. Failure to respond will be construed as a "no objection" response.

4.4 If no written comment is received, the State Engineer will evaluate the project and take appropriate action.

4.5 The State Engineer may hold public hearings to gather information needed to make an appropriate decision.

R625-5-5 ALTERATION PERMIT POLICY

5.1 Before issuing a permit, the State Engineer shall determine that the proposed alteration would not unreasonably or unnecessarily interfere with the natural resources of the State of Utah, pursuant to section 73-3-29, Utah Code Annotated, 1953.

5.2 The State Engineer through the review process will evaluate:

a) Natural stream environment and land value.
b) Impacts to fish and wildlife.
c) Water quality.
d) Alteration of channel capacity.
e) Effects on adjacent landowners.
f) Effects on existing water rights.
g) Proposed designs and construction methods.
h) Recreational uses.

5.3 The State Engineer shall conduct investigations that may be reasonably necessary to determine whether the proposed alteration will unreasonably or unnecessarily affect the aforementioned resources. Detrimental effects may be grounds for denial; nevertheless, the State Engineer may approve the application in whole or in part upon any reasonable terms that will protect the aforementioned resources. This may involve requiring the applicant to perform mitigation work on other areas to compensate for the impacts caused where the alteration is occurring.

5.4 All costs incurred by the applicant, including any incurred from complying with the terms and recommendations made by the State Engineer, are not reimbursable by the Division of Water Rights, whether resulting from the terms imposed or recommendations made by the State Engineer or from any terms or recommendations made following a public hearing.

5.5 When an application is approved to alter a natural stream, the State Engineer will set a time limit for the work to be accomplished. As deemed necessary, upon written request, the State Engineer may extend the completion time or may renew an application to an additional period of time. In renewing an application, the State Engineer may modify the original conditions of approval or impose new conditions to reflect immediate concerns.

5.6 The decision of the State Engineer is subject to sections 73-3-14 and 73-3-15, Utah Code Annotated, 1953 (Appendix III).

R625-5-6 ANNUAL MAINTENANCE

6.1 The State Engineer's approval is required for annual maintenance on stream channels.

6.2 Annual stream maintenance applications shall include but not be limited to:

a) Type of work to be done.
b) Estimated amount of material to be removed annually.
c) Location and capacity of disposal sites.
d) Location of structures that may require annual maintenance.
e) Proposed time schedule for work.

6.3 An application may be filed for annual stream maintenance including but not limited to:

a) Gravel bar removal conditioned upon degree of need.
b) Cleaning debris from and repair of existing structures.
c) Debris and tree removal.
d) Bank stabilization.

6.4 Annual stream maintenance applications will be reviewed the same as other stream channel alteration applications.

6.5 Permits for annual maintenance under a maintenance application may be renewed each year by written request. Conditions of original approval may be modified to reflect immediate concerns.

6.6 Upon request of the applicant, the State Engineer may grant an extension of time on maintenance permits if deemed necessary.

R625-5-7 EMERGENCY PERMITS

7.1 The State Engineer may issue an emergency permit orally or in writing. In the event that an emergency situation arises, which involves immediate or actual flooding and threatens injury or damage to persons or property, steps reasonably necessary to alleviate or mitigate the damage may be taken. Within 72 hours from the start of the emergency work, the State Engineer shall be contacted to indicate the extent of the work being done. The State Engineer, not later than 48 hours following notice, shall inspect the emergency action and authorize the work. After reviewing the work, the State Engineer may impose additional work requirements to be completed as part of the emergency action.

7.2 If approved orally, a written permit shall follow within 5 days confirming the conditions of operation.

7.3 Emergency work may be approved for the period of time needed to complete the emergency action.

7.4 Failure to comply with the requirements outlined in an emergency action, constitutes a violation of section 73-3-29 Utah Code Annotated, 1953.

R625-5-8 ENFORCEMENT

8.1 Alteration of a natural stream cannot legally be started until a permit has been issued by the State Engineer. Any alteration of a natural channel without a permit or contrary to the conditions of approval is a class B misdemeanor.

8.2 The State Engineer may require restoration, stabilization or other additional work on areas that are altered without proper authorization. Further, the State Engineer may require that mitigation work be accomplished to compensate for damages caused by the alteration work. Failure to comply with the conditions as imposed by the State Engineer will constitute the same violation as altering a stream without authorization.

8.3 Violation of state law for a natural stream alteration may also constitute a violation of federal law, pursuant to section 404 of the Clean Water Act. The violator may be subject to federal prosecution.

R625-5-9 SUGGESTED CONSTRUCTION GUIDELINES

These suggested guidelines are presented to give the applicant a concept of the type of work involved in making each proposed alteration. They will be used as a standard in determining if the proposed work will be adequate. They are not established, however, to meet the needs of all proposed alteration work. Each project will be reviewed on its own merits and may require more or less work to adequately and safely accomplish the alteration.

9-1 STREAM CHANNEL RELOCATION
Because of the far-reaching impacts that most channel relocations exert on channel stability and aquatic habitat, they should be allowed only in extreme cases. The following guidelines are suggested when a stream channel is to be totally relocated:

9.1.1 Whenever possible, the length and gradient of the new channel will be similar to that of the abandoned channel to minimize erosion and deposition of material upstream and downstream of the proposed channel relocation.

9.1.2 All alignment changes should be undertaken during periods of low flow in the channel to minimize turbidity and impact on the aquatic habitat.

9.1.3 All flows should be left in that portion of the channel to be replaced until such time as the realigned channel is totally completed and ready to accept the flows.

9.1.4 Provisions should be made to protect the habitat environment, erosion protection, and aesthetic values of the channel by vegetating the disturbed areas. Efforts should also be made to stabilize the banks and bed of the realigned section. It is recommended that the abandoned channel not be backfilled but established as a high flow channel.

9.1.5 In streams with substantial or greater fishery values, special treatments and installations to accelerate the new channel's ability to provide a suitable aquatic habitat may be required. The State Division of Wildlife Resources should be consulted for recommendations to minimize impacts to the wildlife habitat.

9.2 MINOR GRAVEL BAR REMOVAL IN STABLE CHANNELS
The following procedures are recommended for the removal of sand and gravel deposits from a stream channel:

9.2.1 Sand and gravel deposits should not be removed below the water surface at the time the work is undertaken. Removal of bed material is discouraged.

9.2.2 Material removed should be transported to a satisfactory disposal site above the normal high-water line which will insure that the material cannot re-enter the channel during high flows and will not destroy the vegetative cover. Discharge of materials in wetlands requires a permit from U.S. Army Corps of Engineers pursuant to section 404 of the Clean Water Act.

9.2.3 Where material removed is to be used as a source of borrow to fill eroded portions of the channel, an armor coat (riprap) must be installed over the borrow material to prevent erosion of the fill.

9.2.4 Whenever possible, equipment used to remove the deposit should be operated from the bank or the deposit to minimize turbidity.

9.3 STREAM CHANNEL ENLARGEMENT (DREDGING IN UNSTABLE CHANNELS)

Because of the far reaching impacts that dredging has on stream channel stability and aquatic habitat, it should be allowed only in extreme situations. The following guidelines are suggested when dredging a channel to increase the capacity or to prevent damage from flooding:

9.3.1 Whenever possible, equipment should be used which has the ability to excavate the channel deposits and convey them to a disposal site without disturbing the stream bank. Removal of material below original bed, prior to deposition, is discouraged.

9.3.2 All material removed should be transported to a satisfactory disposal site above the normal high-water line which will insure that the material cannot re-enter the channel during high flows and will not injure or otherwise interfere with vegetation on the channel banks or with vegetation whose root zones extend into the channel banks.

9.3.3 Dredging should be undertaken during low flow periods and will be undertaken in such a manner as to minimize turbidity.

9.3.4 To protect the stream banks, dredging should concentrate on the center of the channel. Dredging on the outside of the curves next to the bank should be avoided. Disturbance of streambank vegetation is to be avoided.

9.3.5 Suction dredges shall be operated to insure no mechanized equipment, except the dredge itself, is used below the water line. The operation of the dredge should be done in a manner to prevent the undercutting of stream banks.

9.4 BANK PROTECTION

The following guidelines are applicable to traditional methods of bank protection, which include dumped rock riprap, wire enclosed gabion riprap, broken concrete slabs and jetties to direct the flow away from eroded banks. The State Engineer may approve other means of bank protection such as vegetative alternatives, synthetic liners, fences, anchored timbers, etc., if the applicant demonstrates the proposed method is workable and would represent a reduced impact on the stream environment.

