AD-A150 012 REDDIES RIVER LAKE YADKIN RIVER BASIN REDDIES RIVER NORTH CAROLINA GENERA..(U) CORPS OF ENGINEERS CHARLESTON SC CHARLESTON DISTRICT MAR 75 1/4

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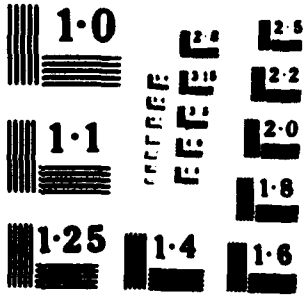
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DAEN-CWP-P (25 Mar 75) 2nd Ind
SUBJECT: Reddies River Lake, Reddies River, North Carolina Design Memorandum 3 - General Design Memorandum - Phase I, Plan Formulation

DA, Office of the Chief of Engineers, Wash., D. C. 20314 4 OCT 1977

TO: Division Engineer, South Atlantic

1. The subject GDM has been reviewed by OCE and ERH and is being returned for additional information and revisions as discussed below and in Inclosure 5.

2. In view of the proposed major changes in this project resulting since authorization, it will be necessary to submit this proposal to Congress for modification of the existing authorization. On 21 May, 29 July, and 15 August 1970, the Office of Civil Functions, OSA, advised the Chief of Engineers that the new project should be reviewed in the same manner as a new project submitted for authorization, including the preparation of a survey scope report. The many changes since original authorization make it obvious that the project is being reformulated. Therefore, the restudy should be in conformance with all current planning criteria including Principles and Standards.

3. There has been considerable discussion between OCE and ERH during the review of this report regarding the application of "willingness to pay" to water supply benefits. It is the position of OCE that the benefits equal the costs of a single purpose alternative, built at the time of first need and discounted to project year one, except that land to be acquired purchased in project year one to preserve the site for water supply. Even on this basis the addition of water supply as a project purpose does not appear to provide benefits sufficient to justify the total project. Therefore, your existing water supply studies are particularly important to determine demand and the time of need. It is understood these studies are being made in connection with the State of North Carolina and Wilkes County. They should include information on the State water plan and any anticipated interbasin water transfers allowable (or projected to be) under existing State law.

4. You should reconsider project formulation in the subject report. All of the conservation storage is shown as being required for recreation in the absence of the water supply purpose; therefore, the storage is the same with or without water supply. To assure dependability for and a benefit to water supply, there should be some separable storage for water supply.

DAEN-CWP-E (25 Mar 75) 2nd Ind 4 OCT 1977

SUBJECT: Reddies River Lake, Reddies River, North Carolina Design Memorandum 3 - General Design Memorandum - Phase I, Plan Formulation

5. After you have made sufficient progress on the restudy, it will be advisable to have a conference with OCE personnel to discuss benefits, formulation and cost allocation.

FOR THE CHIEF OF ENGINEERS:

CHARLES I. McGINNIS
Major General, USA
Director of Civil Works

2 Incl
wd incl 1, 2, & 3
4.nc
Added 1 incl
5. OCE-Lifts' Comments

CF:
District Engineer, Charleston

SAEDP (25 Mar 75) 3d Ind
SUBJ T: Reddies River Lake, Reddies River, North Carolina Design Memorandum 5 - General Design Memorandum - Phase I, Plan Formulation

DA, South Atlantic Division, Corps of Engineers, 510 Title Building, 30 Pryor Street, S. W., Atlanta, Georgia 30303 7 October 1977

TO: District Engineer, Charleston

1. The 2nd Ind is referred for appropriate action.

2. After you have analyzed your work requirements and laid out your schedule for completion of the restudy you should submit an outline of that information along with a request that AE&D funds be made available.

FOR THE DIVISION ENGINEER:

MARVIN E. REES
Colonel, Corps of Engineers
Deputy Division Engineer

2 Incl
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[illegible] RIVER LAKE - CDR PHASE I
GDM & BLEM COMMENTS
MAY 1977

1. The report should be as closely resemble that of a survey report, including [illegible], the standards required of survey reports. The report should meet, at least, the requirements established for Phase I GDM's on [illegible] authorized projects, in accordance with EC 1105-2-29, 14 March 1975. The rationale is that these requirements were closely resemble those of survey reports and are more compatible with the requirements of Congressional decision documents than do the requirements for [illegible] on pre-1936 authorized projects.

2. The following comments relate to evaluation of the flood control features:

a. The report does not include sufficient information to determine the validity of flood control benefits. Data relative to the number, type, and value of structures subject to damage should be included in the report.

b. Future flood benefits appear to be counted for all damage categories. This is inconsistent with present methodology. Estimation of future flood benefits should be restricted to contents of [illegible] and to agricultural products.

c. [illegible] flood damage prevention to future structures can be claimed for areas subject to 100-year flood plain. This type of benefit can also be claimed for prevention of residual damages, above the 100-year flood level, to the [illegible] structures in the 100-year flood plain. Benefits to [illegible] structures within the 100-year flood plain are enhancement. If [illegible] benefits are claimed, the report should contain information relative to the location and flood proofing status of the properties.

3. The following comments relate to evaluation of the recreation features:

a. There is no justifying report for the proposed authorization and acquisition of 77 acres of land adjacent to the existing state Thurman Christensen Land included in the subject report. Apparently, such a report was developed by the Fish and Wildlife Service (FWS) in 1969. The current coordination letter from the FWS, dated 16 April 1974, refers to that report and accepts the "bare-bare proposal a "partial" mitigation plan to offset lost [illegible] opportunities. Despite the lack of justification, the extent of the lands required and their cost, $115,000 seems reasonable and nominal. However, the report does not include the costs for development and management of these lands as recommended in the FWS report (Recommendation 2, page 7). The [illegible] development and O&M costs should be estimated and included in the subject report.

Incl 5

b. The costs of the recreation development proposed seem very low. The cost of the 542 acres of separable recreation lands area is estimated to have a fee cost of $157 per acre - Appendix II, Table 12. The Board staff's visit to the area revealed that these lands were located on a plateau with less than 10 percent slopes, as they should be. Billboard advertisements were seen for residential lots for $1,500 per lot - the size unspecified. It is highly questionable, therefore, that good flat-lands in the suburbs of Wilkes-Barre can be acquired for the price estimated in the report. In addition, the O&M costs for the recreation facilities, to be managed by the local sponsor, have not been included in the economic cost of the project. This would be an expensive item, probably between $100,000 and $200,000 annually. Other estimates of facilities' costs appear low and should be checked against recent experience in this region on an item by item basis.

c. The recreation use estimates are very high and are at the upper limits of experienced density (users/acre of water and land) and are actually only limited by anticipated gross demand. Any project that is estimated to get more than 50 percent of total future recreation demand is suspect. Demand determination methodologies are frequently gross. Supply is rarely treated adequately in studies. This estimated usage/ * acre would be high in a heavily developed metropolitan area. In the instant case, there is an existing highly developed 1,400-acre reservoir in another watershed of similar size about 40 miles away within 100 miles. The recreation-day value used, $1.15, is low compared to other current Corps project estimates but appears proper in this case as 20 percent of the anticipated activity is expected to be fishing, and 33 percent is expected to be swimming and picnicking.

d. On balance, the soundness of the recreation plan is questionable. The report should verify or rectify all the items mentioned above.

4. The report should discuss how the operation of the reservoir to meet the intended purposes (flood control, recreation, water supply) will affect the potential performance of each purpose. This should be divided into whatever time-phase considered appropriate, since certain purposes, i.e., water supply demand, will not come on line until later years. The purpose of this discussion will be to show, for example, how water level fluctuation prior to and after accommodating (the) future water supply demands will influence anticipated recreational use and fish and wildlife values attributed to the lake. Also, it isn't clear if the body contact recreational use (water contact sports, etc.,) in this small reservoir will be compatible with required water quality standards. It is important to clearly show the interrelated impacts between project activities planned for the project. This type of analysis is totally lacking, or at least it isn't clear, in the current DM.

5. The report should discuss recommendations and concerns voiced by coordinating agencies, particularly those aspects that are not accommodated in the design and operation of the proposed project. For example, the

current DM fails to address several recommendations made by DOI, BCS in their letter dated 16 April 1974 (Exhibit 2).

6. When determining water supply benefits, benefits are determined based on non-Federal financing and interest rates. The water supply alternative cost is computed based on Federal financing and interest rates. Accordingly, line 1 and line 2 of Table 20 under "Local Water Supply," will not be the same.

7. Interest during construction on the water supply feature presented in Appendix IV should be based on the water supply interest rate and not on the project interest rate.

8. Recreation formulation, benefit evaluation, and cost allocations are to be based on PL 89-72. As detailed in the report, the intent is to contract for only the initial recreation development prior to construction and then subsequently build the facilities needed for ultimate attendance with Code 710 funds. Accordingly, all costs and benefits for future development should be omitted from the formulation and benefit evaluation. For example, the B/C ratio of 1.3 includes future benefits but not the costs necessary to achieve these benefits. The same error occurs in Table 20.

9. The recreation design is based on using the top of the conservation pool at elevation 1074.2. This is inappropriate as soon as the water supply storage space comes under contract. Recreation design and withdrawals for water supply and stream flow regulation must be in harmony.

10. There are costs for acquirable recreation lands but no discernible costs for relocations on these lands. These relocation costs should either be included or explained as to why they do not apply.

11. Since the intent is not to have future recreation development a part of the basic plan, Article 3(b) of the draft recreation contract should be deleted and the following substituted therefor:

> "(b) Future Development. Neither party is obligated by this contract to undertake any future development of the project, except to the extent this contract may be so modified by future supplemental agreement signed by the parties and approved by the Secretary of the Army or his authorized representative. If at any time the State wishes to undertake further development of the facilities to be leased to it hereunder, it may do so at its expense provided prior approval of the Contracting Officer is obtained, but the Government shall not be obligated to reimburse the County for any portion of such expense in the absence of a supplemental agreement hereto as aforesaid."

12. Article 3(a) (5) of the draft recreation contract requires the first payment within 30 days of notification. Accordingly, the first payment (Exhibit B) should entirely to principal. The water supply contract (Appendix IV) is computed correctly.

14. The repayment obligation for recreation reimbursement is to consider interest during construction at the water supply interest rate instead of the project interest rate (see Article 3(c)(3) of the draft contract).

15. Although benefits are not claimed nor costs allocated, the function of streamflow regulation should be addressed in Appendix V.

16. [illegible], Page II, 1st full Comment No. 3. We do not concur with this comment. While the intent would be for the non-Federal interest to assume responsibility for all land not required for project works, Section 2 of PL 89-72 appears to provide for local interests to assume responsibility for either recreation or fish and wildlife, or both, provided benefits are realized for justification of the project.

17. The following comments are furnished on the EIS:

a. Page 2, paragraph 2.03 and Page 3, paragraph 2.03.1. The former paragraph states that federally [illegible] occurs on the site while the latter paragraph states that Virginia pine (no loblolly) occurs on the site. The latter statement is inconsistent with the comments of the North Carolina Department of Natural and Economic Resources, dated 7 November 1973. This discrepancy should be corrected.

17. For [illegible] Comments, Reference No. 2, 1st Indorsement. Even though the revised low-flow curves will probably not significantly affect the project feasibility, these revisions should be incorporated with revisions to the subject design memorandum.

18. Pages 3-25 and 26 [illegible] No. 3 and 4. The Phase II General Design Memorandum should present the results of an analysis of spillway design flow. Consider the [illegible] material will be washed from the gully into the river. Due to the 90 degree intersection of the gully with the river, an eddy and flow concentrations will develop along the downstream toe of the dam. The Phase II General Design Memorandum studies should consider the guidance in EM 1110-2-1[illegible] in relation to the outlet works stilling basin design. Early determination of the need for a model study in order to develop a proper design of this feature is encouraged.

DAEN-CR

5 NOV 197[illegible]

SUBJECT: General Design Memorandum - Phase I, Plan Formulation, Reddies River Lake, Yadkin River, North Carolina

Division Engineer
U. S. Army Engineer Division, South Atlantic
Atlanta, Georgia 30303

1. The following items should be included in the agenda for the 13 and 14 November field reconnaissance by [illegible] staff:

a. Meeting with a representative of the State of North Carolina who can discuss the State's official interest in financial participation in the proposed project, and particularly with regard to the water supply features. Special emphasis is attributed to the contents of paragraphs 21 and 23, pages 11 and 12, of subject report.

b. Reconnaissance of the flood plain areas estimated to benefit significantly from the proposed project, to include rural and urban damage centers. Particular items of interest include:

(1) The identification of the flood plains with specific reference to the numbers, types, and values of urban and rural properties;

(2) The specific location of affected agricultural lands; and

(3) A discussion of projected land use and cropping patterns.

c. Inspection of the proposed dam site and discussion of the spillway design and surcharge storage allocation.

d. Inspection of the 275 acres proposed for wildlife mitigation and the lands to be mitigated.

e. Inspection of several regional water related recreation facilities and discussion of relationship of proposed recreation plan to the regional recreation system.

5 NOV 1970

DAEN-PR
SUBJECT: General Design Memorandum - Phase 1, Plan Formulation, Reddies River Lake, Yadkin River, North Carolina

2. In view of the Board's basic concern for equitable and consistent interpretation of policy, staff review is focusing on water supply benefit determination, flood damage estimation, and treatment of mitigation aspects. Other concerns center on the adequacy of the report as a "survey type" report, the lack of application of Principles and Standards, and the absence of information relating the proposed project to a basin plan.

3. Coordination of the staff review and field reconnaissance should continue with Mr. Pappas, telephone (202) 325-7161.

FLOYD E. MORRIS
Acting Resident Member

CF:
Dist Engr, Charleston
DAEN-CWP

SAMGE

22 October 1975
DURRIH/318/jf

MEMORANDUM FOR RECORD
SUBJECT: Roanoke River Basin, Dowtin Lake Project, Tentative Prediction of Remaining Actions on Phase I GDM

1. John Lyon called on 22 October 75 and gave me an estimated schedule for Roanoke River Phase I GDM. He got it from Bill Price after discussion with Bill Price of OCE. The schedule is very tentative. The report had been reviewed by the NCDW staff and sent to OCE previously.

2. Note: I discussed Peddies with Keith Price and Alex Shuman when I was in OCE on 5 Sept on the Little Pee Dee/Lumber River Project matter. At that time Keith was concerned about some comments from NCDW staff on the water supply aspects. I reminded Alex the WS was handled like he suggested to me when I was in OCE earlier. He said he would look into the matter. Apparently he did because OCE supported our report according to John Lyon, information.

3. The tentative schedule for the Phase I GDM is as follows.

a. Report returned to NCDW about a month ago with OCE's backing of water supply computations.

b. NCDW is expected to consider Peddies at next meeting scheduled in Dec 75.

c. Report with NCDW comments back to OCE in January 76.

dd. Coordination by OCE complete by April 76.

e. OCE review complete by June 76.

f. Office, Sec of Army submit to Congress in Aug 76.

4. John speculated that the earliest we might get a go-ahead for Phase II GDM would be after OCE coordination was complete in April 76. However, we could be held up until after Congressional action is complete. If we wait until this happens to start the Phase II then I would guess it would be Nov 76 before we could start Phase II.

JERRY L. DURRIH
Chief, General Engineering Branch

SADPD (25 Mar 75) 1st Ind
SUBJECT: Peddies River Lake, Peddies River, North Carolina Design Memorandum 3 - General Design Memorandum - Phase I, Plan Formulation

DA, South Atlantic Division, Corps of Engineers, 510 Title Building, 30 Pryor Street, S. W., Atlanta, Georgia 30303 23 June 1975

TO: HQDA (DAEN-CWP-B), WASH DC 20314

1. This Phase I GDM addresses changes since authorization of the project as a two-dam plan for flood control that was changed to a single dam plan for flood control in the General Design Memorandum of 1952. Subsequent to those actions, the project was restudied and other purposes (recreation and water supply) were added. Its length and detail of documentation is rather full in consideration of the several significant changes in the project. In our judgment, present policy requires submission of recommendations to Congress for reauthorization of the project. If this analysis is correct, we expect to use the Phase I GDM as the basis for a very brief authorization report.

2. The subject Phase I GDM, Final EIS, and Statement of Findings are forwarded as required by current directives. The report finds that the Peddies Lake project is economically feasible to serve the multipurpose of flood control, water supply, and recreation. A single purpose flood control project, as authorized at this site, would not be economically feasible. Subject to the comments in the following paragraphs and Inclosure 2, the Phase I GDM for Peddies Lake project is recommended for approval as a basis for further preconstruction planning or for preparation of a letter report recommending authorization of the multipurpose project. The present plan includes acquisition of lands at another location for wildlife mitigation. This feature is recommended but it will require authorization by Congress.

3. We have some uncertainty as to the desired level of detail in the Recreation Resources Appendix for Phase I GDMs. ER 1120-2-400 calls for detail somewhat beyond the level of other Phase I planning. However, there is no provision for a continuous planning effort thru Phase I and Phase II with a defined product produced in Phase I. A discontinuous planning effort has obvious money and manpower problems. We believe Charleston District's effort on Peddies is generally of an appropriate level of detail for a Phase I GDM on this project; however, planning will have to be resumed and completed in Phase II studies to produce an Appendix fully responsive to the ER. In our opinion the full planning effort could more advantageously be included in Phase I with the Master Plan itself, produced in Phase II.

SADEN (25 Mar 75) 1st Ind 23 June 1975
SUBJECT: Peddies River Lake, Peddies River, North Carolina Design Memorandum 3,- General Design Memorandum - Phase I, Plan Formulation

4. Of the comments in inclosure 2, we believe that the following must be addressed prior to completing a brief reauthorization project for Congress: 1.c.,e.,g.,j.,o.,p.,q; and 3.b.,c.,e.,e.,i. By copy of this indorsement, the District Engineer is being requested to address these comments and prepare revised or new material as needed. With this clarification, we believe the essential elements to support reauthorization will be available. Other comments will be addressed in continuing work on the EIS, the Phase I GDM and follow-on reports as appropriate.

5. Early consideration of the subject report is requested so that orderly [illegible] of the funds and manpower requirements can be made. The FY 76 and TQ budget includes $150,000 for continuing the pre-construction planning.

4 Incls
wd 3 cys Incl 1
added 3 Incls
2. SPD Comments
3. First EIS (20 cys)
4. SOF (20 cys)

Copy furnished:
HQ, Chief, AFEN: SPCWB-D

CARROLL N. LATHAM
Brigadier General, USA
Division Engineer

SAD COMMENTS
ON
[illegible], N. C.,
[illegible]

1. [illegible]

a. [illegible] a [illegible] be [illegible] all [illegible] pol[illegible] the[illegible], Part 3, Chapter 1.

b. [illegible] lati[illegible] How[illegible] ana[illegible] sho[illegible]

c. [illegible] is [illegible] the[illegible] All[illegible] to [illegible] fea[illegible]

d. [illegible] indi[illegible] in the [illegible]

e. [illegible] North [illegible] are[illegible]

f. [illegible] be [illegible] prop[illegible] However, [illegible] dete[illegible]

g. [illegible] be [illegible] the [illegible] supported, [illegible]

from the State which is erroneously listed in paragraph 72 as dated 1975 instead of 1974, only provides an indication of financial assistance. The State and [illegible] should also concur with the overall scope of the proposed development.

h. Page 29, paragraph 71.c. In the last sentence, change "Appendix II" to "Appendix III".

i. Page 31, paragraph 77.a. In line 19 of this paragraph, the phrase "for pre-[illegible] total. Referenced letter does not include the statement and other portions of the EA contradict this statement.

j. Page 35, paragraph 85. It should be noted that the cost of a multilevel [illegible] included in the cost estimate.

k. Page 37, Table 12. The latest approved estimate (effective date 1 July 1974) should be 1 July 1975.

l. Page 38, Table 13. Future flood control and land enhancement benefits [illegible] at $[illegible],000. The report does not explain where the [illegible] are located in relation to the 100 year flood line. If they are [illegible] the 100 year floodplain line, the benefits are not accepted because of the effects of the Flood Insurance Acts. However, the future benefits can be included from the report without changing the B/C ratio. Projected annual benefits would be $2,157,000 as compared to annual cost of $1,719,000 which would produce a B/C ratio of 1.26 to 1.

m. Page 40, paragraph 93. Justification is needed for the use of $1.15 [illegible]. This should be presented in detail in Appendix III. See Section 5(f) of [illegible] on 28 February 1974 plan formulation meeting.

n. Page 49, Table 16. Total wages to locally unemployed should be $2,036 instead of $2,[illegible].

o. Pages 52 & 53, Table 19. The present worth of $1,771,000 expended 23 years [illegible] is $876,000 instead of $855,000. Interest and amortization of this revised value amounts to $28,000 instead of $50,000. (Also see page 3, paragraph 6.c., Appendix II.)

p. Page 58, paragraph 114c. This paragraph should be reworded as follows:

> Prescribe and enforce regulations on downstream channels to prevent encroachments that would reduce their flood carrying capacity and control development along these channels to prevent an undue increase in flood damage potential.

q. Pages 63 thru 67, Table 23.

(1) Social #4. The number of road miles for alternatives 4, 5, and 6 are needed for comparison.

(2) Social #6. The statement made for alternatives 1 and 2 needs to be revised to say "water oriented" opportunities would be limited.

(3) Social #6. The statement for alternative #5 is incorrect. Recreation opportunities can and should be considered under this alternative.