9.4.1 Dumped Rock Riprap

Dumped rock riprap shall comply with the following standards:

9.4.1.1 The riprap should be placed on a compact and stable embankment with side slopes of two horizontal to one vertical (2:1) or flatter. Steeper slopes may be justified at the ends of culverts and bridge approaches.

9.4.1.2 The suggested minimum thickness of the riprap layer should equal the dimension of the largest size riprap rock or 18 inches, whichever is greater.

9.4.1.3 Rock for riprap should consist of sound, dense, durable, angular rock fragments, resistant to weathering and free from large quantities of soft shale and organic matter. The length of the stone should not be more than three times its width or thickness. Rounded cobbles, boulders and streambed gravels do not perform well as dumped riprap.

9.4.1.4 Riprap should be sized so that the average riprap size is at least as large as the maximum size stone the stream is capable of moving. Table 9.4.1, in conjunction with Figure 1 gives one acceptable method of sizing riprap.

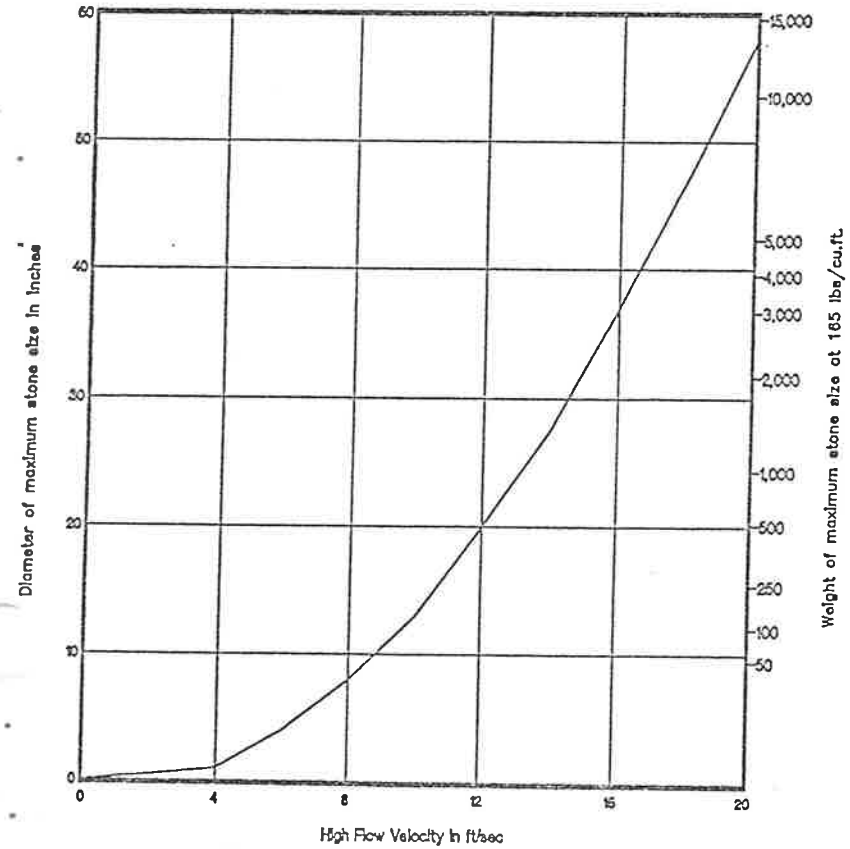
9.4.1.5 A filter blanket, with a minimum thickness of 12-inches, or a suitable commercial filter material, is recommended between the riprap and the protected bank where the bank is composed of fine-grained erodible material such as clays, silts and sands.

9.4.1.6 Precautions should be undertaken to insure the toe of the riprap is protected from undercutting. Figures 2 and 3 show recommended toe protection methods.

TABLE 1

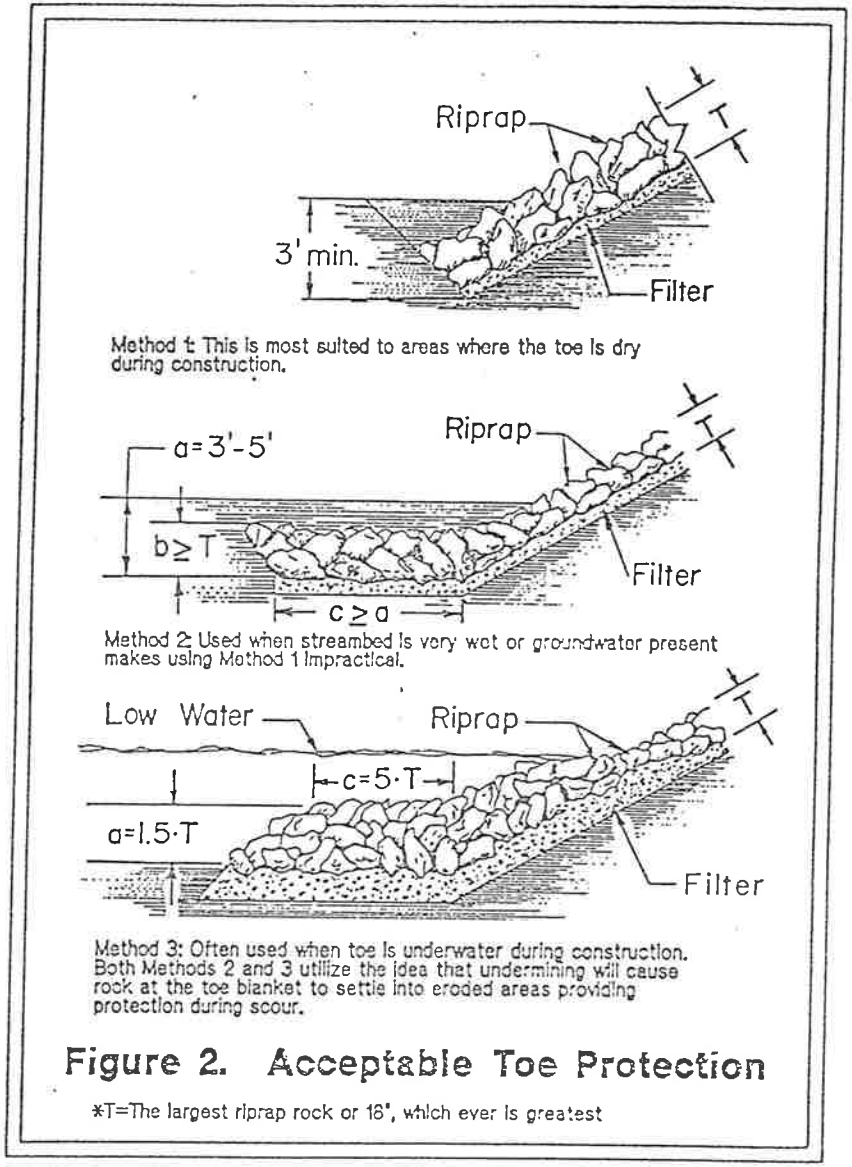
GRADATION OF RIPRAP IN POUNDS

Max. Weight Of Stone Required (lbs.)	Min. and Max. Range In Weight (lbs.)	Weight Range Of 75 % Of Stones (lbs.)
150	25 - 150	50 - 150
200	25 - 200	50 - 200
250	25 - 250	50 - 250
400	25 - 400	100 - 400
600	25 - 600	150 - 600
800	25 - 800	200 - 800
1000	50 - 1000	250 - 1000
1300	50 - 1300	325 - 1300
1600	50 - 1600	400 - 1600
2000	75 - 2000	600 - 2000
2700	100 - 2700	800 - 2700



Source: U.S. Soil Conservation Service "Field Engineering Manual", 1969

Figure 1. Maximum Riprap Size



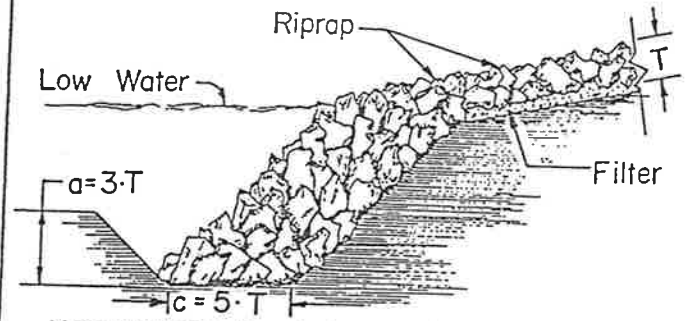
Method 1: This is most suited to areas where the toe is dry during construction.

Method 2: Used when streambed is very wet or groundwater present makes using Method 1 impractical.

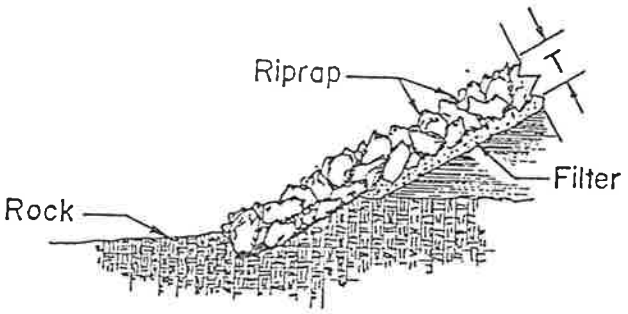
Method 3: Often used when toe is underwater during construction. Both Methods 2 and 3 utilize the idea that undermining will cause rock at the toe blanket to settle into eroded areas providing protection during scour.

Figure 2. Acceptable Toe Protection

*T=The largest riprap rock or 18", which ever is greatest



Method 4: Used underwater in areas with extremely bad streambed erosion conditions which make Method 3 unfeasible. This method may also be preferred where Method 3 would destroy fish spawning beds.



Method 5: When the streambed is non-erodible, no special provisions for toe protection are needed other than insuring that the riprap is well keyed to the rock.

Figure 3. Acceptable Toe Protection

9.4.2 Gabions

The following guidelines for wire enclosed gabions are suggested, whether they are used as a mat installation, or for retaining wall construction:

9.4.2.1 Gabions should be of single unit construction, with the base ends and sides woven into a single unit, and shall be constructed of heavily-galvanized steel woven wire no smaller than 12 gage. All ties, lacing, and other wire used shall be no smaller than 9 gage.

9.4.2.2 Gabions should be placed on a well-compacted, stable embankment and keyed into the channel bottom to prevent undercutting. Typical mat and retaining wall installations are shown on Figures 4 and 5. A filter zone, with a minimum thickness of 6 inches, is recommended between the gabion and the protected area where the bank is composed of fine-grained or erodible material such as clays, silts, and sands.

9.4.2.3 Gabions used as a mat installation shall have a minimum thickness of 12 inches and a minimum dimension of 6 feet. Gabions used as retaining walls should have a minimum thickness of 3 feet and a maximum dimension of 4 feet.

9.4.2.4 Gabion baskets should have corners tied at least every 8 inches along all edges and a minimum of two ties between gabions for every square foot of contact area.

9.4.3 Broken Concrete

Although broken concrete is not the recommended best method of bank stabilization, because of its wide use and relative low cost, the following guidelines are suggested for its installation:

9.4.3.1 Broken concrete should be placed on a compact and stable embankment with side slopes of two horizontal to one vertical (2:1) or flatter. Steeper slopes may be justified at the ends of culverts and bridge approaches.

9.4.3.2 Concrete used should be clean and angular with no exposed rebar, asphalt, timber or other debris.

9.4.3.3 Broken concrete used in bank stabilization should have a length to thickness ratio of 5 or less in any direction (L/T less than or equal to 5) to decrease the displacement potential.

9.4.3.4 Concrete sections should be sized similar to the sizing criteria for riprap in section 9.4.1.4 and Table 9.4.1.

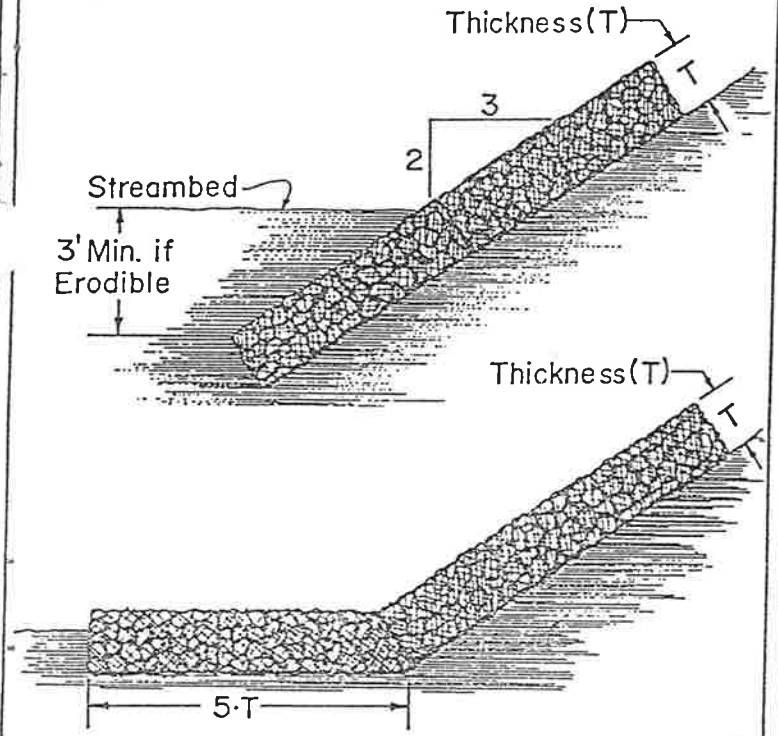


Figure 4. Mattress Gabion

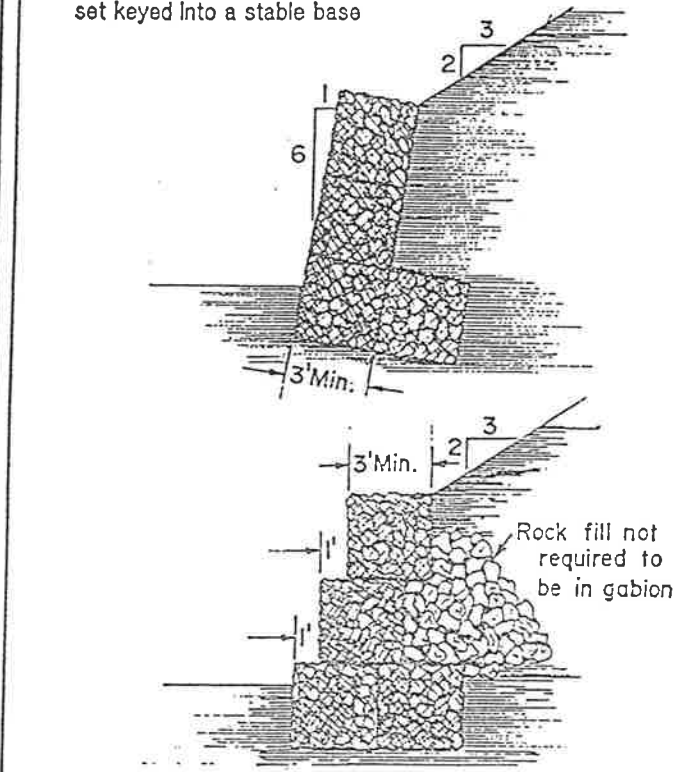


Figure 5. Retaining Wall Gabion

9.4.3.5 A blanket of filter material, with a minimum thickness of 12-inches, is recommended between the concrete and the protected bank where the bank is composed of fine-grained erodible material such as clays, silts, and sands.

9.4.3.6 Precautions should be taken to insure the toe of the concrete embankment is protected from undercutting as indicated in section 9.4.1.6.

9.4.4 Jetties:
The following standards are suggested for the use and construction of jetties for bank erosion control:

9.4.4.1 Jetties are generally not effective on curves having less than a 200-foot radius, unless hydraulic analysis is provided to show otherwise.