(4) Social #6 Recommended Plan. The CDM and the Recreation Resource Appendix have reference to 14 access. The 115 says 10 and Table 25 says 8. This must be clarified.

(5) Economic #1. The B/C ratio of all alternatives should be given. The B/C ratio for the recommended plan is incorrect (see page 47 and page 104). The B/C ratio is 1.5 not 1.4.

r. Exhibit 1. Since the letter of 6 September 1973 is missing, there should be a discussion of paragraphs 2 and 3 of the letter either in the main report or Appendix II.

2. Appendix I.

a. Page I-10, paragraph 3.22. Future flood damages to the urban properties are predicted to start when they begin in 1974 rather than in 1982 when the project completes data. However, the benefits are probably underestimated no more than $50,000 which will have no effect on the B/C ratio.

b. Exhibit I-2, Page 3. Another figure should be included in the report showing the overbank damages that will occur in Reach 1 with the river regulated by Lake Scott and Robbins River Lake.

c. Frequency Curves. The frequency curves have been revised and are being analyzed to determine with best actual data. Revised sheets and back-up data will be furnished for 31 Dec 2. The revised curves have been used in analyzing benefits to commercial properties in Reach 1 only since this is the only example shown in the report. The resulting difference amounts to an increase of approximately 31.5 percent. If this increase is assumed to apply to all types of damages in all 5 reaches, benefits to the project will increase from $424,000 to about $555,000 which will change the B/C ratio from 1.5 to 1.4. Accordingly, the use of the revised frequency curves will not significantly affect the project feasibility.

3. Appendix II.

a. Greater detail is required for each proposed recreation area as indicated in ER 1120-2-503, App. B, para. XII. This should include a narrative description of the physical characteristics of the land, the number and kind of recreation facilities planned, and a graphic presentation showing selected land use areas and access roads.

b. The wisdom of encouraging the development of 12 public use areas is questioned. We should not propose to develop more than 5 areas, including the area below the dam, unless the sponsor desires more areas. Reducing the number of areas would certainly cause O&M problems and expenses to be reduced.

c. Page 4, paragraph 18. Sanitary facilities should be costed with complete sewage treatment systems in mind to cover any increase in cost due to soil conditions described in this paragraph.

d. Page 10, paragraph 34. Data on frequency and duration of lake flooding should be provided in an appropriate figure.

e. Page 22, paragraph 39. Paragraph states that these lands will be transferred to the State "by lease". A more desirable procedure and one which must be followed in any new authorization should provide that the lands be conveyed to the State of North Carolina at no cost.

f. Page 23, paragraph 43. The information concerning the land owned by [illegible] and dealt with special interest. No charge is recommended; but as project planning progresses, a firm concept should be obtained from the City and discussions held to check as to whether or not the donation of the lands could be considered as a contribution under the terms of the 50-75 contract.

g. Page 24, paragraph 45a. This paragraph contains a misconception of the provisions of PL 89-72. The Public Law envisions that all lands other than those required for the project works will be leased to the sponsor.

h. Page 25, paragraph 48. Pre real estate acquisition timbering activities have been a historic detriment to proposed recreation lands. The public information program regarding timber purchase is a good idea. Also, quality recreation lands should be considered for first order real estate purchases.

i. Page 28, Table II-11. Site Preparation costs should be reevaluated. Adequate monies should be programmed to insure quality landscape development for recreation access roads, parking areas, buildings, activity areas, dam and dike, etc. Reforestation costs also seem low. Recent experience in Ohio and WV indicates tree seedling planting by landscape contractors cost an average of one dollar per seedling. This portion of the cost estimate should be revised as necessary.

j. Plate 3. This plate indicates that 11 separate public use areas are proposed around the shoreline of this 680-acre lake. From a management standpoint, this number of individual public use areas should be reduced. At W. Kerr Scott Reservoir, which has a surface area of 1,475 acres, only nine (9) areas have been developed, and this is an adequate number of areas to maintain at a reservoir with only 1,475 acres. The number of areas proposed for Laddies Knob Lake should be reduced.

k. Page [illegible], Appendix II.

(1) The [illegible] should be required to review this inclusive carefully, correcting typographical errors as noted. Examples are the improper capitalization of "Act" in the third sentence; the inclusion of the word "for" appearing at the beginning of line four, Article 3; and, the omission of the word "annually" in Article 5a(2).

(2) Article 11. Since the State has been so specific in stating that they will not agree to participate under the contract in fish and wildlife purposes, it is recommended that the reference to fish and wildlife [illegible] be deleted. In this connection, there are other references to fish and wildlife within the contract which conform to the policy stated but are inconsistent with these other references. Article 6, Article 7, Article 8, Article 9, Article 10, Article 12, Article 13, Article 14, Article 15, Article 16, Article 17, Article 18, Article 19, Article 20, Article 21, Article 22, Article 23, Article 24, Article 25, Article 26, Article 27, Article 28, Article 29, Article 30, Article 31, Article

5. FINAL EIS

a. Summary Page, paragraph 2. The first sentence leads one to believe that the project plans and specifications are completed and awaiting funding for construction. This sentence should be rewritten.

b. Page 2, paragraph 1.01. The word "years" should be "yards".

c. Page 4, paragraph 1.04. Reference is made to 10 tracts developed for recreation and 5, tract "I and I" say 11 tracts. This should be clarified. Also, reference is made to the EIS as it has not been approved as a final document and could not be contained in or released prior to a public meeting, as stated on page 1.

d. Page 10, paragraph 2.05. The word "indian" should be "Indian".

e. Page 11, paragraph 3.06. Since blasting of rock will be required for the construction of this project, a discussion of its impact should be included in the EIS.

f. Page 15, paragraph 4.05, last sentence. This is an incorrect statement. Any portion of facilities "Area I" constructed above the flood [illegible] elevation should be revised.

g. Page 16, paragraph 4.06. The fifth sentence in section 1a is deficient discussion. It is stated that reservoirs are not as good or an alternative for flood control. What about water supply, recreation and their impact on the local and natural environment?

h. Page 19, last paragraph on page 5.02, Section 1a should be 1.05.

i. Page 20, 6th line on page 5.03. Preemption of the effect of Section 12 of the [illegible] should be discussed here.

j. Page 24, 7th line on page 7.01, last paragraph on page "NCPPI". See comments 1.g(4) and 2.c dealing with the [illegible].

k. Page 28, 2nd Reference on page 8.0. The complete Proper Name of the "U. S. Fish and Wildlife Service" should be used.

STATEMENT OF FINDINGS
REDDIES RIVER LAKE
WILKES COUNTY, NORTH CAROLINA

1. I have reviewed and evaluated, in the light of the overall public interest, this report concerning the Reddies River Lake, North Carolina project, including the stated views of other interested agencies and the concerned public, relative to various practicable alternatives to meet at all stages the water resource development needs for flood control, as set forth in the Flood Control Act of 1936 (Public Law 74-526). The current studies have also considered a need for municipal and industrial water supply and recreation, which have been included in the proposed plan of development.

2. The possible consequences of these alternatives have been studied for environmental, social well-being, and economic effects, including regional and national economic development and engineering feasibility. An identified public need for the purposes of water resources development was a major factor in the review of these data.

3. In evaluation of the selected and other viable alternatives, the following points were considered pertinent:

a. Environmental. Alternatives having a lesser environmental impact than the recommended plan were not selected because of their impracticality, excessive cost or inadequacy in meeting the water resource needs of the project area. The major environmental impacts of the project include the permanent inundation of 690 acres of land and 5.1 miles of Reddies River by the conservation pool and the temporary inundation of an additional 655 acres of land and 2.9 miles of Reddies River by the flood control pool. The environmental impact associated with building an impoundment on Reddies River is lessened by the fact of the existence of a low dam just below the project damsite.

b. Social well-being. The project will provide for human needs of area residents by the flood control and water supply benefits, and the recreational opportunities that will result from Reddies River Lake. The adverse social impact that will occur from the relocation of persons and property have been accepted.

c. Engineering. Through a comparative engineering and economic analysis, two alternative damsites were considered along with the recommended site. The selected site is the best location considering both engineering and cost comparisons. The quality of rock is essentially the same at all locations, however, the selected site has less severe weathering than the other sites. Several types of dams can be considered at the selected site, while only a compacted earthfill dam could be considered at the other sites.

d. Economic. From the viewpoint of economics, the selection of the damsite was based on the lower construction costs at the recommended site. The proposed dam is at the general location that was recommended in the Definite Project Report, and the other two sites are within 2,000 feet of this site. The Definite Project Report recommended a dam at this general location. Other damsites, more widely separated, were studied in the Definite Project Report, and a location about 1.7 miles above the confluence with Yadkin River was selected. The recommended damsite will require much less resettlement of homesites than either of the other two sites.

e. Other public interest. In addition to providing benefits from the included project purposes, secondary economic benefits will accrue to the region from the development opportunities induced by the project and increased population and employment. It is concluded that the prospective regional benefits are far in excess of the upstream damage and displacement inconveniences and that reasonable real estate and engineering remedies exist for these project caused damages and inconveniences without undue social and economic effects.

4. I find that the action proposed is based on thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objectives, that wherever adverse effects are found to be involved they cannot be avoided by following reasonable alternative courses of action which would achieve the congressionally specified purposes; that where the proposed action has an adverse effect, this effect is either unplanned or substantially outweighed by other considerations of national policy; that the recommended action is consistent with national policy, statutes and administrative directives; and that on balance, the total public interest would best be served by the implementation of the recommendations.

Date

District Engineer

I have reviewed the Statement of Findings and concur with the recommendations of the District Engineer.

24 Jun 75
Date

CARROLL H. DUNN
Brigadier General, USA
Division Engineer

Date

J. W. MORRIS
Major General, USA
Director of Civil Works

DEPARTMENT OF THE ARMY
CHARLESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 919
CHARLESTON, S. C. 29402

SAMGE-D

25 March 1975

SUBJECT: Reddies River Lake, Reddies River, North Carolina Design Memorandum 3 - General Design Memorandum - Phase I, Plan Formulation

Division Engineer, South Atlantic
ATTN: SADVY

1. Transmitted are 23 copies of the subject design memorandum, submitted for approval in accordance with applicable provisions of ER 1110-2-1150, dated 1 October 1971 and SAD Supplement 1 to ER 1110-2-1150. A copy of the transcript of the public meeting held on 5 October 1972 was previously furnished by SAMGE letter dated 31 August 1973, subject as above.

2. The project plan has been appropriately coordinated with all local, State, and Federal agencies having a special interest in the project. This report as submitted contains pertinent documentation of this coordination.

3. In order to maintain the project on the schedule shown on the Network Analysis attached to SAMVG-P letter dated 20 December 1974, SUBJECT: Preconstruction Planning Estimate for Reddies River Lake, North Carolina, authority is requested to proceed with preparation of the Phase II - GDM by 1 July 1975. The start of Phase II by 1 July is considered essential to maintain proper continuity of the planning effort consistent with funding and reasonably assure adequate development of subsequent design in a timely manner preparatory to initiation of construction in FY 79 as scheduled. This request is considered appropriate for the following reasons: (1) the project has been formulated under the close guidance of the Division Office and in accordance with the Plan Formulation Review Conference of 20 February 1974 and SADYR 3rd Indorsement dated 3 April 1974, SUBJECT: Reddies River Lake, Reddies River, North Carolina, Design Memorandum, Phase I, Plan Formulation; (2) the project, by comparison, is a fairly small multi-purpose project with no significant complications; (3) it has overwhelming support of the local people who are openly appreciative of previous Corps work in the area and, (4) no objections to the project have been expressed by environmental groups. It is

SAWGE-D 25 March 1975

SUBJECT: Reddies River Lake, Reddies River, North Carolina Design Memorandum 3 - General Design Memorandum - Phase I, Plan Formulation

also necessary for the orderly conduct of the Phase II preparation that drilling be scheduled as soon as possible to permit its timely and resourceful accomplishment before prohibitive weather conditions develop.

4. This flood control project is presently formulated with two additional purposes, water supply storage and recreation development, that were not originally authorized by the Congress. Appendix V of the subject report highlights the post authorization changes.

5. The final EIS will be submitted by separate correspondence concurrent with this report.

1 Incl
As stated

HARRY S. WILSON, JR.
Colonel, Corps of Engineers
District Engineer

REDDIES RIVER LAKE
REDDIES RIVER, NORTH CAROLINA

DESIGN MEMORANDUM NO. 3
GENERAL DESIGN MEMORANDUM - PHASE I
PLAN FORMULATION

INDEX OF REPORTS

Design Memo No.	Title	Date Submitted	Date Approved
1	Site Selection	May 1972	4 Dec 1972
2	Hydrology and Hydraulic Analysis	Mar 1973	
3	GDM - Phase I	Mar 1975	

REDDIES RIVER LAKE
REDDIES RIVER, NORTH CAROLINA

DESIGN MEMORANDUM NO. 3
GENERAL DESIGN MEMORANDUM - PHASE I
PLAN FORMULATION

SCHEDULE FOR SUBMISSION OF FUTURE DESIGN MEMORANDA

Title	Scheduled Submittal Date
GDM - Phase II	29 Oct 76
N. Wilkesboro Sewerage Facilities Relocations	7 Oct 77
Real Estate, Dam	28 Oct 77
Dam and Spillway	27 Jan 78
Outlet Works	28 Apr 78
Construction Materials	30 Jun 78
Construction Procedure and Diversion Plan	30 Jun 78
Utility Relocations	30 Jun 78
Site Geology	7 Jul 76
Water Quality Equipment	15 Jun 79
Operations and Administration Facilities	17 Aug 79
Real Estate, Reservoir	17 Aug 79
Reservoir Clearing	17 Aug 79
Road Relocations	28 Sep 79
Recreation Facilities	15 Feb 80
Sedimentation Ranges	14 Nov 80
Instrumentation	2 Jul 82
Master Plan	5 Aug 83

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REDDIES RIVER LAKE
REDDIES RIVER, NORTH CAROLINA

DESIGN MEMORANDUM NO. 3
GENERAL DESIGN MEMORANDUM - PHASE I
PLAN FORMULATION

PERTINENT DATA

Authority for Project. Flood Control Act of 24 July 1946 (Public Law 526 - 79th Congress, 2nd Session).

Purpose of Project. To furnish flood protection in the upper Yadkin River at Wilkesboro and North Wilkesboro, North Carolina, and to reduce flood stages downstream along the Yadkin River. The dam and lake project is a unit in the general comprehensive plan for flood control and allied purposes in the Yadkin-Pee Dee River Basin. Other purposes of the project are to provide storage for water supply and a pool for recreation and fish and wildlife activities.

Location of Project. The project is located in northern North Carolina, approximately 50 miles west of Winston-Salem, and about 70 miles north of Charlotte (See Plate 1). The damsite is on Reddies River, 1.7 miles above its confluence with the Yadkin River. It lies immediately upstream of North Wilkesboro, North Carolina, and the project is entirely within Wilkes County (See Plate 2). Access to the right (west) abutment of the dam will be provided by extending and upgrading an existing road from state route 1505 to the dam. Access to the left (east) abutment will be provided by a connection to an existing subdivision street, Coffey Street.

Drainage Area. At damsite - 94.5 square miles
Total Reddies River - 97.0 square miles

Lake Data and Storage Allocations.

Feature	Elev. (ft. msl)	Surface Area (acres)	Total Capacity (ac. ft.)	Allocated Capacity (ac. ft.)	Runoff (inches)
Top of dam	1140.0	2175	110,640		
Max. water surface	1134.8	2020	99,740		19.79
				41,390	
Top flood control pool	1110.0	1335	58,350		
				35,000	6.95
Top conservation pool	1074.2	680	23,350		
Water supply				18,400	3.65
Streamflow regulation				600	0.12
Sediment pool	1029.8	205	4,350		0.86
Streambed	975.0				

Dam.

a. Embankment.	
Type	Rolled earth
Top Elevation	1,140 feet
Maximum Height	165 feet
Length	960 feet
Top Width	30 feet
b. Spillway.	
Type	Uncontrolled Chute
Crest Elevation	1,110 feet
Bottom Width	250 feet
Protection for Crest	Concrete sill
c. Outlet Works.	
Type of intake	Multi-level
Type conduit	Reinforced concrete
Size conduit	9 foot diameter
Conduit capacity at 1110.0 feet	3,440 cfs
Land Acquisition.	
Fee (excluding recreational lands)	3,220 acres
Recreational lands	542 acres
Wildlife mitigation	275 acres
Relocations.	
a. State Highways	
Existing	0.75 miles
b. Utilities	
Electric transmission line (115 kv)	2,000 feet
Electric distribution lines	2,000 feet
Sewer pump stations	4 units
Sewer force mains	3,900 feet

c. Construction of the lake will also require removal or abandonment of electric distribution and telephone lines. Gravity sewer lines will be abandoned in connection with pump station relocations. There are no known cemeteries within the reservoir area.

Public Access.

Recreation areas	12

Lake Clearing.

Area	700 acres

Local Cooperation. No local cooperation was required in the project document. Local cooperation will now be required for inclusion of water supply storage and recreation development in the project. Local cooperation will be as specified in the Water Supply Act of 1958 (Title III, Public 85-500) and Federal Water Project Recreation Act (Public Law 89-72).

Hydroelectric Power. None

Estimate of Project First Costs.

01.	Lands and damages	$ 2,760,000
02.	Relocations	780,000
03.	Reservoir	580,000
04.	Dam and appurtenances	10,980,000
08.	Roads	252,000
14.	Initial recreational facilities	3,063,000
19.	Buildings, grounds, and utilities	280,000
20.	Permanent operating equipment	135,000
30.	Engineering and design	1,860,000
31.	Supervision and administration	1,190,000
	Total project first cost	$ 21,880,000

Annual Economic Charges - Total $ 1,710,000

Annual Benefits.

Flood Control	424,000
Water supply	1,023,000
Recreation	665,000
Redevelopment	144,000
Total	2,256,000

Ratio, Benefit to Cost. 1.3

REDDIES RIVER LAKE
REDDIES RIVER, NORTH CAROLINA

DESIGN MEMORANDUM NO. 3
GENERAL DESIGN MEMORANDUM - PHASE I
PLAN FORMULATION

DESCRIPTION OF PROJECT AREA

1. Geographic location. The project is located in northern North Carolina, approximately 50 miles west of Winston-Salem, and about 70 miles north of Charlotte (see Plate 1). The damsite is on Reddies River, 1.7 miles above its confluence with the Yadkin River (See Plate 2). The reservoir area lies entirely in Wilkes County. The largest community in the area is North Wilkesboro, which is adjacent to the damsite.

2. Economic and social development in the project area. The greatest economic and social influence from Reddies River Lake would be in Wilkes County, North Carolina. The other North Carolina Counties whose economy would be influenced by water resource conservation development in the upper Yadkin River Basin are Davie, Davidson, Forsyth, Surry, and Yadkin. The dependence of the economy of this area on agriculture is declining as employment in manufacturing, nonagriculture, and nonmanufacturing activities are growing rapidly. Population is shifting from rural to urban areas as a result. See Table 1 for present and projected population of the area. Urban population in 1970 was about 44 percent of the total six-county population of 454,368. The employment mix in 1970 was about 40 percent in manufacturing, 5 percent in agriculture, and 55 percent in all others, such as service, government, transportation, retail, and wholesale sales. Additional discussion of the economy of the area and also of flood damages and benefits downstream from the project are contained in Appendix I, Flood Damages and Benefits.

3. The Yadkin River flood plains for about 60 miles downstream from the project site are comparatively narrow until the river turns to the south and becomes the western boundary of Forsyth County. In its next 70 miles, the flood plains widen considerably and are more extensively used for agriculture than in the upper area. The urban areas of Wilkesboro, North Wilkesboro, Elkin, and Jonesville, N. C. are subject to flood damage. Forsythe County and the city of Winston-Salem have needs for storage of surface water for future water supply.

4. Description of Reddies River Basin. Reddies River, a southeastward flowing tributary of the Yadkin River, has a drainage area of 97 square miles. The Reddies River Basin is somewhat fan-shaped being about 19 miles in length with maximum width in the upper portion of the basin of about 10 miles. Streams within the basin are bounded by steep, heavily wooded terrain, with limited bottom lands.

5. Reddies River is formed by the confluence of the South Fork and Middle

TABLE 1

POPULATION TRENDS
SIX-COUNTY AREA IN UPPER YADKIN RIVER BASIN

County	Actual		Projections		
	1960	1970	1980 1/	2000	2020
Davie	16,728	18,855	22,500	29,000	38,500
Mocksville	(2,379)	(2,529)			
Davidson	79,493	95,627	118,000	171,000	237,000
Lexington	(16,093)	(17,205)			
Thomasville	(15,190)	(15,230)			
Forsyth	189,429	214,348	257,500	352,000	481,500
Winston-Salem	(111,135)	(132,913)			
Kernersville	(2,942)	(4,815)			
Surry	48,205	51,415	56,600	72,500	94,000
Elkin	(2,868)	(2,899)			
Mount Airy	(7,055)	(7,325)			
Pilot Mountain	(1,310)	(1,309)			
Wilkes	45,269	49,524	55,500	65,800	81,500
North Wilkesboro	(4,197)	(3,357)			
Wilkesboro	(1,568)	(1,974)			
Yadkin	22,804	24,599	27,500	35,000	45,500
Jonesville	(1,895)	(1,659)			
Yadkinville	(1,644)	(2,232)			
TOTAL	401,928	454,368	537,600	725,300	978,000

1/ OBERS projections, based on Census C projections.