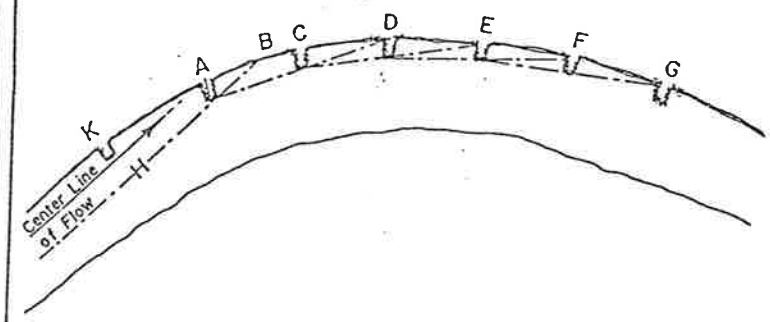
9.4.4.2 Jetties should not extend into the stream more than 20 percent of the channel width, and should have a height equal to the design streamflow depth, unless the jetty is specifically designed for fish shelter or streambank protection. Figure 7 shows recommended geometric configurations for a Full Flow Height Jetty and a Low Partial Flow Height Jetty.

9.4.4.3 Jetties should be spaced close enough to provide continuous protection along the streambank, unless other bank protection measures between jetties is provided. Figure 6 shows a typical jetty spacing procedure.

9.4.4.4 Jetties should be keyed into the channel bottom and the stream bank a sufficient amount to insure that undercutting will not occur.

9.4.4.5 The minimum top width for a jetty should be 3-feet, and the upstream and downstream slopes should be two horizontal to one vertical (2:1) or flatter.

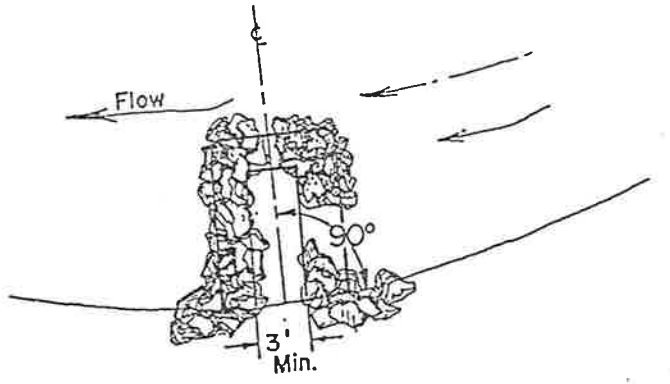
9.4.4.6 Jetties should be protected from erosive damage on all surfaces exposed to flowing water by riprap or other means. This includes areas upstream and downstream from the jetty on the stream banks.



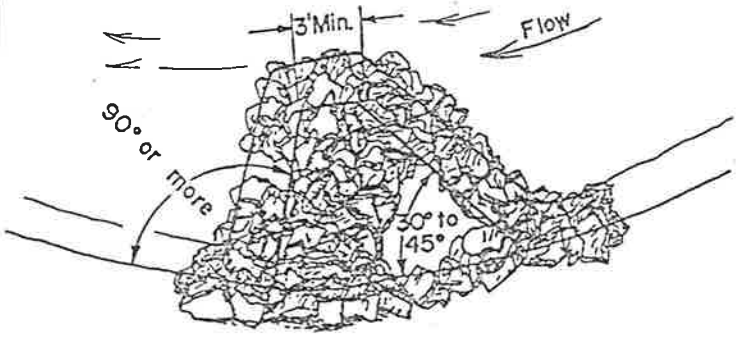
PROCEDURE

Point "A", location of first jetty, is the intersection of the flow line and the eroding bank. Jetty "C" is located by drawing HB parallel to the flow line and across the toe of jetty "A". AC is twice AB. Jetty "D" is located by projecting a line across the toe of jetties "A" and "C". The remaining jetties are located the same as "D". Supplementary jetty "K" is located AC distance upstream from "A".

Figure 6. Method of Locating Jetties



Full Flow Height Jetty



Low Partial Flow Height Jetty

Figure 7. Jetty Dimensions

9.5 DROP STRUCTURES

The following guidelines are applicable to the installation and placement of drop structures in a natural channel. A drop structure installation is a means of artificially establishing a water surface elevation upstream from the structure and for controlling the direction of the river flow.

9.5.1 A drop structure is a river training device usually installed from bank to bank and used to control the stream flow and direct it into areas required to prevent erosion of the beds and banks of the stream and to protect existing structures and keep them operable. Drop structures may be constructed of dumped rock riprap, wire enclosed gabion riprap, poured concrete, metal sheet piling, timber pilings or other materials as approved by the State Engineer.

9.5.2 Drop structures should not restrict the stream flow to the point that excessive upstream heads cause backwater problems and flooding to upstream landowners.

9.5.3 The stream will tend to fall perpendicularly over the drop structure. Therefore, the structure should be installed in such a manner as to move the flow in the desired direction. The structure should be keyed into the existing banks and beds to help stabilize the materials used. The area immediately downstream should be riprapped to prevent scour, or an alternative plan needs to be developed to prevent the structure from being undercut.

9.5.4 It is recommended that when drop structures are installed from bank to bank, the center of the structure be located upstream from the edges to help direct flow away from the banks and prevent excessive scour. See Figure 8.

9.5.5 Drop structures should be designed to allow fish passage during all times of the year. As a general rule, drops should not exceed 18 inches, and should maintain a pool of at least 18 inches depth below the drop to aid in fish passage.

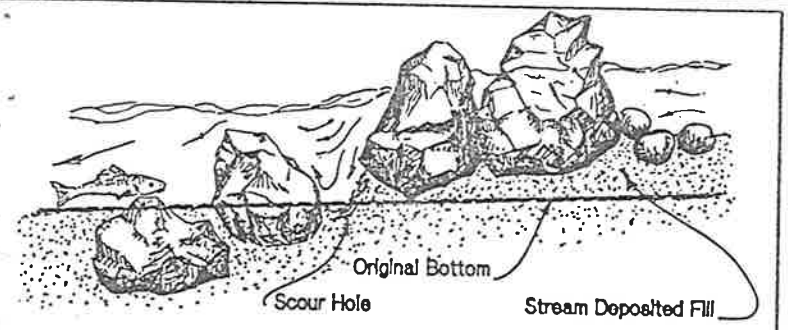
9.6 DIKES AND LEVEES

The following guidelines are suggested for dikes and levees placed in such a manner that they are in contact with the channel, the channel banks, or the vegetation having a root zone in the channel bank:

9.6.1 Dikes should be located on firm foundation material and shall be positioned in such a manner that they will not appreciably obstruct the flow of the channel or raise the water surface elevation.

9.6.2 Materials used in the construction of dikes and levees should have relatively low permeabilities and be free of vegetation, organic material, and other objectionable materials.

9.6.3 Dikes and levee surfaces placed in contact with flowing water should have adequate bank protection such as riprap, gabions or other methods, to insure erosion will not occur.



Section "A–A"

1) Rocks angled upstream and lower near the middle.

2) Rocks buried in streambank.

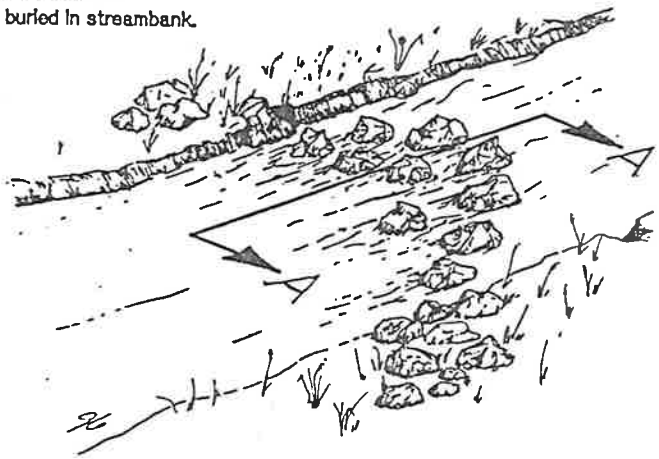


Figure 8. Typical Rock Drop Structure

9.7 CULVERTS AND BRIDGES

The following guidelines are suggested for culverts and bridges installed in natural stream channels:

9.7.1 Culverts and bridges should be located so that a direct line of approach exists at both the entrance and exit. Abrupt bends in culverts should also be avoided.

9.7.2 Whenever practical, the gradient of the culvert or bridge floor should coincide with the average gradient of the natural stream to minimize upstream and downstream modifications to the bottom of the natural channel.

9.7.3 Where fish passage is required, the bottom of the culvert should be buried below the natural bed of the stream to facilitate placement of cobble rock or baffles. The gradient of the culvert should not exceed 0.5% on streams with migratory fish populations.