Fork above the point where North Fork enters the main stem (see Plate 1). Each of these three tributaries rise in the Blue Ridge Mountains at elevations of 4,000 to 3,700 feet where they decend rapidly to 2,000 feet, generally in a distance of less than three miles. Stream slopes then become progressively flatter until they attain a slope of about 18 feet per mile for an 18 mile reach upstream of the Reddies River damsite. Reddies River bed has an elevation of 975 feet at the damsite and an elevation of 944 feet at its junction with Yadkin River. Together the South, Middle, and North Forks drain more than 60 percent of the total drainage area of the Reddies River Basin.

PROJECT AUTHORIZATION

6. Project authorization. The Reddies River Lake project was authorized by Congress in the Flood Control Act of 24 July 1946 (Public Law 526-79th Congress, 2nd Session) which reads in part as follows:

> "the project for the construction of four detention reservoirs at the Wilkesboro, upper Wilkesboro, Reddies No. 1 and Reddies No. 3 sites is hereby authorized substantially in accordance with plans contained in the report of the Chief of Engineers dated June 19, 1946, with such modifications thereof as in the discretion of the Secretary of War and the Chief of Engineers may be advisable, at an estimated cost of $7,194,000." (The 1946 report was modified and approved by Congress in Senate Document No. 31, 81st Congress, 1st Session.)

7. The Chief of Engineers in House Document No. 652, 78th Congress, 2d Session, recommended that the general plan of development outlined in the report of the Division Engineer be adopted as the basis for improvement, step by step, of the Yadkin-Pee Dee River and tributaries for flood control, navigation, and other purposes, and that the Wilkesboro project be authorized for construction as the initial step, generally in accordance with the plans of the District Engineer. The report of the Division Engineer recommends that the Wilkesboro development be provided as a flood control measure with incidental power; and that Tuckertown, Junction, Morven, Greater Blewett, and Crump's Ford be constructed for power development in the order named, as and when the costs of the developments can be justified.

8. Senate Document No. 31, 81st Congress, 1st Session, dated 21 March 1949, revised the recommendations of the Chief of Engineers and the Board of Engineers for Rivers and Harbors contained in House Document 652. This recommendation called for deleting therefrom the dual-purpose reservoir at the Wilkesboro site, and including in lieu thereof, four detention reservoirs for flood control only at the Wilkesboro, upper Wilkesboro, Reddies No. 1 and Reddies No. 3 sites in accordance with plans for these reservoirs outlined under Plan III-b in the report of the District Engineer as modified by the changes suggested by the Division Engineer, with such modifications as in the discretion of the Secretary of War and the Chief of Engineers may be advisable.

9. Project document plan. In Fiscal Year 1948 advance planning was started on the Reddies River portion of the authorized plan. In that planning the two Reddies River dams authorized in 1946 were combined for greater economy into one dam at a site near the mouth of Reddies River. A definite project report on the single dam was submitted in March 1950, however, the estimated benefits were less than the project cost and the project was classified as "inactive." The plan in the definite project report includes a rolled earthfill dam 152 feet high at mile 1.72 (drainage area, 94.5 square miles) to store about 44,100 acre-feet of water. Of this total, 40,200 acre-feet would be for flood control and 3,900 acre-feet for conservation and dead storage. The area of the conservation pool was to be 190 acres. The plan included an uncontrolled spillway and an outlet tunnel discharging in the spillway downstream of the crest; and flows were to be controlled by a single-level control structure. The latest estimated cost of the project under the definite project report plan is $11,500,000 (July 1974 price levels).

10. Authority for plan formulation design memorandum. Preparation of the plan formulation design memorandum on the Reddies River Lake Project was authorized by DAEN-CW (SANGP, 11 July 69) second indorsement. This letter approved the reclassification of the project from "deferred-for-restudy" to "active" status.

CURRENT NEEDS AND DEVELOPMENT OBJECTIVES

11. General. The water resources conservation needs of the Upper Yadkin River Basin were investigated for the report "Development of Water Resources in Appalachia" dated December 1969, prepared by the Office of Appalachian Studies for the Appalachian Regional Commission. Investigations determined that there are unfilled water resource conservation and development needs for flood control, water supply, water quality control, general outdoor recreation, and fish and wildlife conservation. Needs were redetermined and re-evaluated during the preparation of this design memorandum. These needs and the desires of local interests are discussed in the following paragraphs.

12. Desires of local interests. Continued interest in the authorized Reddies River Lake has been evidenced on numerous occasions during the past several years. In a public hearing held during the early stages of the Yadkin-Pee Dee River Basin Study at Winston-Salem on 21 January 1965, the Mayor of North Wilkesboro urged the construction of Reddies River Lake. A public hearing was held on 4 January 1968 in Winston-Salem, North Carolina, in connection with Appalachian Sub-Region D, proposals with particular emphasis on development of the Upper Yadkin River. Widespread support for the early construction of Reddies River Lake was voiced by most interests in the upper Yadkin River Basin. No opposition was voiced but numerous interests in the Winston-Salem area requested that the upper Donnaha site be given a higher development priority than the Reddies River Lake Project. The

North Carolina Electric Membership Corporation also requested prior consideration of main stem sites rather than tributary sites. Another public meeting, held at Wilkesboro, North Carolina on 5 October 1972, in connection with the preparation of this design memorandum was attended by 112 persons. A large number of those in attendance took this occassion to express support for the Reddies River Lake Project and there was substantially no opposition.

13. Flood control needs. Flood control, in addition to that provided by the W. Kerr Scott Reservoir, is needed in the Yadkin River between the W. Kerr Scott Dam and High Rock Reservoir. Estimates of flood control needs presented in this memorandum are based on current detailed flood damage appraisals of urban development and a thorough sampling of losses in the rural areas. Data were obtained from aerial photographs, maps, interviews with farmers and landowners within the flood plain, County Extension Chairmen, State and Federal agricultural workers, industrial plant managers, owners of businesses, real estate agents, and city and county officials whose jurisdiction or interests are affected by the flood problem.

14. Extent and character of the flooded area. The flood plain area downstream from the authorized Reddies River Lake contains the urban areas of Wilkesboro and North Wilkesboro, at the mouth of Reddies River, and Elkin and Jonesville, approximately 26 miles downstream. Agricultural use is made of each of the flood plain reaches lying between W. Kerr Scott Reservoir and High Rock Lake. Major agricultural activities, however, are located in the flood plains of Davie, Davidson, Forsyth, and the eastern portion of Yadkin Counties. Predominant crops include corn, soybeans, and small grain. Other crops include tobacco, truck, and pastures for grazing and hay production. The record 1940 flood inundated about 29,000 acres of land and would cause extensive damage if it were to recur today. Estimates of the present day effect of floods of the magnitude of the August 1940 event and a 200-year frequency event are presented below. Data reflects both unregulated conditions and conditions which would exist with flows properly regulated by the W. Kerr Scott Reservoir Project which became operational in August 1962. A breakdown of land use by reaches is shown in Table I-2, Appendix I, Flood Damages and Flood Control Benefits.

15. Flood losses. Flood damages are classified as urban and rural. Urban damages include tangible physical and business losses to commercial, industrial, and residential property, to utilities, railroads, streets, bridges, and public property. Rural damages include losses to crops and such non-crop losses as loss of livestock, damage to rural buildings, and on-farm fixed improvements such as fences, farm roads, farm drainage systems, etc. Rural nonagricultural losses include damage to railroads, highways, and roads, industrial and commercial establishments in rural areas, and other non-farm rural buildings and installations.

TABLE 2

PRESENT DAY EFFECTS OF FLOODS OF SELECTED MAGNITUDE

Area Flooded In 1,000 Acres	August 1940 Flood	200-Year Frequency Flood
Agricultural Lands:		
Unregulated	13.2	13.9
Regulated	10.2	12.3
Total Lands:		
Unregulated	29.2	33.6
Regulated	19.5	25.6
Flood Damages in $1,000:		
Urban:		
Unregulated	30,200	28,500
Regulated	11,300	11,900
Rural:		
Unregulated	3,300	4,200
Regulated	1,400	2,400
TOTAL:		
Unregulated	33,500	32,700
Regulated	12,700	14,300

16. Summary of flood damages evaluation studies. Table 3 summarizes the results of the flood damage evaluation studies, the details of which are presented in Appendix I. Tabulated data reflects both current (1974) flood plain development and projected development 50 years hence. Average annual damages, based on a 100-year period of evaluation are also shown. Estimated future flood damages are discounted to present worth values based on assumptions of future growth anticipated for the next 50 years without additional improvements for flood control, keeping the same level of development from that point to the end of the 100-year period. A detailed breakdown of flood damages by category and reach is shown in Table I-6, Appendix I.

17. Water supply needs. There is usually an abundance of water available throughout the upper Yadkin River Basin to provide for present needs; however, during dry periods, water shortages do occur in portions of the basin. The growth of basin population, the increasing rate of per capita consumption, and the requirements necessary to meet

TABLE 3

SUMMARY OF AVERAGE ANNUAL FLOOD DAMAGES
UPPER YADKIN RIVER BASIN
WITH W. KERR SCOTT DAM AND RESERVOIR OPERATIONAL
(July 1974 Price Levels)
(Values in $1,000)

Stream Reach[2/]	Current Flood Plain Development			Flood Plain Development 50 Years Hence			Average Annual Equiva Flood Damages (100-Year Period)[1/]		
	Rural	Urban	Subtotal	Rural	Urban	Subtotal	Rural	Urban	Total
Yadkin River									
1	22	141	163	34	182	216	26	154	180
2	38	191	229	58	286	344	45	224	269
3	29	0	29	43	0	43	34	0	34
4	52	0	52	73	0	73	59	0	59
5	222	0	222	342	0	342	262	0	262
TOTAL	363	332	695	550	468	1018	426	378	804

1/ 5 7/8 percent discount interest rate.
2/ Stream reaches are shown on Figure I-1, Appendix I.

industrial expansion have caused an increase in the use of the water resources of the basin. More efficient use of the basin's water resources will be required to meet these increasing needs.

18. Public water supplies. Public water supplies, such as those maintained by cities, towns, and water districts, include water for domestic, commercial, industrial, public, and municipal use. In 1970, there were 14 public water supply systems in the basin between W. Kerr Scott Dam and Reservoir and High Rock Lake. Of these, twelve systems currently use surface water as a source of supply. These 14 systems served an estimated 240,800 people with an average of 49 million gallons of water per day. Data for 1970 on these public water supply systems is shown in Table 4.

19. Projected water supply needs. Studies of projected needs indicate that water supply systems in Davidson and Forsyth Counties will require additional storage to supply their future needs. An estimate of future needs for these areas is shown in Table 5.

a. Water supply needs of the Winston-Salem SMSA (Forsyth County) are used as a base for this county since projected urban growth is expected to develop Forsyth County to such a degree that much of the area will of necessity, require municipal water service in the interest of public health. Projected estimates of population served are based on OBERS projections. Projected per capita water use rates are based on data contained in the state of North Carolina Water Plan and other studies. The projected industrial water supply demand was developed by Charleston District personnel in cooperation with the Office of Water and Air Resources, North Carolina Department of Natural and Economic Resources.

b. Davidson County currently has three systems withdrawing water from the basin above High Rock Lake. These systems are at Lexington and Thomasville, which utilize a common reservoir on Abbotts Creek, and the North Davidson Water, Inc. which serves the western half of presently rural Davidson County. Projected population growth in the county is expected to develop the county as an urban area and a similar situation will develop with respect to a requirement for municipal type water service in the interest of public health, though at a somewhat slower rate than Forsyth County.

20. A summary of gross needs, existing supply, and net needs of the above discussed systems within the basin are shown in Table 6. It is estimated from the foregoing data that additional storage for water supply purposes in Forsyth and Davidson Counties would be required between the years 2000 and 2010.

TABLE 4

PUBLIC WATER SUPPLY SYSTEMS
UPPER YADKIN RIVER BASIN

County - Town	Population Served	Average Use mgd	Average Daily Use gpcd	Source
Davidson County				
Lexington	25,000	4.10	164	Abbotts Creek
Thomasville	18,500	2.41	130	Abbotts Creek
North Davidson Water, Inc. (Rural)	19,200	0.70	37	Yadkin River
Davie County				
Mocksville	4,500	0.40	89	Hunting Creek
Forsyth County				
Kernersville	5,000	0.80	160	Harmon Mill Creek
Rural Hall Sanitary District	2,300	0.13	57	3 Wells
Winston-Salem	140,000	32.26	230	Salem Creek and Yadkin River
Surry County				
Elkin	3,000	0.63	215	Elkin River
Mount Airy	7,000	2.73	390	Lovills & Stewart Creeks
Pilot Mountain	1,600	0.75	469	Toms Creek
Wilkes County				
Wilkesboro	2,800	2.49	889	Yadkin River
North Wilkesboro	6,700	1.18	176	Reddies River
Yadkin County				
Jonesville	2,200	0.22	100	Yadkin River
Yadkinville	3,000	0.13	42	7 Wells
TOTAL	240,800	48.93	203	

TABLE 5

WATER SUPPLY NEEDS
UPPER YADKIN RIVER BASIN

Year	Population Served 1000 People	Municipal Commercial gpcd GAL	Total Mun.-Com. Use MGD	Industrial Use MGD	Total Needs MGD
		WINSTON-SALEM SMSA (FORSYTH COUNTY)			
1970	140	109	15.2	17.1	32.3
1980	197	125	25	26	51
2000	301	180	54	72	126
2020	433	220	95	144	239
2030	511	230	118	172	290
		LEXINGTON AND THOMASVILLE			
1970	43.5	69	3	3.6	6.6
1980	58	110	6	5	11
2000	84	180	15	12	27
2020	161	200	32	24	56
2030	183	210	39	30	69
		NORTH DAVIDSON WATER, INC. DAVIDSON COUNTY			
1970	19.2	37	0.7	0	0.7
1980	21	100	2	2.5	4.5
2000	31	150	5	7	12
2020	43	180	8	14	22
2030	50	200	10	20	30

TABLE 6

SUMMARY OF WATER SUPPLY NEEDS
UPPER YADKIN RIVER BASIN

Year	1/ Gross Needs MGD	Supply MGD	Net Needs MGD
1970	39.6	238 2/	0
1980	66.5	238	0
2000	165	238	0
2020	317	238	79
2030	389	238	151

1/ Summation of needs developed in Table 5.
2/ The dependable yield of the Yadkin River, with W. Kerr Scott Dam and Reservoir estimated at 228 MGD and of Abbotts Creek at 10 MGD.

21. The municipalities of Greensboro, High Point, Asheboro, Burlington, and Graham in the adjacent upper Cape Fear River Basin will face possible water supply shortages by the year 2000. Potential solutions to these water supply problems include diversion from either the adjacent upper Yadkin River Basin or the Dan River Basin to the north. The state of North Carolina, Department of Natural and Economic Resources, Office of Water and Air Resources, in its water plan, progress report, Chapter 27, Cape Fear River Basin, January 1972, further discusses the above comments and suggests that the water supply system of the above named cities should be interconnected with the Yadkin River Basin cities of Winston-Salem and Thomasville and other cities outside the basin in order to develop a unified water service area which would better meet the future water supply needs of the highly developed area known as the Piedmont Crescent, which extends from Gastonia on the west to Raleigh on the east. Implementation of the above plan would involve difficult engineering, legal, institutional, and socioeconomic problems. However, in view of the large projected region wide water supply needs, solutions to the above listed problems would be arrived at and the water resources of all basins would be utilized on a region wide basis rather than the present restrictive basin wide basis. In view of the foregoing, it is estimated that the water supply storage in Reddies River Lake, if constructed, would be needed and utilized by the year 2005.

22. Although Table 6 does not show a need for additional water supply until between the years 2000 and 2020, the State of North Carolina has indicated its intent to begin payment of the costs allocated to water supply upon completion of construction. The state's willingness to start repayment of water supply costs immediately after project completion is necessary in order to claim full benefits for the total water supply storage. Full water supply benefits are essential to project feasibility. Water supply storage for future needs would limit the water supply benefit, resulting

in an infeasible project. The state recognizes that the number of potential damsites is rapidly decreasing due to increased development, and the state wishes to insure that Reddies River Lake will be built.

23. Water quality control needs. Reddies River, from its source to the North Wilkesboro Water Supply Dam, has been classified as a class A-II stream. The tributaries of Reddies River and Reddies River from the North Wilkesboro Water Supply Dam to the Yadkin River have been classified as class C streams. These stream classifications are shown in Table II-5 of Appendix II, Recreation Resources. Yadkin River has been classified as a class A-II stream from W. Kerr Scott Reservoir to High Rock Reservoir. Muddy and Salem Creeks (tributaries of the Yadkin River) have been classified as class D streams. These stream classifications are shown in Table 4 of Appendix III, Upper Yadkin River Basin Water Quality Study. A brief explanation of the best usage of water for the various stream classifications is as follows:

A-II - Source of water supply for drinking, culinary or food-processing purposes and any other best usage requiring waters of lower quality.

B - Bathing and any other best usage except as a source of water supply for drinking, culinary or food-processing purposes.

C - Fishing, boating, wading and any other usage except for bathing or as a source of water supply for drinking, culinary or food-processing purposes.

D - Agriculture, industrial cooling and process water supply, fish survival, navigation, and any other usage, except fishing, bathing, or as a source of water supply for drinking, culinary or food processing purposes.

Dissolved oxygen and temperature standards for the different stream classifications are shown in Table 7 below.

TABLE 7

DISSOLVED OXYGEN AND TEMPERATURE STANDARDS

Stream Class	Dissolved Oxygen	Temperature
A-II	Not less than a daily average of 5.0 mg/l with a minimum of not less than 4.0 mg/l	Not to exceed 5°F. above the natural water temperature, and in no case to exceed 84°F. for mountain waters
B	Not less than a daily average of 5.0 mg/l with a minimum of not less than 4.0 mg/l	Not to exceed 5°F. above the natural water temperature, and in no case to exceed 84°F. for mountain waters

TABLE 7
(Continued)
DISSOLVED OXYGEN AND TEMPERATURE STANDARDS

Stream Class	Dissolved Oxygen	Temperature
C	Not less than 6.0 mg/l for natural trout waters; 5.0 mg/l for put-and-take trout waters; not less than a daily average of 5.0 mg/l with a minimum of not less than 4.0 mg/l for non-trout waters	Not to exceed 5°F. above the natural water temperature, and in no case to exceed 84°F. for mountain waters. The temperature of natural trout waters shall not be significantly increased due to the discharge of heated liquids and shall not exceed 68°F.; however, the temperature of put-and-take trout waters may be increased by as much as 3°F. but the maximum may not exceed 70°F.
D	Not less than 3.0 mg/l	Not to exceed 5°F. above the natural water temperature and in no case to exceed 84°F. for mountain waters

24. The Environmental Protection Agency re-evaluated the need for providing storage for the augmentation of low-flows in the Yadkin River. Their report included as Appendix III, concentrated on two areas of potential water quality degradation: (1) the influence of the city of Winston-Salem wastes on the water quality of the Yadkin River and (2) the nutrient enrichment of High Rock Lake due to the phosphorus and nitrogen discharges from all waste sources in the basin. The results of these investigations indicated that due to the availability of adequate waste treatments techniques at the source, there is no need for reservoir storage for downstream water quality control in the upper Yadkin River Basin.

25. Regulation of streamflow. North Carolina state law requires a release from impoundments equivalent to or greater than the 7-day, 10-year low-flow in the tailwater area. A storage of 600 acre-feet has been provided to assure a minimum release of 36 cfs in accordance with the above stated requirement.

26. The advisability of providing storage for additional downstream flow above State requirements were considered for the project. There is no demonstrated need or justification for providing this additional storage in the interest of esthetics or to support recreational needs except as may be required to enhance the fish and wildlife habitat as discussed below.

27. The U. S. Bureau of Sport Fisheries and Wildlife recommended in their detailed report (Exhibit 2) that an instantaneous minimum release of 36 cfs be provided at project cost to preserve minimum downstream fish habitat.

28. General recreation needs. The need for additional water oriented recreational opportunities in the upper Yadkin River Basin was investigated for this memorandum. The results which also considered the recommendations of USBSF&W (Exhibit 2) are included as Appendix II, Recreation Resources. About 274,000 people now reside in the eight-county day use recreation market area of Reddies River Lake. The anticipated growth of population in the market area will cause an expanding need for water oriented recreation facilities. Recreation needs are projected to increase from about 1,640,500 annual recreation days in 1980 to about 2,541,500 in 2020. There are several recreational areas within the project market area. However, there are only three significant lakes providing water based recreation facilities within the market area. They are the Corps of Engineers' W. Kerr Scott Dam and Reservoir and Duke Power Company's Lake Hickory and Rhodiss Lake. The extent of development at the two Duke Power lakes is not considered sufficient to have an impact on the recreational demand at Reddies River Lake. The existing facilities at W. Kerr Scott is expected to receive about 1,100,000 annual visitors or about 67 percent of projected 1985 demand and only about 43 percent of projected 2020 demand.

29. The existence of adequate recreational facilities is a very important factor in determining the economic growth potential of an area. Extensive studies made by various state and Federal agencies reveal a surprising uniformity in the range of outdoor interests and in the popularity of the various forms of outdoor recreation. Picnicking, swimming, fishing, and boating generally head the list of activities requiring personal participation, with hiking, hunting, and camping following in that order of popularity. The principal recreation interests are directly concerned with the availability of suitable bodies of water, such as Reddies River Lake would provide for recreational purposes.

30. Fish and wildlife needs. Fishery resources in the upper reaches of Reddies River consist primarily of cold water species such as rainbow trout, while the lower reaches provide habitat for warm water species such as small mouth bass, rock bass, bluegill, catfish, and suckers. The North Carolina Office of Fisheries and Wildlife Resources stocks adult trout in the upper reaches, which would be above Reddies River Lake. Present fishing pressure is considered moderate for both cold and warm water species throughout the stream run. Wildlife consists of low to moderate populations of forest and farm game species such as deer, rabbit, squirrel, fox, raccoon, opossum, grouse, quail, and dove. Hunting pressure in the affected area is moderate. Most losses of stream fishing would be replaced by reservoir fishing which would have much greater productivity and utilization. As recommended by the U. S. Bureau of Sport Fisheries and Wildlife (Exhibit 2), the losses in hunting opportunity due to project implementation would be mitigated by purchasing, at project expense, 275 acres of land adjacent to the Thurmond Chatham Wildlife Management Area. This land would be made

available to the North Carolina Wild[illegible]ources Commission for intensive wildlife management purpo[illegible]e Bureau's National Reservoir Research Program estimated in their [illegible] (Exhibit 3) the number of annual angler days that could be expected at Reddies River Lake.

31. Navigation. There is an authorized but inactive navigation project which provides for a channel 2½ feet deep for a distance of 33½ miles above the railroad bridge at the head of High Rock Lake near Salisbury, North Carolina. Abandonment of this project was recommended in House Document No. 467, 69th Congress, 1st Session, 1926. There is no demonstrated need or justification for navigation on the Yadkin River above High Rock Lake. No prospects for movements of commerce on the upper Yadkin River is known of at this time.

32. Hydroelectric power. Most of the electrical generating capacity and energy in the basin is now produced by steam. The basin needs for electrical power are expected to increase 14 times present use by 2020. However, no potential hydroelectric power project in the basin is economically feasible at this time. There would be a market for any power that Reddies River Lake could produce, but the inclusion of hydroelectric power in this project was found by the Federal Power Commission to be economically infeasible at this time.

33. Development objectives. Additional flood control storage is needed in the Yadkin River Basin to supplement the limited control provided by the W. Kerr Scott Dam and Reservoir in the headwaters of the Yadkin River. It was found in the Appalachian studies of this basin that the authorized Reddies River Lake would be an economically feasible project which would provide flood control, water supply, water quality control, general outdoor recreation, and fish and wildlife conservation. Conclusions reached in that study were that Reddies River Lake should be the next major water resource development constructed in the basin, and that it should be followed closely by Roaring River Reservoir, and that Mitchell and Fisher River Reservoirs should be deferred for future study. The primary reason for the recommended delay of the latter two projects is that the combination of W. Kerr Scott, Reddies River, and Roaring River could meet all presently identifiable water needs, except recreation, until about 2010. Another reason for the recommendation was that the recommended system would give a high degree of flood protection to the towns of Wilkesboro, North Wilkesboro, and Elkin-Jonesville, North Carolina, which experience heavy and persistent flooding. The towns could economically develop the scarce relatively level flood free areas created by the three reservoir system, which also could provide some of the other water resource conservation needs of the basin. The justification of the above conclusions has been reinvestigated in the preparation of this memorandum. Those conclusions have been found to be essentially valid except that water quality control as currently defined is not needed in the upper Yadkin River Basin at this time.

ALTERNATIVE SOLUTIONS CONSIDERED

34. General. The range of alternatives for meeting the basin's water needs varies from mutually exclusive alternatives of structural versus nonstructural measures to a system of complementary measures which includes both structural and nonstructural components. A legitimate recommendation should place relevant alternatives in a system which would provide positive net benefits to the nation and to the region. The various methods considered to meet the water resources conservation development needs of the upper Yadkin River Basin are discussed in the following paragraphs. Detailed cost comparisons are discussed in the Plan Formulation Section, beginning with paragraph 62.

35. Structural alternatives. The possibility of local flood protection works including levees, floodwalls, or conveyance improvement appear limited in the upper Yadkin River Basin because of the dispersed developmental pattern along the river. Protection of urban areas only would leave rural developments unprotected. The levees and floodwalls required to protect urban areas would have to extend sufficiently to provide room for projected growth. In relatively intensively developed areas, levees and floodwalls would require land which could be otherwise developed, resulting in more extensive land use over a greater area. With the existing W. Kerr Scott Reservoir, in operation, the additional protection afforded by Reddies River Lake would provide a high degree of flood protection to Wilkesboro and North Wilkesboro and a moderate degree of protection to Elkin and Jonesville, and reduce flood damages to rural development and transportation routes downstream to High Rock Lake. The additional protection that would be afforded by Roaring River Lake, recommended in the report "Development of Water Resources in Appalachia" would provide a high degree of protection to Elkin, Jonesville, and the intervening reach while greatly reducing damages to rural developments and transportation routes downstream to High Rock Lake.

36. Multiple-purpose lake projects. Several adequate sites for the development of surface water storage for water resource conservation development purposes exist throughout the basin. Five multiple-purpose lake sites, the Reddies River, Roaring River, Mitchell River, Fisher River, and upper Donnaha Projects were studied individually and in combination. These sites are shown on Figure I-1, Appendix I, Flood Damages and Flood Control Benefits.

a. Flood control storage. Adequate capacity exists in the above-mentioned multiple-purpose lake sites for the inclusion of flood water storage to provide significant flood stage reduction below each considered lake.

b. Water supply storage. The conservation of surface water by the use of lake storage is the most economical means of increasing the dependable municipal and industrial water supply in the upper basin. A dependable supply of municipal and industrial water to satisfy both present and future needs could be made available through the development of multiple-purpose lake storage projects.

c. Water quality control storage. Supplementary control of residual wastes in a stream by use of surface water storage in lakes was investigated by the Environmental Protection Agency. They found that though this storage could be used to augment low streamflows to increase waste assimilative capacities, it was not needed due to the availability of adequate waste treatment techniques at the source.

d. Regulation of streamflows. A release from impoundments equivalent to or greater than the 7-day, 10-year low-flow in the tail water area is required by North Carolina State laws. Storage to provide for greater releases may be provided under provisions of the Federal Water Pollution Control Act Amendments of 1972 in the interests of recreation including small boat navigation, for enhancement of fish and wildlife habitat, and for esthetic purposes in reaches below the project. However, no justification has been found for regulation of streamflows in the interest of recreation including small boat navigation, or for esthetic purposes. The U. S. Fish and Wildlife Service, in cooperation with the U. S. Geological Survey and the North Carolina Wildlife Resources Commission, made a low-flow study of Reddies River below the damsite. This study concluded that a release of 36 cfs (7-day, 10-year flow) would provide minimum fish habitat conditions in the downstream area.

e. Recreation. The construction of surface water storage lakes in the basin would be a major factor toward providing some of the necessary resources for fishing, swimming, camping, boating, and other water related recreational activities.

f. Fish and wildlife. Fish and wildlife conservation needs can be alleviated by the creation of new fisheries, increased utilization of existing fisheries, and conservation and improvement of wildlife habitat. Reduced pollution and an increase in low-flows as provided by multiple-purpose lake projects, could improve existing fisheries and create additional areas suitable for fisheries development. The lakes could be stocked with suitable varieties of fish; however, some detrimental effects on the existing fishery resources would occur. Losses to the wildlife habitat, due to lake construction, could be mitigated by more intensive and better management practices, particularly on land acquired for project purposes and specifically for mitigation purposes. Zoned "green belt" areas could be provided near urban areas to protect wildlife habitat.

37. The effectiveness of a system of small upstream detention structures was not explicitly analyzed for comparison against Reddies River Lake and the Roaring River Project since an equivalent level of protection would require an extensive number of such structures, having costs about twice that of the larger reservoir projects. While the system of small upstream detention structures could provide protection against cropping season floods to a larger area more effectively than the large reservoirs, difficulty in controlling reservoir releases would sharply reduce the level of protection to urban areas on the main stem from larger storms. Thus, the direct comparison of a large reservoir versus small upstream detention structures would not be completely valid because each type is designed for different objectives.

38. Nonstructural alternatives. Flood plain zoning and flood proofing do not appear to be economically feasible means of protecting agricultural development, many utilities such as railroads, highways, or many structures already located in the flood plain. However, both alternatives can be used as tools of flood plain management by local authorities to inhibit future development of flood plains. Total evacuation of the flood plain would result in significantly higher costs than any practical flood control plan, yet evacuation of certain areas might be a feasible alternative. In much of the upper Yadkin River Basin, flood plain development is required to allow economic development to continue and as such the best alternatives appear to be those which would allow the development to proceed in an orderly and economic manner.

39. The existing W. Kerr Scott Dam and Reservoir on the Yadkin River has reduced the flood potential in the flood plain, and the construction of Reddies River Lake will further reduce this flood potential. These projects will not completely remove this flood potential. Local authorities should institute land use plans to limit development of the flood plain. Only development that can coexist with potential flooding should be allowed in this flood hazard area. Local authorities should be encouraged to institute regulations as presented in paragraph 114c. Presently, there are no city or county land use plans designed to prevent future flood damages in the project area. Flood plain development accelerated following the completion of W. Kerr Scott Dam, and unless local authorities promulgate regulations, these encroachments are likely to increase in anticipation of the Reddies River Project. Local authorities should be made aware that although these projects will reduce flooding, a flood potential will still exist for development in the flood plain.

40. Flood plain information studies have been prepared by the Charleston District and presented to Wilkesboro and North Wilkesboro, and to Elkin and Jonesville, North Carolina, for their consideration in implementing the various flood plain management practices that could reduce both present and future flood damages.

41. Waste treatment at source. The treatment of wastes at their source is most essential in the reduction of pollution. Requirements governing waste treatment are the responsibility of the State of North Carolina and local agencies. The quality of water in the streams has been improved under the pollution abatement program of the North Carolina Office of Water and Air Resources and is expected to continue to improve under this program and the implementation of the Federal Water Pollution Control Act Amendments of 1972. Present technology permits a high degree of treatment of domestic sewage and most industrial wastes. Treatment beyond secondary of all wastes to virtually eliminate residual pollutants would be required under the above act if required to obtain a satisfactory effluent. Adequate waste treatment must be provided at all significant waste sources if maximum development of the basin's water resources for water supply and recreational purposes is to be achieved.

42. Water quality control. Water quality within the Reddies River Basin is good, and the watershed is sparsely developed. The only pollution reported within the basin is occasional turbidity in the North Fork which is caused by erosion from farming and in Reddies River due to gravel washing operations. Dissolved materials are low throughout the watershed. The construction of the Reddies River Lake Project should not be allowed to degrade existing water quality standards in Reddies and Yadkin Rivers or in Reddies River Lake itself. The major effect of the project on water quality will be on dissolved oxygen and temperature. Water quality studies will be initiated during the GDM - Phase II report to determine what D. O. and temperature can be expected in water releases from the dam. These studies will also determine the need for multi-level intake to maintain existing water quality standards. The EPA investigations of water quality control needs and possible solutions (Appendix III), concludes that due to the availability of adequate waste treatment techniques at the source, there is no need for reservoir storage for downstream water quality control in the upper Yadkin River Basin or other alternatives for this purpose. Local interests will be encouraged to participate in water quality control in accordance with the recommended item of local cooperation in paragraph 114b.

43. Water supply. Ground water yields are not available in sufficient quantities to satisfy all the future municipal and industrial water supply needs of the upper Yadkin River Basin which lies in the Piedmont Plateau and Blue Ridge Mountains. This area is underlain with relatively low-yielding aquifiers. In view of the low ground water yields, selection of the most feasible method of providing for water supply needs must be based upon availability and economic considerations. Large needs from point sources are more economically developed from surface sources in the upper Yadkin River Basin. All of the larger cities and towns in this basin now obtain their water supply from surface water sources.

44. Water supply could be furnished from large and small impoundments, ground water development, or the needs could be modified by substitution of water saving processes and devices or from exclusion of those firms which are heavy water users in favor of firms which have very low water requirements. In terms of substitution of technology or exclusion of "wet" industries, the economy of providing additional water supply over the alternatives is considered positive. Projected needs make some allowance for technological changes but the relatively minor influence of water on production costs would indicate that most firms would react most positively to the availability of plentiful supplies of water or to its relative scarcity rather than to its cost. The United States Geological Survey in its Appalachian studies indicated that ground water costs would be on the order of 5 cents per thousand gallons delivered to the well head in the upper Yadkin River Basin. Surface storage costs range a little over one-tenth as much (based on average cost for Roaring and Reddies River Lake). The aspect of transmission cost has been omitted from this comparison, but the advantage of surface storage cost over ground water appears to be sufficient to preclude the consideration of ground water for more than small supply sources.

45. Outdoor recreation. Alternatives for providing water related outdoor recreation opportunities includes small and large impoundments for single and multiple-purpose uses. There do not appear to be any significant opportunities for the expansion of recreation facilities at any publicly owned impoundment in the upper Yadkin River Basin. The magnitude of needs indicates that several large impoundments would be required in addition to all foreseen upstream watershed projects and other impoundments.

46. Summary. The alternatives to the reservoir considered in this report do not appear to satisfy the full range of water resource development needs required to maintain and stimulate the rate of economic development enjoyed at present in the Yadkin River Basin. Reddies River Lake in conjunction with the existing W. Kerr Scott Dam and Reservoir and appropriate flood plain management practices would provide a high degree of flood damage reduction and also provide for needed water supply and outdoor recreation. Provision of these services would assist in maintaining and stimulating the rate of economic development in the Yadkin River Basin.

INVESTIGATIONS

47. Surveys and studies for project document. The more important previous surveys and studies made in connection with the project document, which formed the basis for authorization of the Reddies River Lake Project, and other various investigations relating thereto, are described in the following paragraphs.

48. In 1943, plans for development of the Yadkin-Pee Dee River Basin were prepared. The Chief of Engineers recommended adoption of a step by step plan of improvement of the basin for flood control, navigation, and other purposes in general accord with the Division Engineer's report. This report contained recommendations for the construction of the Wilkesboro project for flood control and power generation, and the construction for power purposes only of the Tuckertown, Junction, Morven, Greater Blewett and Crump's Ford projects in the order named. Authorization of the Wilkesboro project construction was recommended by the Chief of Engineers as the initial step in the development of the basin. Following construction at Wilkesboro the remaining projects were to be considered only as each became economically justified. This report became House Document No. 652, 78th Congress, 2nd Session.

49. A report dated 19 June 1946 revised House Document 652 to delete therefrom the dual-purpose reservoir at the Wilkesboro site on the recommendation of the Chief of Engineers and the Board of Engineers for Rivers and Harbors and including in lieu thereof, four detention reservoirs for flood control only at the Wilkesboro, upper Wilkesboro, Reddies No. 1 and Reddies No. 3 sites. This report became Senate Document No. 31, 81st Congress, 1st Session, and the four reservoirs are outlined under Plan III-b of the District Engineer's report as modified by higher authority.

50. The specific authority for the Reddies River Flood Control Development is contained in the Flood Control Act approved 24 July 1946 (Public Law 526-79th Congress, 2nd Session) which reads, in part, as follows:

> " . . . The project for the construction of four detention reservoirs at the Wilkesboro, upper Wilkesboro, Reddies No. 1 and Reddies No. 3 sites is hereby authorized substantially in accordance with plans contained in the report of the Chief of Engineers dated June 19, 1946, with such modifications thereof as in the discretion of the Secretary of War and the Chief of Engineers may be advisable, at an estimated cost of $7,194,000 ..."
> (The 1946 report was modified and approved by Congress in Senate Document No. 31, 81st Congress, 1st Session.)

51. Studies subsequent to authorization and prior to current report. Studies relating in whole or in part to the Reddies River Lake Project which followed initial authorization and are completed are described in the following paragraphs.

52. Funds for initiation of a Definite Project Report on Reddies River were allocated by advice of allotment No. C-3327, dated 15 August 1947, ENGFB. Preliminary studies prepared at the outset of the Definite Project Report considered 15 different plans. Plans 1 through 12 dealt with the authorized Reddies No. 1 and No. 3 sites, and Plans 13 through 15 dealt with one high dam at the Reddies No. 1 site. In the course of the work, sufficient evidence was developed to demonstrate the superiority of the single dam. The advantages of Site No. 1 are listed below:

a. Lower first cost of construction with greater flood protection than that claimed in the review report.

b. Lower operation and maintenance costs.

c. Elimination of expensive highway relocation at Site No. 3.

d. Simplification of reservoir operation in territory where lag time between rainfall and runoff is very short.

e. Bottom lands in Reddies No. 3 reservoir area contained homes and good farmlands, whereas the added storage capacity in Reddies No. 1 resulted in very limited farm or home damage.

In view of the evidence, approval was granted by the Office of the Chief of Engineers, 14 February 1949, for continuance of the definite project studies on the basis of planning a single "high" dam at Reddies Site No. 1. Final phases of the preliminary studies were devoted largely to developing the project plan on the basis of one high dam. Prior to the submittal of the final report, two conferences were held in the District Office. On 20 October 1949, a conference was held with the representatives

from the South Atlantic Division Office. All plans were discussed and it was decided that the plans that called for one high-dam reservoir should be explored further for benefits. On 22 November 1949, a second conference was held with representatives from the District Office, the Division Office, and the Office of the Chief of Engineers. Various aspects of the plan were discussed, but it was decided that conclusive evidence on present day benefits was lacking and that additional field work and office studies would be necessary but not for the Definite Project Report. The conferees were satisfied that any of the single dam schemes under Plans 13 through 15 would provide greater benefits at less cost than the authorized project. Upon completion of the report, the project was placed on the "inactive" list due to the unfavorable cost benefit estimates.

53. In 1952, studies began on the authorized two-dam plan for the upper Yadkin River. These also resulted in a single-dam plan for a reservoir on the Yadkin at the Wilkesboro site. The Wilkesboro project, later named W. Kerr Scott Reservoir, was approved and constructed. It was completed in 1962.

54. During the Appalachian studies, it was assumed initially to include the Reddies River Project as part of the report. It was further assumed that the Reddies River Project should be treated as a multiple-purpose project in order to meet the water resouce needs of the areas, as envisioned by the Appalachia Act. The District was then directed to make the necessary studies for the Reddies River Project utilizing the basic assumptions. Studies were made of survey scope which included Reddies River, Roaring River, Mitchell River, and Fisher River projects operating as a system. Storage allocations of the various purposes assigned to the Reddies River Project were based on the designated system which would best meet the water resource development of the basin. These studies were presented in the first draft of the report to the Office of Appalachian Studies in Cincinnati. That office made the decision not to include the Reddies River Project in their report per se, but to treat the development as an authorized project in place. However, it was concluded that the authorized Reddies River Project would be a multiple-purpose project since the studies made for the first draft clearly indicated that the project should share in satisfying the water resource needs of the basin.

55. In 1969, an Economic Restudy was made which provided information to reclassify the Reddies River Lake Project from "deferred for restudy" status to "active" status, and to show that the Reddies River Project was economically feasible. During the course of the restudy, a review of the Definite Project Report was made. It was found that the information as presented was sound and that the best location of a dam was at the previously selected Reddies Site No. 1. The study extended the investigations made for the 1950 definite project report by updating the hydrologic and other engineering information but without new foundation explorations or other field surveys. Economic data was developed concurrent with the reservoir system studies for the development of the

upper Yadkin River Basin. For study purposes, a logical system of developmental projects was adopted and these consisted of the following:

a. W. Kerr Scott (existing).

b. Reddies River Project (authorized).

c. Roaring River Project (to be recommended, Office of Appalachian Studies).

d. Mitchell River Project (recommended for future study, Office of Appalachian Studies).

e. Fisher River Project (recommended for future study, Office of Appalachian Studies).

56. On 4 December 1970, a post-authorization supplement to the Economic Restudy was submitted and served as notification of and justification for significant post-authorization changes. Most significant of the changes were the addition of water quality control, water supply, and recreation as project purposes along with the previously authorized flood control. The District Engineer at that time recommended that the Reddies River Project be approved for funding purposes and that work be allowed to proceed on the basis of present study and evaluation through the advanced engineering and design stage. He also recommended that further treatment of project formulation, if desired, be accomplished in the General Design Memorandum and, if appropriate, be submitted to higher authority for review and recommendations. On the basis of the aforementioned investigations, the Charleston District Engineer was instructed to proceed with the advanced engineering phase of the study with design support to be supplied by the Savannah District.

57. In accordance with instructions contained in SADEW (4 Dec 70) 3rd Indorsement, dated 19 January 1971, preparation of a design memorandum entitled Economics and Project Formulation commenced. Prior to completion of this study, Charleston District was instructed to prepare a Phase I GDM as prescribed in ER 1110-2-1150. Work accomplished to date was to be used in preparation of a Phase I GDM.

58. In their design support role, the Savannah District has submitted the Design Memorandum on Site Selection, D.M. No. 1 dated 22 May 1972. The Site Selection Study reaffirmed the Definite Project Report findings that a single dam at the Reddies Site No. 1, now called Site A, should be adopted for design and construction.