9.7.4 The culvert or bridge opening shall be capable of passing design flows without overtopping the stream bank, causing flooding, or inducing significant back water. The design flow used in the analysis should be based on a return period commensurate with the project requiring the bridge or culvert.

9.7.5 Outfalls at culverts and bridges should be designed in such a manner that a smooth transition to the natural channel is made to minimize erosion. If the velocities through the culvert or bridge are of sufficient magnitude that erosion of the downstream channel will occur, riprap or other protection may be needed.

9.7.6 Construction of the culverts and bridges in the natural channel should be undertaken during low flow periods whenever possible. If significant activity is to occur within the channel, suitable cofferdams or other devices should be installed around the affected area to isolate it from the remaining stream channel and keep silt loading and sedimentation problems to a minimum.

9.7.7 In constructing culverts and bridges in a natural channel, every effort should be made to minimize the use of heavy equipment within the channel and to restore any affected portions of the channel to their pre-construction condition.

9.8 OBSTRUCTIONS

Obstructions will be defined as piers, banks, diversion structures, retaining walls, and any other permanent structures which occupy or otherwise encroach upon a natural stream channel or its banks. Because of the multitude of obstructions which can be constructed, detailed guidelines are not possible; however, the following suggestions are offered:

9.8.1 Obstructions should not restrict the cross-sectional area of a natural stream channel so that the flow is significantly impaired or excessive upstream heads have to be generated to clear the obstructions. Obstructions restricting the cross-sectional area of a natural stream channel, which are needed to divert water shall be designed in such a manner as to pass the flood flow requirements.

9.8.2 Where multiple obstructions are proposed, the spacing should be adequate to allow the free passage of the largest anticipated floating debris.

9.8.3 Construction of obstructions in the natural channel should be undertaken during low flow periods whenever possible. If significant activity is to occur within the channel, suitable cofferdams or other devices should be installed around the affected area to isolate it from the remaining stream channel.

9.8.4 In constructing obstructions in a natural channel, every effort should be made to minimize the use of heavy equipment within the channel and to restore any affected portions of the channel to their pre-construction condition.

9.9 PIPELINE AND UTILITY CROSSINGS BELOW CHANNEL BED

The following standards are suggested for pipeline and utility crossings below the bed of a natural channel:

9.9.1 All pipelines or utilities should be installed below the streambed to a depth which will prevent erosion and exposure of the line to free flowing water. In channels with high velocities, the pipeline or utility should be encased in concrete or covered by a concrete cap. It is recommended that valves be installed at both ends of the stream channel crossing for pipelines carrying materials that may be damaging to the environment should a leak occur.

9.9.2 All points on the pipeline or utility should be welded, glued, or otherwise fastened to insure a watertight connection.

9.9.3 Construction methods should provide for eliminating or minimizing discharges of turbidity, sediment, organic matter or toxic chemicals. Settling basins, cofferdams, or stage construction may be needed to protect the channel.

9.10 PIPELINE AND UTILITY CROSSINGS ABOVE CHANNEL BED

9.10.1 All pipelines and utilities installed above the bed of a natural stream should be installed in such a manner to adequately pass an expected flood and provide enough space between the water surface and the pipeline or utility to pass logs and other debris floating in the channel.

9.10.2 Pipeline and utility crossings should not restrict the cross-sectional area of a natural stream channel so that the flow is significantly impaired or excessive upstream heads have to be generated to clear the crossings.

APPENDIX I

MAJOR CHANNEL CLASSIFICATIONS

The State Stream Channel Classification is utilized to make all applicants aware of the six major classes of streams and some of the critical characteristics and concerns of each class.

STREAM CLASSIFICATIONS:

CLASS I: These are the top quality fishing waters of the state and deemed of critical value to aquatic wildlife. They should be protected or improved for fishery and other recreational uses at all costs. No water developments should be allowed which might destroy any of the recreational values. These waters are judged on their aesthetics, availability and productivity as described.

Aesthetics - These waters are generally outstanding in natural beauty and of a unique type.

Availability - Access is satisfactory for modern vehicle to suitable points. Larger waters are floatable, with launching facilities such that boats can be launched and landed. Public access is not a serious problem. Camping or lodging is available within a reasonable distance. Aquatic vegetation is not a major problem to the angler.

Productivity - These waters support a high fish population, in good condition, of one or more species of the more desirable game fish. Natural reproduction, or stocking of small fish, maintains an excellent sport fishery.

CLASS II: These waters are of great importance to the fishery program, and are deemed of critical value to aquatic wildlife. Fishing and other recreation should be the primary uses. Developments on these waters should not decrease any fishery or other recreational value. They are judged by their aesthetics, availability, and productivity as is Class I; however, for the following reasons these waters rate lower.

Aesthetics - They are comparable to Class I, except that there may be developments such as roads, farms, or commercial establishments along or near them. Climatic or biological factors, such as excessive rainfall, extreme cold, or insect pests may be the difference.

Availability - Vehicular access is relatively good (road may be alongside stream). The shoreline and aquatic vegetation are not unduly restrictive to fishermen and posting is not extensive. Larger streams are not readily floatable. Some camping or lodging facilities are generally available.

Productivity - These waters support a moderate to high population of one or more game fish. Natural reproduction and fry or fingerling plants maintain a very good to excellent sport fishery. Water fluctuation may be the difference between Class I and II.

CLASS III: The majority of Utah waters are in this class, making them a very high priority to the fishery program. Fishing and other recreation should be the primary uses. These should be protected and improved. Should water developments be necessary, they should be planned to minimize any fishery losses. In some cases these streams could be improved as fisheries with little expense if more water were available.

Aesthetics - These are waters of considerable natural beauty, although of a more common type than those in Classes I or II. They are usually clean and clear.

Availability - Access is relatively good and posting, though it may exist, is not considered an important restrictive problem. Waters requiring access by foot, horseback, or four-wheel drive vehicle are usually in this class. Areas where bank cover or aquatic vegetation restricts fishing may also be included here.

Productivity - There are all sizes of waters in this class. Generally, productivity is fairly high in the smaller waters, and low in the larger waters. Artificial stocking of catchalbles, fingerling, or fry may be required to maintain the fishery program. The management situation determines the size of fish that are planted.

CLASS IV: This class is of substantial importance to the fishery resource of Utah. Some of the factors that adversely affect the fishery values are partial dewatering, diversions, dams, heavy or complete drawdown of reservoirs, or natural drought. Whenever possible and economical, these waters should be improved for fisheries.

Aesthetics - Waters are of fair scenic value but lack unusual or outstanding scenic qualities.

Availability - Access is often difficult or posting so extensive as to seriously restrict fisherman access.

Productivity - Waters are generally small. There is a short growing season and excessive drawdown or dewatering may occur. Planting of catchables is generally required to maintain a sport fishery. Summer or winter mortality problems may occur. Various habitat factors are not conducive to the survival and growth of game fish in numbers necessary to provide a reasonable fishery.

CLASS V: Due to the natural environment of the area or the effect of human development, these waters are of limited value to the present fishery program. Some waters could be of more importance if habitat were improved or other factors altered to benefit fisheries.

Aesthetics - Waters are poor in quality. The water is often turbid from noxious domestic and industrial wastes or natural erosion; the water level may fluctuate excessively or the stream may be dewatered every year. Stream flows may also be naturally too low to support fish populations. The adjacent area may be of little or mediocre appeal and of common occurrence.

Availability - Access is inadequate, as natural or man-made restrictions cause fisherman utilization to be almost impossible.

Productivity - These waters support few or no game fish. They may be large or small, but a long-term fishery cannot be maintained by either natural or artificial means. Some waters could be very valuable if a sustained downstream flow were available for streams or a conservation pool provided in reservoirs.

CLASS VI: These streams are dewatered and considered of limited value. It is impossible at present to carry on a long-term fishery by either natural reproduction or stocking.