59. Design Memorandum No. 2, Hydrology and Hydraulic Analysis presents a description and analysis of the hydrology for Reddies River Lake. The criteria employed and the results of studies used in establishing the basic hydraulic design are also described. The following data is presented in this memorandum:

a. Area and storage capacity of the lake.

b. Standard project flood.

c. Spillway design flood.

d. Storage allocations.

e. Tentative length and crest of the spillway and outlet works capacity.

f. Tentative elevation of top of dam.

g. Tail water rating curve.

h. Hydrologic characteristics of the basin.

i. Natural and modified frequency curves.

j. Unit hydrograph studies.

This memorandum was submitted for approval on 9 March 1973.

60. Studies for General Design Memorandum, Design Memorandum No. 3. Material developed for the economics and project formulation design memorandum is used in this memorandum where it is practicable. Savannah District prepared the Recreation Resources Appendix to this memorandum. This appendix provides the basis for recreational development at the Reddies River Lake Project. Paragraph 121 discusses recreation development in greater detail. Information developed in the following studies were used in preparing this memorandum.

a. Surveys. Topographic map of the damsite area was prepared to a scale of one inch equals 100 feet, and a contour interval of five feet. Topographic maps of the entire project area were prepared to scales of one inch equals 400 and 800 feet, and a contour interval of ten feet. These maps were prepared from aerial photographs. Field surveys supplemented the aerial surveys in order to obtain road and bridge data, cemeteries, powerlines and telephone lines, and contours in densely wooded areas.

b. Foundation explorations and studies. The exploration program following project authorization was initiated in 1946 with borings and testpits completed in 1947 and 1948. The additional foundation investigations that were conducted for Design Memorandum No. 1 - Site Selection consisted of a geologic reconnaissance of the potential damsites, six new borings at the selected site, and testing of the overburden materials.

c. Real estate appraisals. The real estate studies included the accumulation of available land maps, determination of estate to be acquired, gross appraisal of land and improvement costs including severance and crop damages, analysis of land sales in the vicinity and estimates of resettlement costs. The appraisals were made in sufficient

scope to determine reliable estimates of land costs for the pool levels considered in the project.

d. Relocations investigations. The road relocation studies included field examination of the area, preliminary discussion of relocation needs with the North Carolina State Highway Commission and the preliminary planning for needed relocations with estimates of cost. Of the existing roads within the proposed lake area, only two, SR 1540 and SR 1546 will be relocated; the others will be abandoned. These two roads will be raised to an elevation of 2 feet above the flood control pool elevation. Additionally, the highway commission informed the District that they have programmed a future North Carolina 18-268 bypass of North Wilkesboro. Their selected route, which is about 1500 feet upstream of the dam, would run along Hoopers Branch. This location would be inundated by the project. In response to a Charleston District suggestion that other locations for the bypass be studied, the Commission proposed a location about 500 feet further upstream from the Hoopers Branch route. It was planned to have the Corps assume the increased cost of the bypass due to the construction of Reddies River Lake. In a letter dated 25 October 1973 (Exhibit 16), the North Carolina Division of Highways stated the bypass was not included in the continuing seven-year highway improvement program. They also stated that this program will be reviewed annually. As a result of the omission of the bypass from the current highway improvement program, no consideration will be given to this future bypass at this time. Public utilities serving the project area were also contacted concerning facilities that would be affected by the pool levels planned for the construction of the project. Discussions were held with the town of North Wilkesboro to determine the effect of the project on a section of their sewage collection system. A preliminary plan of sewerline relocations and an estimate of cost were provided by the town.

e. Structure design and alternate plan studies. The site selection design memorandum (DM 1) studies three dam and spillway locations and Site A, as shown on Plate 3, was adopted for the Reddies River Lake Dam. Preliminary design and siting of outlet works, location and width of the spillway, and the establishment of dam embankment slopes were accomplished in DM 1. Alternate plan studies consisted of dams for a single purpose (flood control, water supply, or recreation). Preliminary design and cost estimates were developed for these single-purpose dams. These were located at the same location as the recommended damsite.

f. Public meeting. The Reddies River Lake Project was described during a public meeting at Wilkesboro, North Carolina, 5 October 1972. A brief summary of prior studies of water resources development of Reddies River was presented. The proposed plan of development was also described, and statements from interested parties were received. The criteria that will be used to determine what lands are to be acquired for this project was also discussed. Approximately 112 persons attended the meeting, including state, county, and municipal officials, representatives of civic organizations and interested individuals. The state and local government officials indicated strong support for the proposed Reddies River Lake. Civic organizations and local residents also supported the project. There appears to be little opposition; only three individuals spoke against the project.

61. Future studies and investigations. Additional field and office work will be required before final plans and specifications can be prepared. The future investigations program planned is generally outlined by the listing of future design memoranda to be prepared in continuing project studies. These are listed in the fly-leaf at the front of this memorandum.

PLAN FORMULATION

62. Basic considerations. The major water resource development needs in the upper Yadkin River Basin are for flood damage prevention, water supply, general outdoor recreation, and fish and wildlife conservation. The factors discussed herein are those considered in developing the most feasible plan for satisfying these needs. Consideration was given to tangible and intangible benefits and environmental effects that would result from both structural and nonstructural measures and the costs associated with providing these measures. Considered structural measures includes lakes, levees, floodwalls, and channel improvements. Considered nonstructural measures included flood plain zoning, building codes, subdivision regulations, evacuation and flood proofing, all of which would have to be implemented by local communities.

63. The results of studies for this memorandum and the report on "Development of Water Resources in Appalachia," prepared by the Office of Appalachian Studies, ORD, for the Appalachian Regional Commission indicated that Reddies River Lake, previously authorized as a single-purpose flood control project should be a multipurpose project, with flood control, water supply, streamflow regulation, recreation, and fish and wildlife conservation as project purposes. It would be one unit of a reservoir system that could provide for the water resource conservation needs of the basin. The system includes the in-place W. Kerr Scott Dam and Reservoir, Roaring River Lake, which is recommended in the Appalachian Report, and Reddies River Lake, which was considered in-place in that report. Mitchell and Fisher River Lakes, though not recommended for immediate construction, should be reviewed later when the basin's needs would require their construction.

64. Evaluation of structural measures. An inventory of potential project sites in the upper Yadkin River Basin was made from projects which were selected primarily on the basis of their location and potential of providing for the water resource development needs. This preliminary selection and evaluation resulted in the elimination of potential local flood protection measures since a major need in the basin is for water conservation measures for various purposes not attainable by the use of dikes, levees, channel improvements, etc. The projects remaining after this initial evaluation includes Reddies, Roaring, Mitchell, and Fisher Rivers Lakes on tributary streams and upper Donnaha Lake on the main stem below the mouth of Fisher River.

65. Rationale of plan selected. The results of project evaluation

TABLE 8

SUMMARY OF PROJECT COSTS AND BENEFITS OF CONSIDERED PROJECTS

(100-YEAR PERIOD OF EVALUATION - [illegible] PRICE LEVELS)
(Values in $1,

Plan and Description	Flood control storage (inches)	Total project investment (economic)	Annual 1/ charges (economic)	Annual Benefits 1/ Flood control	Water supply	Recreation	Residual	Total Project Benefits	Benefit-cost Ratio	Net Tangible Benefits Amount	Rank
A (1) Reddies River Lake	6.95	22,729	1,627	431	1,323	66	425	2,245	1.38	618	1
(2) Reddies River Lake	6.95	24,020	1,710	424	1,023	665	144	2,256	1.32	546	2
(3) Reddies River Lake	6.94	25,016	1,775	431	1,023	665	144	2,263	1.27	488	4
B Roaring River Lake	7.00	22,657	1,428	292	547	431	200	1,470	1.03	42	5
C Reddies River Lake and Roaring River Lake	6.95 7.00	46,677	3,138	648	1,570	1,096	344	3,658	1.17	520	3

1/ 5 7/8 percent discount interest rate.

studies indicated that, of the projects considered, only Reddies and Roaring River Lakes were found to be economically feasible at this time. Economic data on the Reddies and Roaring River Lake Projects are shown in Table 8. Reddies River Lake, Plan A-2, with a benefit-cost ratio of 1.3 would produce net tangible benefits of $546,000 annually and Roaring River Lake, Plan B, with a benefit-cost ratio of 1.03 would produce net tangible benefits of $42,000 annually. Therefore, Reddies River Lake would rank first as the most economically feasible project in the basin and should receive priority of construction because of the greater physical output of the project. It would produce more flood control, water supply and recreation benefits, but less redevelopment benefits than Roaring River Lake.

66. Justification of the scale of development. The justification of the scale of development for Reddies River Lake for each project purpose is discussed in the following paragraphs.

a. Water supply. The water supply needs of the upper Yadkin River and adjacent basins are discussed in paragraphs 17 through 22 inclusive in the "Current Needs and Development Objectives" section. Reddies River Lake with a storage allocation of 18,400 acre-feet for water supply purposes, would supply a dependable yield of about 32 MGD, which is about 40 percent of the basin's documented 2020 unsatisfied needs. As discussed in the above-referenced paragraphs, a regional shortage of water supply storage projects is expected to develop between the years 2000 and 2020. Therefore, it is expected that all of the water supply storage included in Reddies River Lake would be needed around that time. However, as previously discussed in paragraph 22, North Carolina has indicated its intent to begin repayment of water supply costs upon project completion.

b. Regulation of streamflow. A storage of 600 acre-feet is included in Reddies River Lake to provide the required minimum flow, equal to the 7-day 10-year low-flow in the tailwater area of 36 cfs, in accordance with North Carolina state law. No monetary benefits would accrue to this minimum required reservoir release. All costs incurred in providing for this storage are considered to be joint costs.

c. Recreation. Recreation development, discussed in detail in Appendix II, Recreation Resources, is designed to provide for the maximum practical carrying capacity of the proposed site. The recommended recreation plan of development proposes features and facilities functional to the area that is considered adequate for the using public. Unfilled recreation needs in the recreation market area of Reddies River Lake are greater than the Lake's ability to provide a maximum of 650,000 recreation days annually. Therefore, maximum development of the site's potential is appropriate. A further discussion of recreation demand, needs, and other aspects of recreational development is contained in Appendix II. The economic feasibility of adding recreation on a last added basis is shown by the fact that annual benefits estimated at $665,000 accrue with an incremental annual cost of $446,000.

d. Flood control. The effects and costs of Reddies River Lake, with varying amounts of flood control storage, were evaluated in order to determine the optimum project size for this purpose. The data presented in Table 8, shows total project costs, annual charges, annual benefits, benefit-cost ratios, and net tangible benefits for three scales of project development, 4.97, 6.95, and 8.94 inches of flood control storage. The economically optimum-sized project was considered to be that size project where the net tangible benefits were the greatest. The analysis indicated that net tangible benefits amounted to $618,000, $546,000, and $488,000, respectively, for 4.97, 6.95, and 8.94 inches of flood control storage. Consideration is given to the fact that while the maximum flood of record in the basin only produced 4.86 inches of runoff, storms with over six inches of runoff have occurred over adjacent basins and it is concluded that while the scale of development with 4.97 inches of flood control storage has slightly greater net tangible benefits than the plan with 6.95 inches of storage, the latter plan should be constructed in order to contain the runoff from the maximum regional storm of record. Additionally, if flood control is considered on a last added basis, it would provide annual benefits of $424,000 at an incremental annual cost of $241,000.

67. The adopted flood control storage of 6.95 inches plus the conservation storage included for sedimentation and streamflow regulation and needed water supply purposes provides for the maximum practical physical development of the selected Reddies River site. Additional development would be impractical while lesser site development would not permit maximum practical utilization of this reservoir site.

68. Nonstructural alternatives. A comprehensive plan of flood damage prevention should include a combination of structural and nonstructural measures. The structural measures of the reservoir system would reduce damages to existing development that result from flooding. As previously discussed, nonstructural measures would not be an alternative to structural measures in the prevention of flood damages in the upper Yadkin River Basin. However, if nonstructural measures are implemented by the local communities, they could reduce future developments that would be subject to flood damage.

69. Flood plain information studies. Studies have been prepared by the Charleston District and presented to the towns of Wilkesboro-North Wilkesboro and Elkin-Jonesville, North Carolina, for their consideration in implementing the various flood plain management practices that could reduce both present and future flood damages. The construction of Reddies River Lake will not completely remove the flood potential from the flood plain. Some flood potential will always exist at Wilkesboro and North Wilkesboro. As discussed in paragraphs 39 and 114c, local authorities can reduce this flood damage potential by flood plain management.

COORDINATION

70. General. Federal, state, and local agencies were consulted during the preparation of Economic Restudy and the Post-Authorization Supplement reports. The coordination that was effected during these previous studies was updated as required during the preparation of this memorandum.

1. Coordination with Federal agencies.

a. Bureau of Outdoor Recreation (BOR). BOR was initially contacted in 1967 during the Appalachian Studies to provide an estimate of recreation benefits for the project. On 15 August 1973, a meeting was held with representatives of BOR to discuss the recreation development planned for the project. In addition to this meeting, a field inspection of Reddies River Lake area was conducted during 21-22 August with a representative of BOR and the North Carolina Department of Natural and Economic Resources, Recreation Division. After these meetings, BOR, in a letter dated 6 September 1973, commented on a recreation plan that was affected by a proposed location of the North Carolina route 18-268 bypass. The State Highway Department later informed the District in October 1973 that the bypass is not in the current highway improvement program, and a revised recreation plan was prepared without regard to this bypass. This revised plan was submitted for BOR review, and their comments are included as Exhibit 1. BOR will be requested to review the detailed recreation plan that will be presented in GDM - Phase II.

b. Bureau of Sport Fisheries and Wildlife (USBSF&W). This agency prepared a letter report in 1969 based on the plan presented in the Economic Restudy Report. In a letter dated 6 December 1972, this agency was advised that a general design memorandum was being prepared and they were requested to review and update their 1969 report, if necessary. USBSF&W submitted a re-evaluation of the Reddies River Lake Project in a letter report dated 16 April 1974 (Exhibit 2). This re-evaluation is essentially the same as the original report with the addition of a minimum downstream flow to maintain fish habitat. Fishery values contained in the 1969 report have been updated and are contained in a report prepared by the Bureau's National Reservoir Research Program (Exhibit 3).

c. Environmental Protection Agency (EPA). In a 1967 report, the Federal Water Pollution Control Administration (FWPCA) evaluated the need for and value of water supply and water quality control storage in the upper Yadkin River Basin, North Carolina. In a 4 August 1972 letter, EPA was requested to provide their current views on water quality storage for inclusion in our memorandum. EPA responded to this letter and indicated that the earlier recommendations for water quality storage by FWPCA cannot be supported in light of current EPA policy guidelines (Exhibit 4). They also requested basic data that would be required before a reappraisal of the Reddies River Project could be made. In a 17 November 1972 letter, the requested data was sent to EPA. EPA, in a 12 March 1973 letter, submitted their report on water quality storage at Reddies River Lake. This letter and report are included as Appendix II.

d. National Park Service (NPS). The National Park Service was contacted concerning the existence of archeological or historical sites in the project area. Their reply is included as Exhibit 5. On 14 October 1970, the District informed NPS of the tentative construction schedule for Reddies River Lake, so that a archaelogical and historical data recovery program could be initiated. NPS recommended that funds be included in the FY 74 budget to conduct archaelogical investigations at the Reddies River Lake Site (see Exhibit 6). NPS informed Charleston District that they were unable to perform this work. They have now reprogrammed the survey test for FY 75 and the excavation work for FY 76.

e. Federal Power Commission (FPC). FPC was requested by letter dated 26 April 1973 to analyze the hydropower potential of the Reddies River Lake Project. FPC replied that the installation of hydroelectric power at Reddies River is not feasible at this time (Exhibit 7).

f. Geological survey. On 3 August 1972, a letter was sent to the Geological Survey to inform them that a gaging station would be inundated by the project and to solicit their views on the project. Geological Survey did not have any comments on the project and they assumed that the gaging station would be relocated when construction of dam is started (Exhibit 8).

72. Coordination with state agencies.

a. The Department of Water and Air Resources (presently the Office of Water and Air Resources, Department of Natural and Economic Resources) provided letters of assurance in 1969 to fulfill the required items of local cooperation for water storage space and recreation development at Reddies River Lake. During the preparation of this report, the Department was requested to reaffirm their assurance to provide local cooperation for water supply storage and recreation development. In a letter dated 26 November 1975, the Department gave its intent to assume the role of sponsor for water supply storage in the Reddies River Lake Project and to repay the costs allocated to this storage for present demand (Exhibit 9). The state signified its intent to sponsor recreational development of the Reddies River Lake Project and to repay one-half of the costs allocated to recreation in a letter dated 23 September 1974 (Exhibit 10).

b. Department of Archives and History. In a letter dated 14 September 1972 (Exhibit 11), the Department of Archives and History stated that no historic sites will be affected by Reddies River Lake.

c. State Highway Commission. The highway commission was contacted numerous times to determine the effect of the project on existing roads. The most recent letters from the highway commission are summarized below and included as exhibits to this report. In a letter dated 5 June 1972 (Exhibit 12), the commission recommended changes to existing roads and informed the District of a future N.C. 18-268 bypass. The highway commission in a 19 July 1972 letter (Exhibit 13) concurred with a Charleston District suggestion that an existing road be abandoned. In letters dated 14 August 1972 and 15 May 1973 (Exhibits 14 and 15), the highway commission submitted information on alternate locations for the

bypass. A letter, dated 25 October 1973 (Exhibit 16), from the North Carolina Division of Highways advised the District that the N.C. 18-268 bypass is not in the current seven-year improvement program.

73. Future coordination. Additional coordination will be effected with the State Highway Commission to arrive at an agreement for road relocations. The Department of Natural and Economic Resources will be kept informed by the project's progress, and the Department will be requested to enter a cost-sharing agreement for providing water supply and recreation in the project prior to initiation of construction. An additional public meeting will be held just prior to land acquisition. If there are changes in the project from the features that were presented at an earlier meeting in 1972, a meeting will be scheduled to solicit the public's views.

ENVIRONMENTAL ANALYSIS

74. Environmental setting without the project. The Reddies River drains a small narrow valley off the eastern slope of the Blue Ridge Mountains and empties into the Yadkin River at North Wilkesboro. The basin is about 97 square miles in area and is about 19 miles in length and has a maximum width of about 10 miles. The tributaries of the Reddies River rise in the mountains at elevations of 3,000 to 3,700 feet and rapidly descend to about 2,000 feet, generally within a distance of less than 3 miles. Stream profiles then become progressively flatter and in the 18-mile reach above the damsite, the stream slope becomes about 18 feet per mile. The city of North Wilkesboro has built a low dam on Reddies River about one mile above its outlet in the Yadkin River and about 0.7 miles downstream from the Reddies River damsite to impound water for municipal use. The dam impounding water for the North Wilkesboro water treatment plant would appear to create an effective barrier to fish movement upstream except during flood or near-flood conditions on the Yadkin River. Approximately 75 percent of the basin is in woodlands, most of which is the oak-hickory type. There are no known unusual species of plants in the project basin. Isolated farms and residences account for the relatively small amount of cleared land. The upper reach of Reddies River provides habitat for trout, while the lower reaches support small mouth bass, redbreast sunfish, and catfish. The animal life found in the Reddies River Basin is characteristic of forest and agricultural lands in the Blue Ridge Mountians and foothills. There are no endangered or unusual species in the project basin. Game animals found in the basin include deer, squirrel, rabbit, raccoon, fox, bobcat, bobwhite, dove, and grouse. There are no historical resources located within the area of project influence. The National Park Service advises that archeological sites have been recorded within the project area and requests that the Director of the Southeast Region be kept informed of work schedules to permit them to plan and program the necessary salvage work. This is being done through the annual coordination meetings with personnel of that office. The human population is predominately rural but the greatest source of income is derived from manufacturing. Fishing is the major recreational activity in the basin with hunting, sightseeing, nature walking, horseback riding, and canoeing attracting fewer participants.

75. Environmental impact of the proposed action. The project will reduce downstream flooding and damages resulting therefrom, provide a new source of municipal water, and improve water quality below the reservoir by the retention of sediment within the reservoir. The project will not interfere with the operation of the North Wilkesboro water supply impoundment because no adverse water quality changes are anticipated, and the quantity of downstream releases is sufficient to meet the needs of North Wilkesboro. There is not now a significant turbidity or sedimentation problem in Reddies River. The beneficial impact of Reddies River Lake in this regard is based simply on the inherent characteristic of a reservoir for accumulating sediment transported by its tributaries. The 680 acres in the conservation pool of the reservoir will provide a much larger habitat for fish with a corresponding increase in fishing opportunity than is now provided by the river. The reservoir together with the 1239 acres of land proposed for recreational development around the reservoir will provide new opportunities for swimming, boating, camping, picnicking, and other outdoor recreation. The reservoir will permanently inundate 680 acres of land and 8.15 miles of Reddies River and an additional 655 acres and 2.9 miles of Reddies River will be subject to inundation by the flood control pool. As mitigation for the loss of hunting opportunity due to project implementation, 275 acres of land will be acquired adjacent to the Thurmond-Chatham Wildlife Management Area for public hunting and general recreation.

76. Alternatives to the proposed action. Alternatives to the recommended action include land use controls; nonstructural control; system of small upstream reservoirs; levees, floodwalls, and channel improvement; two reservoir systems; and no action. Land use controls would prevent future encroachment into the flood plain but would leave present developments unprotected. Nonstructural control is impractical because of the extent of existing development. A system of small upstream reservoirs would cost more but would be less effective in protecting urban areas and was rejected because it offered no significant advantage. Levees, floodwalls, and channel improvement would avoid the specific impacts of the proposed reservoir, but would require a larger amount of land and would adversely affect a longer reach of stream. This alternative was rejected because of higher costs and the absence of any significant advantage. A two reservoir system would offer a similar degree of flood protection, but would inundate more land and stream and would also cost more. The alternative of no action would leave the project area unchanged and subject only to already established trends of development. The flood control, water quality, water supply, and recreation benefits to be derived from the project would be foregone.

77. Preparation and coordination of the environmental statement. A draft EIS was prepared and circulated for public review on 17 September 1973. Most of the comments received were submitted by Federal and non-Federal government agencies. The limited interest on the part of the public in reviewing this draft EIS is indicative in part of the general approval of this project. The comments on the draft EIS were used in the preparation of the final EIS which is being transmitted concurrently with this report to higher authority.

PROJECT PLAN

78. General. Since the Reddies River Project was authorized in 1946, the project plan has undergone many post-authorization changes, each based upon succeeding studies of the development of the adjacent area. The project plan consists of a multiple-purpose lake on Reddies River located at the site recommended in Design Memorandum No. 1 - Site Selection. The project will serve the purposes of flood control, water supply, and general and fish and wildlife recreation.

79. Description of the area. The dam and lake will be located on Reddies River 1.7 miles above its junction with the Yadkin River. The dam and lake are located entirely in Wilkes County. The town of North Wilkesboro is located immediately downstream of the damsite.

80. Geology of the area. Reddies River Lake is primarily in the Piedmont physiographic province. Upper reaches of the proposed lake are in the Blue Ridge physiographic province. Topography of the area consists of narrow ridges with fairly steep slopes. Elevation generally range from about 1,000 feet msl to about 1,300 feet msl, except in the upper reaches of the lake where elevations range between about 1,200 to about 2,000 feet msl.

81. Residual soils blanket the project area except where rock outcrops or where alluvial soil are present in the Reddies River and Hoopers Branch flood plains. Residual soils covering upland areas vary in thickness from about 20 feet to over 100 feet. Most of these residual soils are sand-silt-clay mixtures. Alluvial soils are confined to the Reddies River and Hoopers Branch flood plains. These soils appear to be relatively dirty sands and gravels; there are also some silt, and gravelv, sandy clays. The flood plain alluvium is up to 20 feet thick at the selected damsite.

82. The Reddies River Project is located in Brevard fault zone. This zone does not include active seismic faults. Rocks in the Brevard zone are relatively low grade metamorphic rocks of greenschist-amphibolite transition facies. Most of these rocks are of late Precambrian or early Paleozoic sedimentary origin which have been metamorphosed more than once during the middle to late Paleozoic and possibly Triassic times. Metamorphosed igneous intrusive rocks, younger than the surrounding rocks of sedimentary origin, are also present.

83. The elevation of the ground water has not been established; however, the water table appears to be tributary to the river. Numerous permanent springs are located in the project area.

84. Plan Accomplishments. The recommended plan will reduce flood damages along the Yadkin River from Wilkesboro, North Carolina, to High Rock Lake near Salisbury, North Carolina. Regulation of Reddies River Lake will be coordinated with the regulation of W. Kerr Scott Reservoir to reduce flooding downstream of each to the fullest extent possible. For both projects to effectively use the flood control space provided and to

operate as designed, channel capacities downstream of each must be preserved. Design releases for W. Kerr Scott and Reddies are 5400 and 2400 cfs, respectively. Channel capacities in the Yadkin River from at least Wilkesboro to Elkin also need to be maintained to provide space for local runoff as well as space for reservoir releases. Storage space will be provided in the conservation pool for the state of North Carolina in a quantity sufficient to provide a yield of 32.6 MGD for municipal industrial use. Storage for the purpose of water quality control was authorized in the Reddies River Project. Since authorization, the Federal Water Pollution Control Administration (FWPCA) in a 1967 report recommended that space be provided for that purpose. Subsequent to this recommendation the Environmental Protection Agency (successor to FWPCA) re-evaluated the need for water quality control storage and concluded that there is no need for water quality control storage in the upper Yadkin River Basin. Reddies River Lake will provide storage for a flow equivalent to the 7-day, 10-year low-flow (36 cfs). State of North Carolina laws also require this minimum release. The project will provide water oriented recreation for the project area. Initial visitation is estimated at 481,000 persons annually and ultimate visitation, limited by optimum use of the water area, is expected to be 650,000.

56. Design features. The adopted general plan for the dam provides for the construction of an earth dam across Reddies River about 1.7 miles above the junction with the Yadkin River and just upstream of North Wilkesboro, North Carolina. The dam will be 960 feet long with a 30-foot wide top and a maximum height above the streambed of 165 feet. A cutoff trench excavated to firm rock will be constructed in both abutments. A single cutoff curtain will be built on the centerline of the dam; the curtain will be grouted from the bottom of the trench rock surface. The grout curtain will be extended along the narrow rim of the right abutment to a point beyond the right side of the spillway crest. Internal seepage would be controlled by an inclined drain and a drainage blanket with a toe drainage system provided across the valley. The upstream slope will be protected by dumped rock from the top of the dam to elevation 1020.7 feet msl. Dumped rock will also be provided on the downstream slope up to elevation 1018.0 feet msl. The dam section will be asymmetrical with a slope of 1-V on 2.5H on the upstream face and a slope of 1-V on 2.5H on the downstream slope. A free overflow, ungated spillway is proposed for the right abutment with a crest width of 250 feet at crest elevation of 1110.0 feet msl. Design Memorandum No. 1 - Site Selection considered a narrow concrete sill at the crest and Design Memorandum No. 2 - Hydrology and Hydraulic analysis considered a concrete ogee crest. A concrete sill at the spillway crest is reflected in costs presented in this design memorandum. Treatment of the spillway crest will be studied further in General Design Memorandum - Phase II. Precast liner slabs are proposed for the spillway slopes; the requirement for these slabs will be studied in detail in the feature design memorandum. The outlet works is located in the left (east) abutment bed. Discharges from the lake will be through a 9-foot diameter conduit regulated by gates in the concrete control tower located in the upstream dam embankment. In order to provide suitable entrance conditions for the outlet works the high terrain upstream of the outlet works will be excavated. The material removed from this excavation will be utilized in constructing the dam. The requirement for a multilevel intake will be studied in a supplement to

Design Memorandum No. 2, Hydrology and Hydraulic Analysis. Access will be provided to both abutments of the dam. Primary access to the outlet works will be from the right (west) abutment; however, during operation of the spillway, access will be from the left (east) abutment. This will preclude the construction of a bridge across the spillway. A saddle dike will be constructed across a low area located about 1,400 feet east of the left (east) abutment. Typical dam, outlet works and spillway section and general plan of the damsite are shown on Plate 3. Location of the saddle dike is shown on Plate 4.

54. Hydroelectric power potential. In compliance with ER 1110-2-1, the Federal Power Commission was contacted by a letter dated 26 April 1974, requesting their current analysis of the hydroelectric power potential for the Reddies River Lake project. Based on the recommendations of the Regional Engineer, Federal Power Commission (Exhibit 7), no provision has been made in the design of the project for the development of hydroelectric power.

COST ESTIMATE

55. Cost estimates. Estimated cost of Reddies River Lake is based upon quantity estimates derived from field surveys, land appraisals, and foundation investigations. Cost estimates are based on past experience and current contract prices applied to the estimated quantities. Costs covering contingencies, engineering and design, and supervision and administration are included in the estimates. A detailed cost estimate of Reddies River Lake is given in Table 9. A summary of construction expenditures is given in Table 10. A summary of annual charges for the project is shown in Table 11.

56. Comparison with prior estimates. A comparison between the current estimate (price levels July 1974) and the latest approved estimate (PB-3, effective date 1 July 1974) is given in Table 12. The PB-3 estimate, although dated 1 July 1974, was prepared a few months in advance of the approval date. The current estimate was prepared after the PB-3 estimate and reflects actual price levels as of 1 July and minor design changes. The project document estimate is also shown in this table. The total overall cost of the project as presented in this design memorandum has decreased approximately 1 percent or $320,000 below the latest approved estimate. The project document estimate is for a single-purpose flood control structure at June 1949 price levels. The largest part of the net change has occurred in the cost of relocations, which has decreased $2,262,000, and dam and appurtenances, which has increased $1,469,000. Other changes are shown in Table 12. The decrease in relocations (cost account 02) is largely due to the deletion of a future North Carolina Route 18-268 bypass of North Wilkesboro by the State Highway Department from its improvement program. The increase in dam and appurtenances (cost account 04) is due to using current unit prices for similar work in the project area. The total non-Federal cost is $12,472,000. Coordination with local interests is continuing regarding their participation in the project.

TABLE 9

REDDIES RIVER LAKE, PHASE I GDM
COST ESTIMATES

	Unit	Quantity	Unit Cost	Total Cost
01. LANDS AND DAMAGES				
Land	Acre	3,762	Varies	$ 727,000
Timber	Acre	3,400	Varies	123,000
Improvements	L.S.	Job		770,000
Severance damage	L.S.	Job		60,000
Subtotal				$ 1,680,000
Contingencies				434,000
Acquisition cost	Tract	215	$1,600.00	344,000
Resettlement (PL 91-646)	Tract	44	4,250.00	187,000
Subtotal				$ 2,645,000
Wildlife Mitigation Lands	L.S.	Job		115,000
Account 01. Total				$ 2,760,000
02. RELOCATIONS				
.1 Roads				
North Carolina State secondary roads	L.S.	Job		$ 320,000
Account 02.1 Subtotal				$ 320,000
.2 Utilities and structures				
Powerlines	L.S.	Job		$ 57,000
Telephone lines	L.S.	Job		6,000
North Wilkesboro sewer system	L.S.	Job		290,000
U.S.G.S. gaging station	L.S.	Job		5,000
Account 02.2 Subtotal				$ 358,000
Account 02. Subtotal				$ 678,000
Contingencies				102,000
Account 02. Total				$ 780,000

Table 9 Cont'd.

	Unit	Quantity	Unit Cost	Total Cost
03. RESERVOIRS				
Reservoir clearing	Acre	730	$ 650.00	$ 475,000
Removal of bridges	L.S.	Job		10,000
Misc. clearing (fencing, foundations, debris, etc.)	L.S.	Job		20,000
Subtotal				$ 505,000
Contingencies				75,000
Account 03. Total				$ 580,000
04. DAMS				
Construction Facilities	L.S.	Job		$ 18,000
Clearing and Grubbing	Acre	51	$1,000.00	51,000
Excavation:				
Borrow	C.Y.	1,690,000	0.90	1,521,000
Common	C.Y.	1,030,000	0.90	927,000
Cut-off trench	C.Y.	63,000	0.90	57,000
Rock:				
Outlet works	C.Y.	400,000	3.00	1,200,000
Spillway	C.Y.	8,400	3.00	25,000
Care and diversion of water	L.S.	Job		1,270,000
Foundation preparation	S.Y.	3,200	7.50	24,000
Foundation grouting	L.S.	Job		630,000
Concrete outlet works	L.S.	Job		2,460,000
Concrete spillway structures	L.S.	Job		270,000
Dumped rock	C.Y.	41,000	6.00	246,000
Compacted fill:				
Soil	C.Y.	1,460,000	0.30	438,000
Rock fill	C.Y.	140,000	0.35	49,000
Cut-off trench	C.Y.	63,000	0.35	22,000
Sand (drainage blanket and drains)	C.Y.	50,000	6.00	300,000
Drain pipe (toe drain)	L.F.	1,200	8.00	10,000
Embankment instrumentation	L.S.	Job		30,000
Subtotal				$ 9,548,000
Contingencies				1,432,000
Account 04. Total				$10,980,000

Table 9 Cont'd.

	Unit	Quantity	Unit Cost	Total Cost
08. ROADS				
Access roads	Mile	1.50	$130,000	$ 195,000
Service road	Mile	0.25	68,000	17,000
Launching ramp	L.S.	Job		7,000
Subtotal				$ 219,000
Contingencies				33,000
Account 08. Total				$ 252,000
16. RECREATIONAL FACILITIES				
Initial				
Detailed estimate given in Appendix II	L.S.	Job		$ 2,663,000
Contingencies				400,000
Account 16. Total				$ 3,063,000
Deferred				
Detailed estimate given in Appendix II	L.S.	Job		$ 1,252,000
Contingencies				188,000
Account 16. Total (Deferred)				$ 1,440,000
19. BUILDINGS, GROUNDS AND UTILITIES				
Administration center	L.S.	Job		$ 110,000
Site work, clearing and grading	L.S.	Job		15,000
Vehicle storage shed	L.S.	Job		10,000
Concrete and soils lab and core storage building	L.S.	Job		33,000
Utilities	L.S.	Job		30,000
Public viewing areas	L.S.	Job		20,000
Marine facilities	L.S.	Job		26,000
Subtotal				$ 244,000
Contingencies				36,000
Account 19. Total				$ 280,000

Table 9 Cont'd.

	Unit	Quantity	Unit Cost	Total Cost
20. PERMANENT OPERATING EQUIPMENT				
Office equipment	L.S.	Job		$ 5,000
Shop equipment	L.S.	Job		5,000
Diesel-electric generator	L.S.	Job		15,000
Water Quality Instrumentation	L.S.	Job		20,000
Precipitation station	L.S.	Job		8,000
Stream gaging station	L.S.	Job		8,000
Radio communication facilities	L.S.	Job		6,000
Transportation, reservoir and grounds maintenance equipment	L.S.	Job		35,000
Flowing plant	L.S.	Job		10,000
Sediment ranges	L.S.	Job		5,000
Subtotal				$ 117,000
Contingencies				18,000
Account 20. Total				$ 135,000
Project Subtotal				$18,830,000
30. ENGINEERING AND DESIGN				1,860,000
31. SUPERVISION AND ADMINISTRATION				1,190,000
TOTAL COST				$21,880,000

TABLE 10

SUMMARY OF CONSTRUCTION EXPENDITURES
AND ECONOMIC INVESTMENT
MULTIPLE-PURPOSE REDDIES RIVER LAKE[1/] PROJECT
(Values in thousands of dollars)

Item	Specific Costs (recreation)	Join-Use Cost	Total Cost
Initial Construction Costs:[2/]			
01. Lands and damages	262	2,498	2,760
02. Relocations	-	921	921
03. Reservoir	-	685	685
04. Dam and appurtenances	-	12,960	12,960
08. Roads	-	297	297
14. Initial recreational facilities	3,767	-	3,767
19. Buildings, grounds, & utilities	-	331	331
20. Permanent operating equipment	-	159	159
TOTAL	4,029	17,851	21,880
Interest during construction	237	1,048	1,285
Initial economic investment	4,266	18,899	23,165
Deferred Construction Cost:			
Future recreational facilities	1,771	-	1,771
Present worth of future recreational facilities	855	-	885

1/ No specific costs for flood control or water supply.
2/ Includes engineering and design and supervision and administration for all accounts except .01 Lands and Damages.

TABLE 11

SUMMARY OF ANNUAL CHARGES (ECONOMIC)
MULTIPLE-PURPOSE REDDIES RIVER LAKE PROJECT
(Values in thousands of dollars)

Item	Amount
Interest on investment	1,411
Amortization	5
Operation and maintenance	160
Major replacements	19
Future recreation operation, maintenance, & replacement	30
Economic cost of future additions (recreational facilities)	50
Economic cost of lands	35
Total Annual Charges	1,710

TABLE 12

COMPARATIVE ESTIMATE OF TOTAL INITIAL PROJECT COST
REDDIES RIVER LAKE, NORTH CAROLINA
(ALL COSTS IN $1,000)
(FEDERAL AND NON-FEDERAL)

Item No.	Item	Project Document Estimate	Latest Approved Estimate (Effective Date 1 July 1973)	Current Estimate (July 1974)	Net Change Over Latest Approved Estimate	% Change Over Latest Approved Estimate
01	Lands and Damages	$ 168	$ 2,620	$ 2,760	$+ 140	+ 5
02	Relocations	12	3,042	780	-2,262	- 74
03	Reservoir	34.3	583	580	- 3	- 0.5
04	Dam and Appurtenances	2,230.2	9,511	10,980	+1,469	+ 14
08	Roads	39.1	95	252	+ 157	+165
14	Recreation Facilities (Initial)	20	3,159	3,063	- 96	+ 3
19	Buildings, Grounds, and Utilities	25	138	280	+ 142	+102
20	Permanent Operating Equipment	10	127	135	+ 8	+ 6
30	Engineering and Design	370.4	1,777	1,860	+ 83	+ 5
31	Supervision & Administration	156	1,148	1,190	+ 42	+ 4
		$3,065	$22,200	$21,880	$- 320	- 1%

Current Estimate (July 1974) NON-FEDERAL COSTS $12,472,000

(Reimbursement for cost allocated to water supply and 50% of cost allocated to recreation including interest during construction.)

89. Alternative single-purpose projects. In order to provide equivalent, alternative single-purpose sources for water supply and recreation in the absence of the Federal multiple-purpose project, investigations were made of alternative sites. These investigations indicated that an alternative project at the Reddies River Lake site could be developed to provide each of these functions singly, and more economically than could be provided at other locations.

90. Alternate costs for water supply. A single-purpose water supply project was analyzed, with the same water supply storage as the multiple-purpose project at the Reddies River Lake site. This project was considered to have a construction completion date in the year 2000, when the water supply storage is estimated to be needed. This project would have a first cost estimate at $14,120,000 and annual charges, based on a 100-year amortization period, of $1,073,000.

91. Alternate costs for recreation. A single-purpose project, with the same conservation pool area as the multiple-purpose project and the addition of recreation facilities and required additiona lands, would provide the same recreational benefits more economically than a single-purpose reservoir at other sites investigated. The total cost for this plan is estimated at $18,000,000.

92. Alternate costs for flood control. Consideration was given to alternate projects for flood control purposes. The most feasible method of producing flood damage reduction effects equal to those of the multiple-purpose Reddies River Lake would be single-purpose flood control project, using the Reddies River Lake site with a cost estimated at $14,390,000. No further consideration of other alternative plans was given after it became obvious that excessive costs would be involved.

ESTIMATES OF BENEFITS

93. General. Benefits that would accrue to Reddies River Lake stem from flood control features, water supply storage, recreational facilities, fish and wildlife conservation measures, and from redevelopment aspects. Total project benefits are discounted to present-worth values and distributed over a 100-year evaluation period in an equivalent annual series, using a 5 7/8 percent discount interest rate.

94. Flood control. Benefits would result from the reduction of flood damages and the enhancement of flood plain lands due to the flood protection afforded by the plan of improvement. Flood-damage-reduction benefits were determined as the difference between the estimated annual damages without and with Reddies River Lake, considering normal development of the area in the absence of the project. Land-enhancement benefits would be derived from a reduction of flooding along the upper Yadkin River, resulting in greater productivity and utilization of flood plain land. Such benefits would be general in nature and would be distributed throughout the area benefited.

95. The flood plain of the Yadkin River, which would benefit from flood control provided by storage in Reddies River Lake, extends about 126 miles from W. Kerr Scott Dam downstream to the head of High Rock Lake. The area flooded by the unregulated record flood of August 1940 was about 29,000 acres. The existing W. Kerr Scott Dam and Reservoir would reduce the area flooded to about 19,500 acres. The flood plain is divided into five reaches for flood damage computation purposes as shown on Figure 1, Appendix I. A summary of flood damage reduction, land enhancement, and flood control benefits by reach is shown in Table 13. A detailed breakdown of benefits by category and reach is shown in Table 8, Appendix I.

96. Average annual flood control benefits based on present development and July 1974 price levels amount to $424,000 for this evaluation. Average annual flood control benefits claimed in the authorizing document, published as Senate Document 31, 81st Congress, 1st Session, were estimated at $56,000, based on 1945 flood plain development and price levels.

97. Water supply. The state of North Carolina Department of Economic Resources through the Office of Water and Air Resources, the state agency empowered under the authority of Article 38 of Chapter 14 of the North Carolina General Statutes to contract for storage in a Federal reservoir for local water supply purposes, requested the inclusion of water supply storage in Reddies River Lake. A storage allocation of 18,400 acre-feet, provided in the lake would provide an estimated dependable yield of 32 MGD for needed future municipal and industrial water supply for the Winston-Salem/Davidson County, North Carolina, area or other areas as may have need of it. Even though water supply needs, as shown in Table 6, do not indicate an immediate demand for the water storage in Reddies River Lake, North Carolina will begin repayment of the allocated costs immediately after construction completion. This permits the full amount of water supply benefits to be claimed versus the discounted benefits allowed for future water storage. Local water supply benefits were estimated as the cost of providing water supply by the most economical alternate means that would most likely be developed by the potential water users in the absence of the Federal project. Local water supply benefits estimated at $1,023,000 annually, based on a 100-year evaluation period, would result from the storage of 18,400 acre-feet in Reddies River Lake. These benefits were considered as equal to the annual charges for an alternate single-purpose water supply reservoir project at the Reddies River Lake site. A description, estimate of costs, and estimate of annual charges for the alternate single-purpose water supply reservoir project are shown in the cost estimate section of this memorandum.