APPENDIX II

PERMIT APPLICATION

PERMIT APPLICATION

TO ALTER A NATURAL CHANNEL IN THE STATE OF UTAH

1 Application Number _____

Applicant's Name (Last, First, M.I.)	Authorized Agent	Telephone No. & Area Code
		( )

Address (Street, RFD, Box Number, City, State, Zip)

Quarter Section(s)	Section(s)	Township(s)	Range(s) & Base

County	Watercourse to be altered	Drainage Area

Common Description or Address of Proposed Project

2 Nature of proposed alteration (Check applicable box/es)

☐ fill	☐ excavate	☐ bridge	☐ culvert
☐ remove	☐ construct	☐ riprap	☐ wetland
☐ abandon	☐ realign	☐ channel	☐ obstruction
☐ install	☐ maintain	☐ diversion works	☐ watercourse
☐ bank protection	☐ instream structure	☐ other _____	☐ other _____

3 Estimated Cost of Project

$

4 Project Plans

Plans included? Number of attachments _____

5 Brief Explanation of Project

6 Justification (Explain why this project is needed)

7 Detrimental Effects (Anticipated changes to the water and related land resources, including unavoidable detrimental effects)

COPY

8 Alternatives [other alternatives to the proposed action]

9 Names and addresses of adjoining property owners, lessees, etc.

10 Estimated Starting Date of Project	Estimated Completion Date of Project

COPY

I hereby make application pursuant to 73-3-29, Utah Code Annotated, 1953, and all other supporting rules for a permit to alter a natural channel in the State of Utah. If approved, the work will be done in accordance with conditions of approval, supporting maps, plans and other information submitted with this application. The information submitted and statements made concerning this application are true and correct to the best of my knowledge.

Signature of Owner or Authorized Agent	Date

FOR OFFICE USE ONLY

Recommendations of the Area Engineer Approve/Reject

Area Engineer	Date

INSTRUCTIONS FOR MAKING APPLICATION TO ALTER A NATURAL CHANNEL TO THE STATE OF UTAH PURSUANT TO 73-3-29, UTAH CODE ANNOTATED, 1953, AN ALL SUPPORTING RULES.

WHO APPLIES

Any federal or state agency, county, city, corporation or person desiring to change the course, current or cross-section of a natural channel shall file a written application with the state engineer.

PROCEEDING WITHOUT A PERMIT

Alteration of a natural channel cannot legally be started until a permit has been issued by the state engineer. Any alteration of a natural channel without a permit or contrary to the conditions of approval is a misdemeanor and is punishable by fines not less than $10 or more than $299, or imprisonment in the county jail of not less than ten days, or fine and imprisonment.

The applicant should be aware that other federal, state and local permits may also be required which are the responsibility of the applicant to obtain.

APPLICATION

Each section below corresponds to the appropriate section on the application form.

COPY

Part 1. General Information:
The application must include the applicants name, mailing address, and telephone number and the location of the proposed project by quarter section, section, township, range and county. Include the name of the watercourse involved and the drainage area. Also include a common description or address of the proposed project.

Part 2. Nature of Alteration:
Please check the appropriate boxes.

Part 3. Estimated Cost:
What is the total estimated cost of this project?

Part 4. Project Plans:
Are the appropriate plans included? Total number of attachments included.

Part 5. Brief Explanation of Project:
Briefly describe the nature of the proposed change

Part 6. Justification:
Explain why this project is necessary. Be specific as to what the objective of the project is. If more space is needed to fully explain, or supply pertinent information, attach extra sheets.

Part 7. Detrimental Effects:
Complete this section by indicating proposed changes in natural resource features, character, or quality, and effects that may be harmful but unavoidable [i.e. loss of wildlife habitat, loss of vegetation, increased downstream flooding, effects on water right diversions, etc.]

Part 8. Alternatives:
Describe any and all possible alternatives to the proposed project.

ATTACHMENTS

Before an application can be considered for approval, the following attachments are required for all projects. These maps and drawings should be submitted on 8½" x 11" white paper. A 1" margin is required at the top edge, a ½" margin is required on the other three edges. Examples of typical maps and drawings are provided for reference.

Attachment 1. Location Map:

- Provide a map that will clearly indicate the project location with respect to existing roads, landmarks, etc. You may use a U.S. Geological Topographic Survey Map or road map. Draw an arrow to the exact project location.

Attachment 2. Plan View Sketch:

A plan view should show the project from the topview (overhead) and include the following:

a. Name of the watercourse to be altered
b. High and low water lines
c. Property boundaries adjacent to project
d. Location and dimension of proposed project
e. Points of reference (house, road, north arrow, vegetation, etc.)

Attachment 3. Cross Sectional Sketch:

A cross sectional sketch should show the profile (endview) of the project and should include the following:

a. Average and high water depth
b. Location and dimension of proposed project
c. Location of existing vegetation (trees and brush)

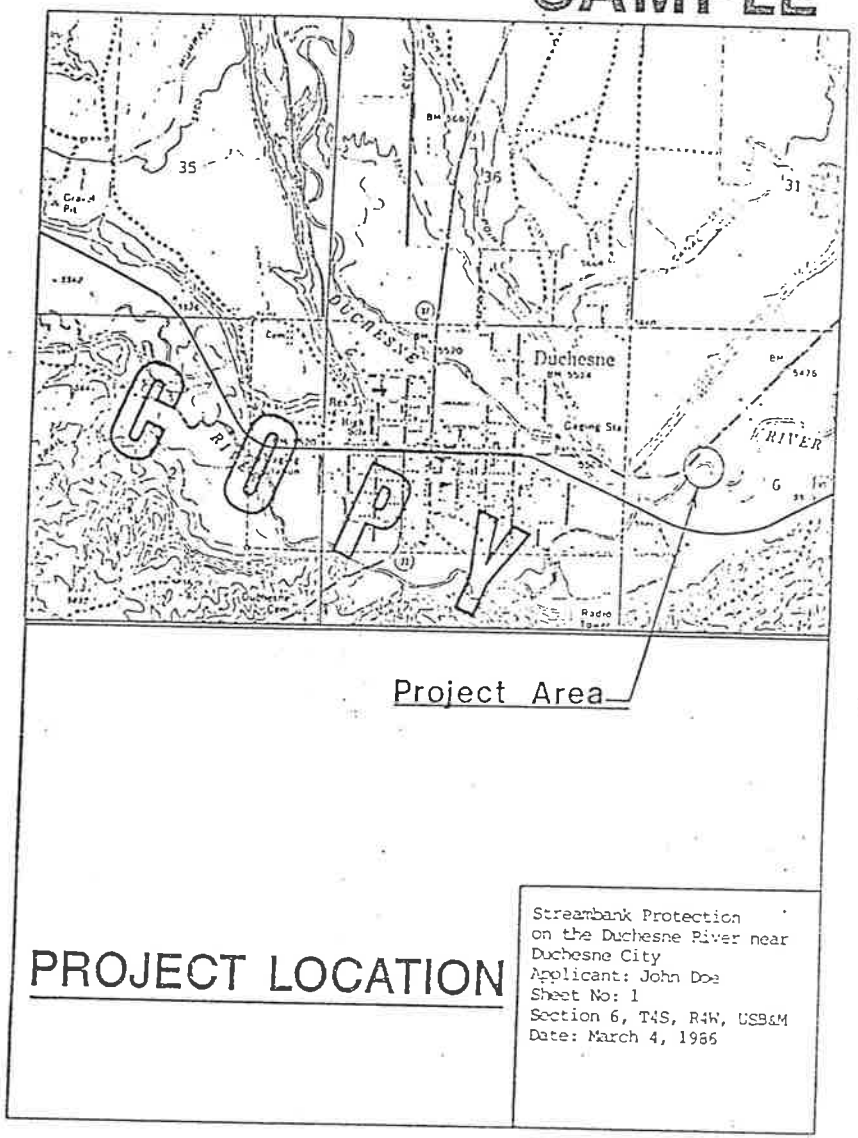
COPY

QUESTIONS

If you have any questions concering the procedure for making application, please contact the Area Office closest to you.

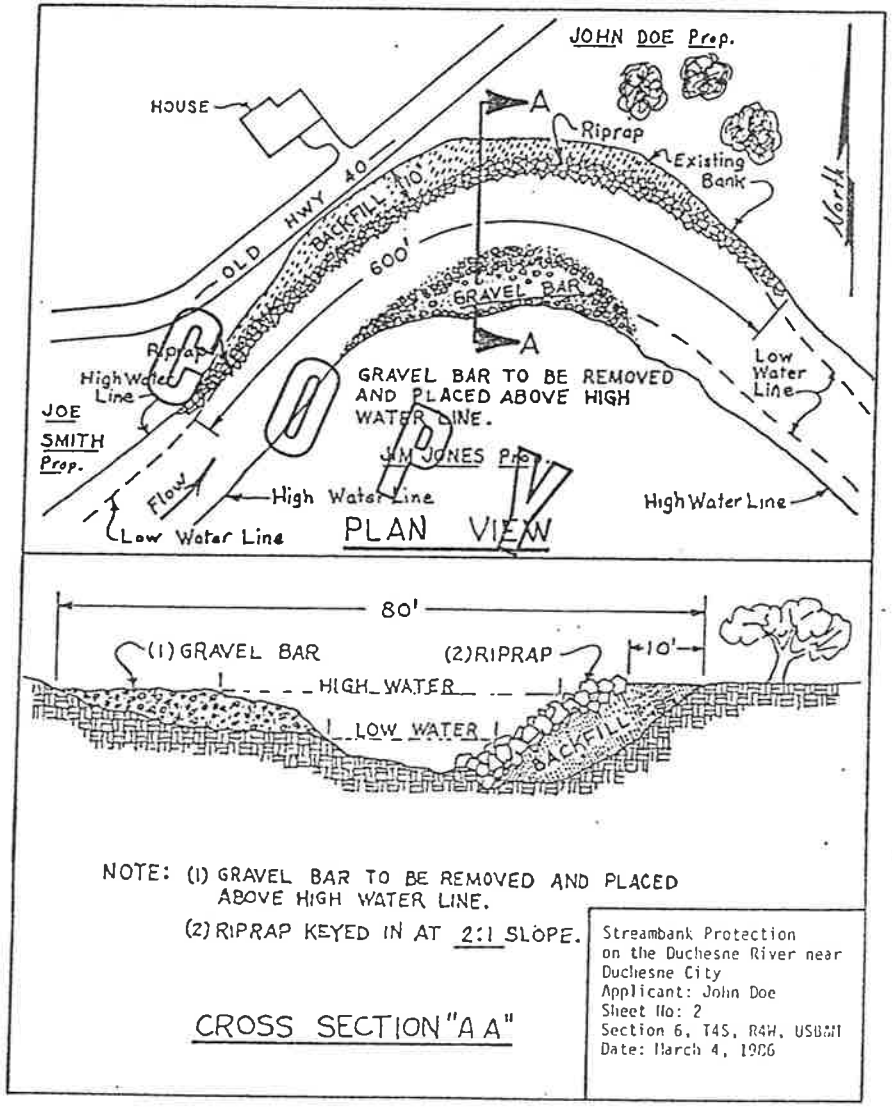
Salt Lake City Office — 1636 W. N. Temple, SLC, Utah 84116, 533-6071
Cedar City Office — 585 N. Main, Cedar City, Utah 84720, 586-4231
Logan Office — 55 E. 100 N., Logan, Utah 84321, 752-8755
Price Office — 453 S. Carbon Ave., Price, Utah 84501, 637-1303
Richfield Office — 130 N. Main, Richfield, Utah 84701, 896-4429
Utah Lake/Jordan River Office — 1636 W. N. Temple, SLC, Utah 84116, 533-6071
Vernal Office — 152 E. 100 N. Vernal, Utah 84078, 781-0770
Weber/Davis Office — 1636 W. N. Temple, SLC, Utah 84116, 533-6071

SAMPLE



PROJECT LOCATION

Streambank Protection
on the Duchesne River near
Duchesne City
Applicant: John Doe
Sheet No: 1
Section 6, T4S, R4W, USB&M
Date: March 4, 1986



APPENDIX III

SELECTED WATER LAWS OF UTAH

73-3-29. (Effective January 1, 1988). Relocation of natural streams - State engineer's approval - Emergency exception - Considerations and investigation - Applicant's costs - nonreimbursable - Penalty for violation.

(1) (a) No state agency, county, city, corporation, or person may relocate any natural stream channel, or alter or change the beds and banks of any natural stream without first obtaining the written approval of the state engineer.

(b) Written approval is not required to take steps reasonably necessary to alleviate or mitigate any injury or damage to person or property in a situation involving immediate, potential, or actual flooding, or injury or damage to person or property.

(2) All applications to relocate any natural stream channel or to alter or change the beds and banks of any natural stream shall be in writing and shall contain the following:

(a) the name and address of the applicant;

(b) a complete and detailed statement of the location, nature, and type of relocation, alteration, or change;

(c) the methods to be employed;

(d) the purposes of the application; and

(e) any additional information that the state engineer considers necessary, including, but not limited to, plans and specifications of the proposed construction of works.

June 5, 1989

ROLLINS, BROWN and GUNNELL, INC. professional engineers

Mr. Denton Beecher
Box Elder County
01 South Main
Brigham City, UT 84302

Dear Denton:

In response to your request the following is a summary of the work covered by the two invoices.

Invoice dated August 11, 1988:

I received a copy of plans from your office through the Food District in early April 1988. I spend 11 hours in review of these plans and sent the enclosed letter to Onesco Engineering on April 28th.

I then received a second set of plans from the Flood District and I spend 14 hours in the review of these plans. My letter of review is Dated August 4, 1988.

Mr. Keith Hansen representing Willard City had many questions regarding the Hydrology in our 1981 studies of the Willard area. I met with him on March 21, 1989 and agreed I would redo the Hydrology for Cooks Canyon and send it to him for review so that every one would be working with the same numbers.

I spend 7 hours and Mr. Cook spent 26 hours redoing the Hydrology. The results are a part of our September 1988 report which you have.

Invoice Dated November 14, 1988:

This invoice covers the review of the amended plan as prepared by Mr. Lew Wansgard. The results of this review are included in our September 1988 report which I sent you on November 11, 1988. It was my understanding from the Flood District that these invoices should be sent to Box Elder County.

Sincerely,

ROLLINS, BROWN & GUNNELL, INC.

Russell O Brown

Russell O. Brown, P.E.

cc: Wayne Braegger

1435 WEST 820 NORTH
POST OFFICE BOX 711
PROVO, UTAH 84603

PROVO 374-5771
SALT LAKE CITY 521-5771
AREA CODE 801

Att no. 3

ROLLINS, BROWN and GUNNELL, INC. professional engineers

April 10, 1989

Box Elder County
01 South Main Street
Brigham City, Utah 84302

Attn: Commissioner Valantine

INVOICE

Job Number: 8703-007
Description:

Billing for engineering service requested by the planning commission on the Darrell Neilson Gravel Pit.

Invoice dated 08-11-88 to Box Elder County-Willard City Flood District	$2,640.00
Invoice dated 11-14-88 to Box Elder County-Willard City Flood District	900.00
TOTAL DUE.....	$3,540.00

Thank you

1435 WEST 820 NORTH
POST OFFICE BOX 711
PROVO, UTAH 84603

PROVO 374-5771
SALT LAKE CITY 521-5771
AREA CODE 801

ROLLINS,
BROWN and
GUNNELL,
INC. professional engineers

August 11, 1988

Box Elder County - Willard City
Special District for Flood Control
c/o Wayne Braegger
36 North 200 West
Willard, Utah 84340

INVOICE

Job Number: 8703-07
Description:

Review of plans for Drainage Facilities for the Darrell Neilson Gravel Pit, April 1 through August 10, 1988.

Russell O. Brown 32 hours @ $50.00	$1,600.00
Carl Cook 26 hours @ $40.00	1,040.00
TOTAL DUE	$2,640.00

Thank you.

1435 WEST 820 NORTH
POST OFFICE BOX 711
PROVO, UTAH 84603

PROVO 374-5771
SALT LAKE CITY 521-5771
AREA CODE 801

ROLLINS,
BROWN and
GUNNELL,
INC. professional
engineers

November 14, 1988

Box Elder County - Willard City
Special District for Flood Control
c/o Wayne Braegger
36 North 200 West
Willard, UT 84340

INVOICE

Job Number: 8703-007
Description:

Billing for engineering services on the Darrell Nielson gravel pit, August 11 - October 31, 1988.

Russell Brown 18 hrs. @ $50.00	$900.00
TOTAL DUE	$900.00

Thank you.