98. Recreation. Recreational benefits are expected to accrue from the proposed Reddies River Lake from general recreation and fishing. The water impounded by the lake would be suitable for boating and fishing, and beautiful scenery would be enjoyed from access points and overlooks. Much of the shoreline could be developed for use as parks, boat harbors, group camps, and fishing camps. The development of the reservoir boundaries for public recreation would require careful planning in cooperation with appropriate State and Federal agencies. Total recreational benefits from the plan of improvement, estimated at $665,000 annually, were evaluated in two categories: general recreation and fishing. They are further discussed in the following paragraphs.

TABLE 13

REDDIES RIVER LAKE
SUMMARY OF AVERAGE ANNUAL FLOOD CONTROL BENEFITS
(100-YEAR EVALUATION PERIOD - JULY 1974 PRICE LEVELS)
(Values in $1,000)

Stream Reach	Flood Damage Reduction							Land Enhancement			Total Flood Control Benefits
	Present Development			Future Development 1/			Total				
	Rural	Urban	Subtotal	Rural	Urban	Subtotal		Rural	Urban	Total	
Yadkin River											
Reach 1	15	124	139	3	13	16	155	0	49	49	204
Reach 2	20	81	101	4	13	17	118	0	24	24	142
Reach 3	7	0	7	1	0	1	8	0	0	0	8
Reach 4	13	0	13	2	0	2	15	0	0	0	15
Reach 5	45	0	45	10	0	10	55	0	0	0	55
TOTAL	100	205	305	20	26	46	351	0	73	73	424

1/ Future benefits discounted using a 5 7/8 percent discount interest rate.

99. General recreation. These benefits were evaluated on the basis of expected annual attendance at the project and the average value of a visitor day of those attending the lake. Details of the recreation analysis are presented in Appendix II, Recreation Resources. Pertinent recreation data are shown in Table 14. As shown in Table 14, anticipated attendance at the proposed lake would increase from the initial annual attendance of 481,000 annually to the peak annual attendance of 650,000 annually and remain constant thereafter. Average annual general recreation benefits, using an estimated value of $1.15 per recreation day, are estimated at $648,600 based on a 100-year evaluation period.

TABLE 14

SUMMARY OF PERTINENT RECREATIONAL DATA AND BENEFITS

Item		
Estimated year of construction completion		1982
Water surface area available for recreational purposes, conservation pool (acres)		680
Land area developed for recreational purposes (acres)		1239
Severable land to be purchased (acres)		542
Estimated attendance:	Year	Annual Attendance (1,000 Persons)
	1982	481
	1985	498
	1990	554
	1995	573
	2000	612
	2005	650 1/
	2082	650 1/
Average Annual Recreational Benefits:		
General		$648,600
Fishing		16,400
Total Benefits		$665,000

1/ Maximum attendance, based on optimum use of water area.

100. Fish and wildlife. The U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, has prepared a report presenting data relative to the evaluation of the fish and wildlife benefits to be derived from Reddies River Lake. A copy of the report is included as Exhibit 2. The Bureau's Reservoir Research Program report (Exhibit 3) estimated the fishery that would be produced by the project. The number of angler days attributable to Reddies River Lake is discussed in Appendix II,

[illegible] Resources. Based on an estimated value of $1.00 per fisherman [illegible], fishing benefits are estimated at $16,000 annually.

101. Redevelopment. The project would be located in Wilkes County, North Carolina, which is not presently designated a redevelopment area by the Economic Development Administration under the Public Works and Economic Redevelopment Act of 1965. Ashe County, within commuting distance of the project, has been so designated. Redevelopment benefits have been estimated for the project for the Yadkin-Pee Dee studies. Redevelopment benefits are computed as the amortized value of wages of workers locally hired for construction of the proposed project, plus the amortized value of wages of locally hired workers for operation and maintenance of the project after it is completed. Construction wages are amortized over the 100-year project life at an interest rate of 5 7/8 percent. Operation and maintenance wages are reduced to zero in a 20-year period and converted to an average annual equivalent at an interest rate of 5 7/8 percent. Average annual redevelopment benefits expected to accrue from construction of Reddies River Lake are estimated at $144,000; supporting data and details of the benefit computations are shown in Tables 15, 16, and 17.

102. Other Benefits. There are intangible benefits, not subject to direct monetary evaluations, which would be realized in addition to the previously evaluated benefits attributable to the water-resource development plan for the Yadkin River Basin. The relatively abundant supply of water in the Yadkin River Basin would be a major factor in promoting expansion of industry if assured water supplies are made available. Other factors, such as adequate labor supply, climate, and a variety of available sites, provide strong stimulation for continuing industrial growth. Augmentation of low stream flows would assist in providing an overall improvement in general sanitation and improve the appearance of the stream. The reservoir would reduce the sediment load of the stream and aid in channel stabilization. Additional benefits to the basin, other than those evaluated, would result from the recreational facilities provided under the plan. Commercial activities would develop to support the recreational activities of both the resident and non-resident population. These benefits would be secondary, and have not been evaluated.

103. Summary of Benefits. A summary of project benefits creditable to Reddies River Lake is shown in Table 18, based on the current Federal interest rate of 5 7/8 per cent.

104. Benefit-cost ratio. The benefit-cost ratio creditable to the project is 1.1 as shown in Table 18.

TABLE 15

REDDIES RIVER LAKE
LABOR FORCE STATISTICS FOR COUNTIES WITHIN COMMUTING DISTANCE OF PROJECT 1/

County	Civilian Work Force	Employment	Unemployment	Percent Unemployment
Ashe 2/	7,220	6,830	390	5.4
Alexander	7,710	7,430	280	3.6
Surry	29,190	28,130	1,060	3.6
Wilkes	19,300	18,530	770	4.0
Total			2,500	

1/ Average for 1971 - North Carolina Employment Security Commission, Raleigh, N. C.

2/ Ashe County is presently qualified under Title IV, subsection (1), Public Works and Economic Development Act of 1965. The three other listed counties are not so designated, at present, by the Economic Development Administration but are located in Appalachia.

TABLE 16

REDDIES RIVER LAKE
TOTAL LABOR REQUIREMENTS AND POTENTIAL USE OF LOCALLY UNEMPLOYED
LABOR IN PROJECT CONSTRUCTION

Labor Category	1 Man-Hrs. /$1,000 of Const Cost 1/	2 1,000 Man-Hrs. for Proj. Const 2/ (On-site)	3 Rate /man-Hour 3/ ($)	4 Total Labor Costs ($1,000)	5 Total Workers Req'd 4/	6 Workers Obtained Locally %	 No.	7 Wages to Locally Unemployed ($1,000)
Skilled	27	434	6.90	2,995	104	25	26	749
Semi-Skilled	13	209	5.30	1,108	50	50	25	554
Unskilled	12	193	3.80	733	46	100	46	733
Totals	52	836		4,836	200		97	2,036

1/ Bulletin 1390, U.S. Dept. of Labor, "Labor and Material Requirements for Civil Works Construction by the Corps of Engineers," March 1964, updated to July 1974 price levels.

2/ Based on initial project construction cost, July 1974 price level, less "Lands and Damages, Engineering and Design, and Supervision and Administration," (amount used $16,074,000).

3/ Composite area prevailing wages for heavy construction and building.

4/ Average number of workers during 2-year construction period: Each worker assumed to work a total of 4,160 hours. Column 5 equals column 2 divided by 4,160.

TABLE

REDDIES RIVER LAKE
ESTIMATE OF ANNUAL REDEVELOPMENT BENEFITS
(100-YEAR AMORTIZATION PERIOD; 5 7/8% INTEREST RATE)

Annual Redevelopment Benefits from Project Construction:		
Present worth of locally-received construction wages:	$2,036,000	
($2,036,000) *		
Capital recovery factor (5 7/8% - 100 years)	x 0.05895	
Equivalent annual redevelopment benefit (initial)		$120,000
Annual Redevelopment Benefits from Operation and Maintenance:		
(Assumed to be reduced from full value to zero after 20 years. PW factor for uniformly decreasing annuity, decreasing from 1 to 0 in 20 years, at 5 7/8% = 7.2)		
Annual O & M costs, July 1974 price levels:	$160,000	
Labor costs estimated at 70% of total	112,000	
Assume 50% of this would accrue to local workers who would be otherwise unemployed	56,000	
Present worth factor (as above)	x 7.2	
Present worth of redevelopment benefit with 20-year cutoff	$403,000	
Capital recovery factor (as above)	x 0.05895	
Equivalent annual redevelopment benefit (O&M)		$24,000
TOTAL ANNUAL REDEVELOPMENT BENEFITS		$144,000

TABLE 18

SUMMARY OF AVERAGE ANNUAL PROJECT BENEFITS
(100-YEAR PERIOD OF EVALUATION - JULY 1974 PRICE LEVELS)
(Values in $1,000)

Type of Benefit	Interest Rate 5 7/8%	
Flood control		424
Water supply		1023
Recreation:		
General	649	
Fishing	16	
Subtotal		665
Total		2112
B/C ratio		1.2
Redevelopment		144
Total		2256
B/C ratio		1.3

COST ALLOCATION AND APPORTIONMENT

105. Costs. A summary of costs, annual charges, and benefits for the multiple-purpose Reddies River Lake Project, alternative single-purpose projects for each project purpose, and for the multiple-purpose project with each feature omitted are shown in Table 19.

106. Cost allocation. Allocation of costs of the multiple-purpose features of Reddies River Lake for flood control, water supply, and recreation was made by the separable cost remaining benefits method. Details of the cost allocation are presented in Table 20.

107. Apportionment of costs among interests. The division of project costs for Reddies River Lake is summarized in Table 21. The presently applicable laws and regulations governing cost sharing practices, on which these costs were based, are discussed briefly in the following paragraphs.

TABLE 19

SUMMARY OF COSTS, ANNUAL CHARGES, AND BENEFITS FOR THE REDDIES [illegible] LAKE
(100-YEAR PROJECT ECONOMIC LIFE FROM 1982)
(VALUES IN THOUSANDS OF DOLLARS - JULY 197[illegible] PRICE LEVELS)

	Multiple Purpose	Alternative Single Purpose			[illegible] Purpose Plans		
		Flood Control	Local Water Supply	Recreation	[illegible]	Local Water Supply	[illegible]
PROJECT FIRST COST							
Lands and damages	2,760	2,000	1,440	2,110	2,110	2,760	2,44[illegible]
Relocations	780	780	780	780	780	780	78[illegible]
Reservoir	580	70	580	450	580	450	58[illegible]
Dam and appurtenances	10,980	8,990	8,410	8,410	8,410	10,980	10,98[illegible]
Roads	252	252	252	252	252	252	252
Initial recreational facilities	3,063	-	-	3,063	3,063	3,063	-
Buildings, grounds, and utilities	280	240	280	280	280	280	25[illegible]
Permanent operating equipment	135	125	105	95	105	125	13[illegible]
Engineering and design	1,860	1,158	1,145	1,560	1,575	1,844	1,63[illegible]
Supervision and administration	1,190	735	728	1,000	1,005	1,176	91[illegible]
TOTAL PROJECT FIRST COST	21,880	14,390	14,120	18,000	18,160	21,710	17,45[illegible]
DEFERRED CONSTRUCTION COST							
Future recreational facilities	1,771	-	-	1,771	1,771	1,771	-
INVESTMENT SUMMARY							
Interest during construction	1,285	845	830	1,058	1,067	1,275	1,04[illegible]
Initial investment	23,165	15,235	14,950	19,058	19,227	22,985	18,499
Present worth of future recreation additions	855	-	-	855	855	855	-
TOTAL ECONOMIC INVESTMENT	24,020	15,235	14,950	19,913	20,082	23,840	18,499

Table 19 (Cont'd)

	Multiple Purpose	Alternative Single Purpose			Cost not Feature Omitted		
		Flood Control	Local Water Supply	Recreation	Flood Control	Local Water Supply	Recreation
ANNUAL CHARGES							
Interest on investment	1,611	845	826	1,171	1,186	1,161	1,171
Amortization	5	3	3	4	4	5	4
Operation and maintenance	160	100	100	160	160	160	160
Major replacements	19	15	15	19	19	19	19
Future recreation operation, maintenance, and replacements	30	-	-	30	30	30	-
Economic cost of future additions	50	-	-	50	50	50	-
Economic cost of lands	35	25	23	25	46	35	23
TOTAL ANNUAL CHARGES	1,710	1,042	1,023	1,459	1,469	1,700	1,377
ANNUAL BENEFITS							
Flood control	424	424	-	-	-	424	424
Local water supply	1,023	-	1,023	-	1,023	-	1,023
Recreation	649	-	-	649	649	649	-
General	16	-	-	16	16	16	-
Fishing							
TOTAL ANNUAL BENEFITS	2,112	424	1,023	665	1,688	1,089	1,447

TABLE 20

ALLOCATION I - SEPARABLE COST REMAINING BENEFITS METHOD, REDDIES RIVER LAKE
(VALUES IN THOUSANDS OF DOLLARS)

Item	Flood control	Local Water Supply	Recreation	Total
		100-YEAR PROJECT ECONOMIC LIFE		
Allocation of annual costs				
1 Benefits	426	1,023	665	2,112
2 Alternate cost	1,042	1,023	1,459	1,524
3 Benefits limited by alternate cost	426	1,023	665	2,112
4 Separable cost	241	10	446	697
5 Remaining benefits	183	1,013	219	1,415
6 Allocated joint cost	181	725	157	1,013
7 Total allocation, economic cost	372	735	603	1,710
8 Economic cost of lands	2	17	11	35
9 Future recreational facilities			50	50
10 Future recreation operation, maintenance, and replacement			30	30
11 Total allocation, project costs	365	718	512	1,595
Allocation of operation and maintenance costs:				
12 Separable cost	0	0	60	60
13 Allocated joint cost	13	72	15	100
14 Total allocation, operation and maintenance	13	72	75	160
15 Specific cost	0	0	60	60
16 Allocated joint-use cost	13	72	15	100
17 Ratio for allocation of joint use, operation and maintenance (percent)	13.0	72.0	15.0	100.0
Allocation of major replacements:				
27 Separable cost	0	0	0	0
28 Allocated joint cost	2	14	3	19
29 Total allocation, major replacements	2	14	3	19
Allocation of investment:				
30 Annual investment cost	350	632	434	1,416
31 Allocated investment	5,726	10,339	7,100	23,165
Allocation of construction expenditures:				
32 Specific investment	-	-	4,266	4,266
33 Investment in joint-use facilities	5,726	10,339	2,834	18,899
34 Interest during construction of joint-use facilities	318	574	157	1,049
35 Construction expenditures for joint-use facilities	5,408	9,765	2,677	17,850
36 Percent of construction expenditures for joint-use facilities	30.3	54.7	15.0	100.0
37 Construction expenditures for specific facilities	-	-	4,030	4,030
38 Total construction expenditures	5,408	9,765	4,707	21,880

TABLE 21

APPORTIONMENT OF COSTS FOR REDDIES RIVER LAKE
100-YEAR PROJECT ECONOMIC LIFE - JULY 1974 PRICE LEVELS
(VALUES IN THOUSANDS OF DOLLAR

Project purposes	Federal First Cost	Federal Interest During Construction	Federal Total Investment	Federal Percent	Non-Federal First Cost	Non-Federal Interest During Construction	Non-Federal Total Investment	Non-Federal Percent	[illegible]	[illegible]	[illegible]	[illegible]
Construction costs:												
Flood control	$ 5,408	$318	$ 5,726	23.0					$ [illegible]	$318	$ [illegible]	[illegible]
Water supply					$9,765	$574	$10,339	41.4	9,765	[illegible]	[illegible]	[illegible]
Recreation:												
Initially separable, general	1,975	116	2,091	8.4	1,975	116	2,091	8.4	1,975	[illegible]	[illegible]	[illegible]
Initially separable, fishery enhancement	40	2	42	0.1	40	2	42	0.1	40	[illegible]	[illegible]	[illegible]
Subtotal, initially separable recreation	2,015	118	2,133	8.5	2,015	118	2,133	8.5	2,015	[illegible]	[illegible]	[illegible]
Joint	2,677	157	2,834	11.4					[illegible]	[illegible]	[illegible]	[illegible]
Total first construction costs	10,100	593	10,693	42.9	11,780	692	12,472	50.0	21,880	[illegible]	[illegible]	[illegible]
Future recreation separable costs	885		885 [2/]	3.5	886		886 [2]	3.6	[illegible]		[illegible]	[illegible]
TOTAL CONSTRUCTION COSTS	10,985	593	11,578	46.4	12,666	692	13,358	53.6	23,651	[illegible]	[illegible]	[illegible]

	Costs	Percent	Costs	Percent	[illegible]	[illegible]
Annual operation, maintenance, and replacement costs:						
Flood control	$ 15	7.2			$ [illegible]	[illegible]
Water supply			$ 86	41.2	[illegible]	[illegible]
Recreation (initial)	18	8.6	90	28.7	[illegible]	[illegible]
Recreation (future)			30	14.3	[illegible]	[illegible]
TOTAL OPERATION, MAINTENANCE, AND REPLACEMENT COSTS	33	15.8	176	84.2	209	[illegible]
Annual charges:						
Flood control	365	22.9			365	22.9
Water supply			718	45.0	718	45.0
Recreation	321	20.1	191	12.0	512	32.1
TOTAL ANNUAL CHARGES	686	43.0	909	57.0	1,595	[illegible]

1/ One-half of separable costs from Table 18. Multipurpose cost (23,165) less project cost with recreation omitted [illegible] equals 2,133.

2/ One-half of separable costs from Table 18 of future recreational facilities.

3/ Excluding economic cost of land and future recreation facilities.

108. Apportionment of flood control costs. Costs allocated to flood control were apportioned in accordance with Section 201 of the Flood Control Act of 1958, as amended. Costs allocated to flood control for reservoirs are considered to be Federal.

109. Apportionment of water supply costs. The cost of providing water supply storage for immediate or anticipated future use must be apportioned to non-Federal interests in accordance with the Water Supply Act of 1958 (Title III of Public Law 85-500). Repayment of costs allocated to water supply may be made either by sharing construction costs during project construction, plus annual payment of operation and maintenance costs and payment or replacement costs when incurred; or by annual payment for the construction costs, including interest during construction and interest on the unpaid balance, plus annual payments of operation and maintenance costs and payment of replacement costs when incurred.

110. Apportionment of recreation costs. The cost of providing for recreation facilities must be apportioned to Federal and non-Federal interests in accordance with the Federal Water Project Recreation Act, Public Law 89-72 (S. 1229; H.R. 5269). Non-Federal interests must bear not less than one-half of the separable project cost allocated thereto, and bear all separable costs of operation, maintenance, and replacement of recreation and fish and wildlife lands and facilities. Repayment of costs allocated to recreation may be made either by contributing in kind, sharing construction costs during project construction, plus annual payment of operation and maintenance costs and payment of replacement costs when incurred, or by annual payment (which may be through user fees) for the separable construction costs, including interest during construction and interest on the unpaid balance, plus annual payments of operation and maintenance costs and payment of replacement costs when incurred.

PROPOSED LOCAL COOPERATION

111. Local cooperation required for authorized project. The Reddies River Lake Project was initially authorized in the Flood Control Act of 1946 for the purpose of flood control. No local cooperation was required for the initially authorized project. In accordance with subsequent legislation and post-authorization studies, water supply and recreation have been added as project purposes. The requirements of local cooperation for these purposes are listed in the following paragraphs.

112. Water supply. The provisions of the Water Supply Act of 1958 (Title III of Public Law 85-500) set forth the requirements for local interests to participate with the Federal government in developing the water supply features of Federal water-resource development projects. The provisions of this act as applied to Reddies River Lake would require that local interests:

> repay all costs allocated to water supply, presently estimated at $10,339,000 for construction and $86,000 annually for operation, maintenance, and replacements.

The state of North Carolina, through the Department of Natural and Economic Resources, Office of Water and Air Resources, under the authority of Article 38 of Chapter 143 of the North Carolina General Statutes, is empowered to contract for the assurances of repayment necessary for the inclusion of water-supply storage in a Federal lake. The Department is empowered under the above-mentioned state law to transfer to local levels of government within the state, any part of the use of storage which it acquires. After determining the needs of various local governments for the stored water, the Department will allocate the storage to the various local governments in consideration of all needs in the basin. The state was requested to reaffirm their assurance to provide payment of the separable cost of water supply. Their reply is included as Exhibit 9.

113. Recreation. The provisions of the Federal Water Project Recreation Act (Public Law 89-72) set forth the requirements for local interests to participate with the Federal Government in developing the recreational features of Federal water-resource development projects. The provisions of this act, as applied to the authorized Reddies River Lake requires that local interests:

a. Administer project lands, facilities, and water areas for recreation,

b. Pay, contribute in kind, or repay (which may be through user fees) with interest no less than one-half of the separable first costs allocated to recreation, presently estimated at $2,133,000,

c. Bear all separable costs of operation, maintenance, and replacements allocated to recreation, presently estimated at $60,000.

The state of North Carolina, through the Department of Natural and Economic Resources, Office of Recreation Resources was requested to furnish a statement of intent to participate in the recreation development and assure repayment of one-half of separable cost of recreation. The Secretary of the Department in a letter dated 23 September 1974 (Exhibit 10) responded that the state will participate in recreation development, and that funds will be requested in the Department's budget at the appropriate time.