1435 WEST 820 NORTH
POST OFFICE BOX 711
PROVO, UTAH 84603

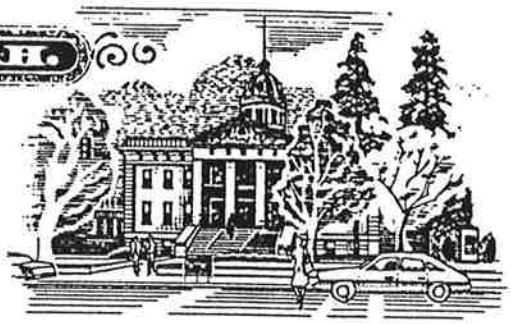
PROVO 374-5771
SALT LAKE CITY 521-5771
AREA CODE 801

CIRCA 1890'S

Box Elder County,

STATE OF UTAH

COUNTY COMMISSIONERS
FRANK O. NISHIGUCHI
ROBERT G. VALENTINE
JAMES J. WHITE



CIRCA 1980'S

OFFICERS
AFTON R. DARNELL, COUNTY TREASURER
JAY R. HIRSCHI, COUNTY CLERK
ROBERT E. LIMB, COUNTY SHERIFF
MARIE G. KORTH, COUNTY RECORDER
JON J. BUNDERSON, COUNTY ATTORNEY
VON R. CURTIS, COUNTY ASSESSOR
DENTON BEECHER, COUNTY SURVEYOR
DORIS L. OLSEN, COUNTY AUDITOR

1 April 1988

Wayne Braegger
36 North 200 West
Willard City, Utah 84340

Re: Darrell Nielsen gravel pit

Dear Wayne,

Inclosed please find a copy of the plans which the Box Elder County Planning Commission would like to have reviewed by the Flood District. Would you please have Mr. Russ Brown review these plans as they apply to flood control. We would like to know if the by pass plan would be possible. This design to handle the Cook Canyon flows concerns us. Also does the control to handle water along the acess road sufficient to divert water into the basin?

We would also like to know if the District will accept the additional ground for the basin as well as the maintenance of same? Will the District accept the easements for any drainage channels that are needed?

As the Commission is asking that Mr. Brown review this plan for them as well as the District we would agree to participate in the cost of this review. If you will let us know the cost we will assist in the payment.

Also inclosed is a copy of the engineers estimate for this proposal. Would you please have Mr. Brown check these prices that apply to flood control to be sure they will cover the cost to do the work designed.

Thank you for your assistance in this matter.

Respectfully,

Denton H. Beecher

Denton H. Beecher County Surveyor

801-734-2031

01 SOUTH MAIN BRIGHAM CITY, UTAH

ROLLINS, BROWN and GUNNELL, INC. professional engineers

April 28, 1988

Onesco Engineering Inc.
105 Skyline Drive
Brigham City, Utah 84302

Dear O'Neil:

Enclosed is an summary of the Hydrology that should be used for the Design of flood control facilities proposed for the Darrel Neilson Gravel Excauatrion project. In order to complete my review of the drawings numbered sheet 1 through 5 dated February 9, 1988, and sent to me by Denton Beacher of Box Elder County, I need to have computations that route the flood through the proposed woks.

In accordance with page 15 of the Master plan dated July, 1981 the design of the improvements should be based on the 100 year flow at the mouth of the canyon. Detention Basins, channels and other improvements need to be sized such that when the 100 year flows are routed through the system the outflow from the existing debris basin does not exceed the locks capacity of the storm drain. I have included for your information the computer print out for the 100 year 2 hour storm. The existing debris basin was not designed to provide detention to reduce flow but only to settle out the gravel to protect the pipe. Its current capacity according to your figures on sheets is 3400 cubic yards or 2.11 acre feet.

Phase 1 of the flood control plan, as I understand it from sheet 3 of the plans, consists of the following:

*Construct a temporary dike labeled 7 on sheet 3. This dike would restrict the flow to the northern-most channel of the several channels now being used for flooding. This will reduce the area available for seepage, and as a result increase the flow and sediment at the existing Basin. I need calculation that take the hydrograph at the canyon mouth, adjust it for seepage based on channel area and a seepage rate and then route the resulting hydrograph through the debris basin to determine how large of a detention basin needs to be constructed to limit the out flow to 70 cfs.

1435 WEST 820 NORTH
POST OFFICE BOX 711
PROVO, UTAH 84603

PROVO 374-5771
SALT LAKE CITY 521-5771
AREA CODE 801

I am also concerned about the velocity in the channel and the steps that would be taken to prevent erosion. At the present time erosion occurs in an area and then deposition causes the flow to jump to a different channel and as a result very little sediment arrives at the existing basin. Channeling the flow will increase the velocity and cause more erosion. Space needs to be provided in the enlarged basin for the additional sediment.

Note 3 under General comments on sheet 3 is in error. According to the data on sheet 5 the proposed expansion of the debris basin is 6900 cubic yards or 4.28 acre feet.

> *Warp the access road section. This is to assure that the surface flow from the frontal area south of Cooks Canyon would go into the debris basin and not down the road. There are no elevations on sheet 4 but it appears that the dip is about 6" deep. Is this sufficient?

When phase 2 is begun the storm flow from Cooks Canyon would be diverted in a temporary channel labeled 3 on sheet 3. This channel cross section is shown on the drawings. I need calculations that take the flows at the mouth of the canyon route it through the temporary channel and then determine the size of the detention basin that is needed to limit the outflow to 70 cfs.

There are three additional concerns for this temporary channel:

> (1) It is quite difficult to make a flow with substantial amount of sediment change directions. Usually the sediment deposits in the channel and then the flow over tops the dike and continues in its original path. How is the direction change to be made?
>
> (2) Is the channel across the 2:1 slope stable. Will the seepage cause a failure of the downstream bank?
>
> (3) How is erosion to be controlled on the southern most section where the channel goes down the slope? What happens to the sediment in this system?

At the completion of phase 2 the flow is diverted sown a channel labeled 2 on sheet 3. This slope is 2:1. Riprap is shown on sheet 2. Will the riprap eliminate the erosion in the channel? If not, what happens to the sediment? At this stage very little of the flow will be lost to seepage. The flow at the mouth of

the canyon needs to be routed through this system and the amount of detention determined to limit the outflow to 70 cfs.

If you have any questions, please call me.

Sincerely,

ROLLINS, BROWN AND GUNNELL, INC.

Russell O. Brown

Russell O. Brown

cc: Denton Beecher
Wayne Braegger

ROB:amh

ROLLINS, BROWN and GUNNELL, INC. professional engineers

August 4, 1988

Box Elder County - Willard City
Flood Control District
c/o Wayne Braegger
36 North 200 West
Willard City, Utah 84340

Re: Darrell Nielsen Gravel Pit

Gentlemen:

On April 1, 1988, the Box Elder Planning Commission submitted to the Flood District plans for a gravel pit in the Cooks Canyon Drainage. These plans were sent to me for a review of the flood control features of the Excavation plan.

I made a preliminary review of the plans and sent a letter on April 28, 1988 to Mr. Nielsen's engineer expressing my concerns with the plan. A copy of the letter is attached. In response to my letter, Mr. Nielsen's engineer has submitted a revised plan for flood control. The revised documents consist of the following:

1. 5 sheets of drawings titled Gravel Excavation Project Area prepared by Onesco Engineering, Inc., dated July 27, 1988.

2. A three-page letter from Onesco Engineering, Inc. dated July 28, 1988.

3. Attached to the above letter, an addendum consisting of 10 pages of hydraulic calculations for the flood control features of the plan.

It is my opinion that the flood control plan as described in the above documents provides facilities for the water originating on the project as well as waters originating in Cooks Canyon and the small frontal canyon to the south and would be an improvement to the existing system.

1435 WEST 820 NORTH
POST OFFICE BOX 711
PROVO, UTAH 84603

PROVO 374-5771
SALT LAKE CITY 521-5771
AREA CODE 801

If the Box Elder planning commission approves an excavation permit incorporating the proposed flood control plan, there are some items associated with the plan that need Flood Control Board action. I would recommend approval of the flood control plan with the following items included:

1. Easements and land titles. I would recommend that the land required for the expansion of the lower basin be transferred by Warranty Deed to the Flood District. Other facilities should be constructed on the owner's property and no easements or titles would be accepted.

2. Maintenance of the new basin above the canal and the 36" pipe under the Haul Road should be the responsibility of the permit holder.

3. Excavation should not be permitted on phase 2 until the new basin above the canal is complete. Detailed plans of the basin shall be submitted to and approved by the State Engineer prior to its construction.

Sincerely,

ROLLINS, BROWN, AND GUNNELL, INC.

Russell O Brown

Russell O. Brown, P.E.

ROB:jsh

Enclosures