114. Other requirements. Other items of local cooperation that should be required in addition to the items in paragraphs 112 and 113 are that local interests:

a. Hold and save the United States free from water rights claims due to the construction and operation of the project for water supply and recreation;

b. Take appropriate measures to prevent pollution that would reduce the effectiveness of the reservoir for water supply and recreation;

c. Prescribe and enforce regulations to prevent obstruction or encroachment on channels and interior ponding areas which would reduce their flood carrying capacity or hinder maintenance and operation, and control development in the project area to prevent an undue increase in the flood damage potential.

The addition of water supply and recreation as project purposes may require that Congress reauthorize Reddies River Lake as a multiple-purpose project. The legislation reauthorizing the project should contain the items of local cooperation contained in paragraphs 114a, b, and c in addition to those items in paragraphs 112 and 113. If it is determined that approval of water supply and recreation as project purposes may be made by OCE and the Secretary of the Army without reauthorizing legislation, then the local cooperation in paragraph 114c should be required. The prevention of encroachment on the downstream channel is especially important since the construction of this project will give the local people a sense of security from flood damage. However, the downstream channel should be kept clear to insure that the release of flood storage will not cause damages to structures that encroach on the channel. This requirement is consistent with current flood plain management policy. Existing legislation permitting Federal participation in water supply and recreation development already require the local cooperation shown in paragraphs 112 and 113.

115. Prospects for fulfillment of local cooperation. In 1969 during the restudy of the feasibility of adding the purposes of water supply and recreation to the project, the state of North Carolina provided letters of intent to comply with the requirements of local cooperation. Since five years have passed since the initial restudy of Reddies River Lake, the state was requested to reaffirm their intent to provide local cooperation for this project. The state has provided letters of intent to comply with the requirements of local cooperation for water supply and recreation. The state also indicated that they would request funds at some time in the future as required. The state was not requested to show their intent to comply with local cooperation requirements discussed in paragraphs 114a, b and c. Since these items are not required by the authorizing document or subsequent legislation governing Federal participation in water supply and recreation, it was considered not proper to request compliance from the state. After a determination is made on whether or not project reauthorization is needed, the state will be requested to show their intent to comply with paragraphs 114a, b and c for the condition of reauthorization and paragraph 114c for the condition of no reauthorization. Since local interests in Wilkes County strongly support this project, it is felt that all items of local cooperation including cost-sharing agreements for water supply storage and recreation will be obtained. Coordination of local cooperation has been conducted with the following:

a. Mr. James E. Harrington, Secretary
State of North Carolina
Department of Natural and Economic Resources
P. O. Box 27687
Raleigh, North Carolina 27611

b. Mr. James S. Stevens, Jr., Director
Office of Recreation Resources
N. C. Dept. of Natural & Economic Resources
P. O. Box 27687
Raleigh, North Carolina 27611

c. Colonel D. F. McDonald, Assistant Director
Office of Water and Air Resources
N. C. Dept. of Natural & Economic Resources
P. O. Box 27687
Raleigh, North Carolina 27611

DEPARTURES FROM THE PROJECT DOCUMENT PLAN

116. Changes in project plan. Pertinent project and lake data suggested in the project document and those proposed in this memorandum are tabulated in Table 22. The changes in lake data shown in Table 22 have been made as a result of the following:

a. Inclusion of water supply as a project purpose.
b. Inclusion of storage for a minimum release.
c. Revision of storages needed for flood control and silt reserve.

117. Departures from project document considered within discretionary authority of the Chief of Engineers. The Flood Control Act approved 24 July 1946 (PL 526, 79th Congress, 2nd Session) authorized four detention reservoirs at Wilkesboro, upper Wilkesboro, Reddies Numbered 1 and Reddies Numbered 3 sites. The Definite Project Report on Reddies River Dam and Reservoir, dated 15 March 1950, resulted in the recommendation for only one earthfill dam and Reddies Numbered 1 site, and this modification was approved by the Chief of Engineers 28 August 1950. The Definite Project Report studied a single-purpose flood control structure and concluded that the project benefits were less than the project cost. The Reddies River Project was classified as inactive. In recent years, the project was restudied considering the additional purposes of water supply storage and recreation. The additional water supply storage and recreation as project purposes are discussed in the following paragraph.

118. Departure from project document requiring notification to the Congress and/or Office of Management and Budget. The change, in the project from the authorizing document, to combine the two dams into one equivalent dam at mile 1.6 was reported to Congress during the Senate Appropriations Hearings for FY 1962. Congress was also informed that the Corps of Engineers was studying the addition of water supply, water quality control and recreation as project purposes during appropriation hearings for FY 1968. The dam is located at essentially the same location as planned in the Definite Project Report. Changes in project storages have been made to accommodate the addition of water supply storage, streamflow regulation, and sediment storage. The addition of water supply storage and recreation as project purposes is documented in Appendix V, Post-Authorization Changes. Congressional approval is also

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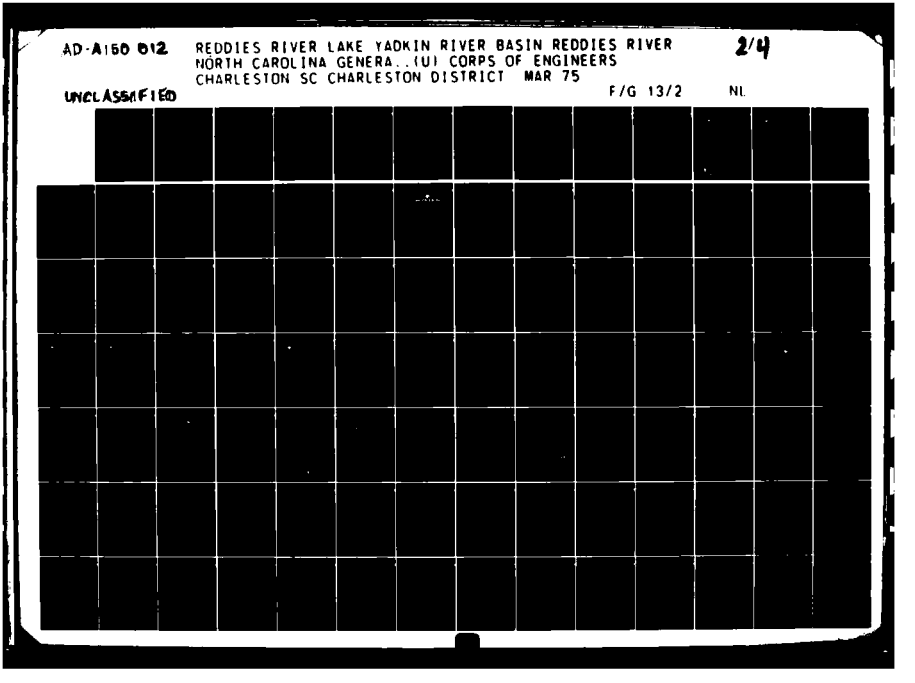

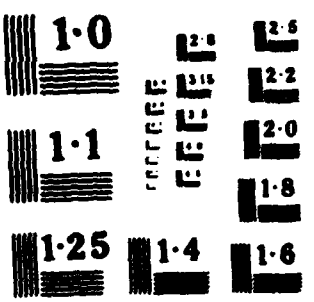
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required for the purchase of 275 acres of land for wildlife mitigation. This recommendation is contained in a Bureau of Sport Fisheries and Wildlife letter (Exhibit 2) and has been adopted in the presented plan.

RECREATION RESOURCES

119. Existing scenic and recreational resources of the project.

a. Scenic resources. The Reddies River Lake Project is located in a very scenic area of North Carolina. The combination of scenic, mountainous terrain of Blue Ridge foothills and the proposed 680-acre lake, surrounded by steep wooded slopes and irregular identations, will provide an attraction well suited for recreational development. Two prominent overlooks several hundred feet above streambed will each provide a spectacular view of the lake and surrounding development. The native evergreens, flora, and fall color of the deciduous cover provide a scenic resource which is recognized throughout the southeast.

b. Recreation resources. W. Kerr Scott Reservoir, operated by the U. S. Army Corps of Engineers, is the major source of water-oriented recreation in the project area. This lake provides facilities similar in scope and quantity to those proposed for the Reddies River project. The only other lakes within the 50-mile zone of influence are located at the extreme southern end of this zone, and are owned by Duke Power Company. These Duke Lakes, Rhodhiss Lake and Lake Hickory, provide only 36 acres of land for public use.

120. Potential for recreational development.

a. Potential use. Since the major supply of water-oriented recreation in the zone of influence is provided by W. Kerr Scott Reservoir and is expected to accommodate only 1,100,000 visitors by 1985, this facility is not considered sufficient to cause significant impact on the Reddies project. The demand from this zone is estimated at 1,640,000 annual users by 1985. This indicates the need for facilities to accommodate 540,000 additional recreationists. Because of the socioeconomic level and lack of mobility of the local residents, there is a great need for outdoor recreation in the immediate area of this proposed project.

b. Access. The project is ideally located for meeting recreation needs of the area. The lower portion of the lake will be within the city limits of North Wilkesboro, and some residential neighborhoods will adjoin day-use areas. The Reddies River Basin is surrounded with adequate state and county road access. The eastern side is served by State Road #18; the west side is served by State Roads 1372, 1315, and 1540. This system of roads provides adequate access to the project and will require minimum extension of existing systems to provide direct access to the proposed recreation sites.

c. General recreation. Suitable land areas for development of general recreation facilities such as camping, picnicking, and boat launching have been designated to accommodate the proposed visitation. Careful site planning in the feature Recreation Facilities Design Memorandum will insure proper distribution and location of activities and uses.

d. Fishing. Construction of this project will inundate approximately 45 acres of warm-water fish habitat in 8 miles of the lower stream reach. This will be replaced by a 680-acre lake providing habitat for approximately the same warm-water species now found in the stream with the addition of such species as large mouth bass and crappie. The increase in habitat area will result in 12,600 angler days.

e. Wildlife. The lake will also cause a complete loss of existing farm and forest game habitat in the conservation pool and a partial loss of similar habitat in the periodically inundated flood pool. This will reduce the hunting opportunity in the affected areas. To replace this impact, subject to Congressional approval, 275 additional acres of land adjacent to Thurman-Chatham Wildlife Management Area are proposed for acquisition. This area is located in the upper reaches of Roaring River Watershed and will provide recreational hunting to compensate for the displacement of wildlife resources within the Reddies River Lake Project.

121. Recreation facilities proposed.

a. Initial development. Initial development will be limited to that required to accommodate the 498,500 projected attendance for the 3 years of use following completion of project construction. The cost of facilities to accommodate this attendance is currently estimated to be $3,767,000.

b. Future development. Remaining work required for ultimate development will be constructed with Code 710 funds. This future work is currently estimated to cost $1,771,000. Ultimate development will be designed to accommodate 650,000 annual visitors. Appendix II of this design memorandum (Recreation Resources) presents a detailed analysis of the recreation plan proposed for the Reddies River Lake Project.

122. Assessment of effects summary. A profile showing the sociological, economic and environmental implications of the proposed project and the alternatives considered during project formulation has been prepared in response to Section 122 of the River and Harbor and Flood Control Act of 1970. This profile is summarized in Table 23.

STATEMENT OF FINDINGS

123. General. In light of the overall public interest, this report concerning the Reddies River Lake, North Carolina project, including the stated views of other interested agencies and the concerned public, has evaluated the various practicable alternatives to meet or alleviate the water resource development needs for flood control, as set forth in the Flood Control Act of

TABLE [illegible]

ASSESSMENT OF EFFECTS SUMMARY

Consideration	No Action (Profile w/o improvements)	Non Structural Control	Land Use Controls	System of Small Upstream Reservoirs	Levees, Floodwalls & Channel Improvement	Two Reservoir System	Plan 8 of 7 Recommended Projects
SOCIAL							
1 Population - Mobility, Density, Displacement of people	Mobility - No change under normal conditions but could be severely restricted during floods Density - No change Displacement due to flood damages can be expected	Mobility - Same as no action. Density - No change No displacement except possibly during flood conditions	Mobility - Same as no action Density - Would decrease if flood plain evacuation is accomplished, future increase would be limited Displacement due to flood plain evacuation of all residents in the flood plain.	Mobility - Slight change from present situation Density - Possible slight increase due to lifting of construction restrictions Displacement of some residences. Emergency displacement would be eliminated	Mobility - Slight change from present situation Density - Possible slight increase due to lifting of construction restrictions. Displacement of some residences. Emergency displacement would be eliminated.	Mobility - Some change from present situation. Most restrictive of all alternatives Density - Possible slight increase due to lifting of construction restrictions Displacement of some residences. Emergency displacement would be eliminated	Mobility - Some change from present situation Density - Possible slight increase due to lifting of construction restrictions Displacement of 40 residences. Emergency displacement would be eliminated.
2 Housing	Existing and future residences will be subject to periodic flooding.	Relocation or flood-proofing of buildings subject to flood damage	No new construction of residences in the flood plain due to the flood hazard. Existing houses subject to periodic flooding	Presently undeveloped land could be put to higher use.	Presently undeveloped land could be put to higher use	Presently undeveloped land could be put to higher use	Presently undeveloped land could be put to higher use
			← Existing development protected from flooding →				
3 Historical/ Archaeological Structures or Remains	No impact	No impact	No impact	No impact.	No impact	No impact	No impact
4 Transportation	No impact except during flood conditions	No impact except during flood conditions	No significant impact	Minor impact due to relocation of some secondary road. Possible increase in traffic due to recreation development	Minor impact due to relocation of some secondary road. Possible disruption during construction	Minor impact due to relocation of some secondary road. Possible increase in traffic due to recreation development	Minor impact due to relocation of some 75 miles of secondary road. Possible increase in traffic due to recreation development
5 Education Opportunities	No impact.	No impact	No impact	No impact.	No impact	No impact.	No impact
6. Leisure Opportunities	Leisure opportunities would be limited	Leisure opportunities would be limited	Under land use controls small parks could be developed consistent with the flood hazard.	Parks could be built at each of the small reservoirs providing mountain-oriented activities.	No provision for recreational opportunities	Parks could be built at each reservoir providing mountain-oriented activities.	Plan provides for development of eight areas for mountain-oriented activities such as camping, hiking, picknicking, and boat launching facilities

TABLE 23
(Continued
ASSESSMENT OF EFFECTS SUMMARY

Consideration	No Action (Possible minor improvements)	Non-Structural Control	Land Use Controls	System of Small Upstream Reservoirs	Levees, Floodwall & Channel Improvement	Two Reservoir Alternative	New Reservoir Recommended Project
7. Community Cohesion	Floods would be highly disruptive as well as damaging to the existing community. The growing community will be adversely affected by flooding	Flood evacuation would be disruptive to the existing community	Community growth would be restricted due to flood hazard	Community growth and cohesion would be enhanced due to removal of flood hazard. In addition, the social well being of both the immediate and neighboring communities could be greatly enhanced by the recreational opportunities	Community growth and cohesion would be enhanced through elimination of the flood hazard. Additional rights of way for channel would affect some residences	Community growth and cohesion would be enhanced due to removal of flood hazard. In addition, the social well being of both the immediate and neighboring communities would be greatly enhanced by the recreational opportunities provided	Community growth and cohesion would be enhanced due to removal of flood hazard. In addition, the immediate and neighboring communities would be greatly enhanced by the recreational opportunities provided by the project
ECONOMIC							
1. Local Government Finance	Present average annual costs resulting from flood damage amounts to $641,000. This is expected to increase.	Similar to No Action but possible slight reduction in annual costs.	Much of the area in the flood plain could not be used and there would be a subsequent reduction in county tax revenue	The benefits of flood protection would not offset the cost. There would be an increase in county tax revenue	Elimination of the flood hazard would raise the property values particularly as developable urban lands diminish. Increased property values would increase tax revenues. However estimated annual charges would be higher than the estimated annual benefits	By giving flood protection, there would be an increase in county tax revenue. The cost would be double that of the recommended project	By giving flood protection, a new water supply and additional recreation, the project benefits would exceed annual costs by a ratio of 1.6 to 1.0. The economic development of the basin would increase and improve the county's tax revenues
2. Public Facilities	Facilities valued at about $20,000 (roads & bridges) would continue to be subject to flood damage.	Same as No Action	Same as No Action	Flood protection for public facilities would result in average annual benefits of $9,200	Flood protection for public facilities would result in average annual benefits of $9,200	Flood protection for public facilities would result in average annual benefits of $9,200	Flood protection for public facilities would result in average annual benefits of $9,200
3. Public Services	Disruption of essential public services can be expected during floods. Additional emergency services such as cleanup and repair of damaged public facilities can be expected.	Same as No Action	Same as No Action	Flood protection for public services would result in average annual benefits of $14,700	Flood protection for public services would result in average annual benefits of $14,700	Flood protection for public services would result in average annual benefits of $14,700	Flood protection for public services would result in average annual benefits of $14,700

TABLE 23
(Continued)
ASSESSMENT OF EFFECTS SUMMARY

	Considerations	No Action (Profile w.o improvements)	Non-Structural Control	Land Use Controls	System of Small Upstream Reservoirs	Levees, Floodwalls & Channel Improvement	Two Reservoir System	Dam Reservoir Recommended Project)
4	Local Regional Activity and Growth	Activity during storms would continue to be overshadowed by the threat and fear of floods. Activity during floods would be severely restricted	Same as No Action	Growth of the area would be restricted since most of the flood plain could not be used	Plan would stimulate orderly development of the flood plain free from periodic flooding and unscheduled displacement of residents. The possible parks at each reservoir could provide recreational activities.	Plan would stimulate orderly development of the flood plain free from periodic flooding and unscheduled displacement of residents	Plan would stimulate orderly development of the flood plain free from periodic flooding and unscheduled displacement of residents. Possible parks at the two reservoirs could provide local and regional recreational activities	Plan would stimulate orderly development of the flood plain free from periodic flooding and unscheduled displacement of residents. In addition, the recreational aspects of the plan would stimulate local as well as regional recreational activity.
5.	Business Activity	Commercial and industrial establishments would continue to sustain average annual damages amounting to $311,300.	Floodproofing the commercial and industrial establishments would reduce the average annual structural damage, but the area would still be subject to flood conditions	Future business activity would be greatly restricted in the flood plain and many of the existing establishments would probably have to be removed.	Commercial activity within the flood plain would be protected against floods resulting in average annual benefits of $196,800. Some increase in business activity may occur as a result of flood protection	Commercial activity within the flood plain would be protected against floods resulting in average annual benefits of $196,800. Some increase in business activity may occur as a result of flood protection	Commercial activity within the flood plain would be protected against floods resulting in average annual benefits of $196,800. Some increase in business activity may occur as a result of flood protection.	Commercial activity within the flood plain would be protected against floods resulting in average annual benefits of $196,800. Some increase in business activity may occur as a result of flood protection
6	Agricultural Activity	Agricultural activities in the flood plain will continue to sustain an average annual damage amounting to more than $238,000	Same as No Action	Same as No Action	Protection from flood damage would result in average annual benefits of $62,800	Protection from flood damage would result in average annual benefits of $62,800	Protection from flood damage would result in average annual benefits of $62,800	Protection from flood damage would result in average annual benefits of $62,800.
ENVIRONMENTAL FACTORS								
1	Man-made Resources	Existing - Man-made resources particularly the residential and commercial developments would be subject to flood damage. Future - Addition of future man-made resources would be subject to flood damage.	Existing - Man-made resources, particularly the residential and commercial developments would be subject to flood damage, but floodproofing will reduce damage. Future - Addition of future man-made resources would be subject to flood damage but floodproofing would reduce the amount of damage.	Existing - Man-made resources would be restricted and some would have to be removed from the flood plain. Future - Addition of future man-made resources would be restricted within the flood plain.	Existing and future man-made resources would be protected against floods. In addition, there could be man-made recreational resources provided.	Existing and future man-made resources would be protected against floods	Existing and future man-made resources would be protected against floods. In addition, there could be man-made recreational resources provided	Existing and future man-made resources would be protected against floods. In addition, the project would provide man-made recreational resources

TABLE 21
(continued)
ASSESSMENT OF EFFECTS SUMMARY

Considerations	No Action (Profile W.O. Improvements)	Non-Structural Control	Land Use Controls	System of Small Upstream Reservoirs	Levees, Floodwalls & Channel Improvement	Two Reservoirs System	Dam Reservoir Recommended Project
2 **Natural Resources**							
a. Flora and Wildlife	No change from existing conditions	No change from existing conditions	No change from existing conditions	Permanent loss of wildlife habitat due to inundation. Change of stream habitat to reservoir habitat	Depending upon type and extent of work some stream life habitat may be lost. Loss of some wildlife habitat	Permanent loss of wildlife habitat due to inundation. Change of stream habitat to reservoir habitat	Permanent loss of wildlife habitat due to inundation. Plan also provides for the acquisition of 1,200 acres of land adjacent to the Thurmond-Nathan Wildlife Management Unit to compensate for the loss of the wildlife habitat. Change of stream habitat to reservoir habitat
b Vegetation	No significant changes expected	No significant changes expected	Possible increase in amount of native vegetation with the removal of some buildings and crop lands	Inundation and or removal of vegetation for dams and pools	Removal of existing vegetation limited to lands required for channel widening, easements, and/or levees. Non-urbanized lands basically unchanged.	Inundation and or removal of vegetation for dams and pools. Possible increase in amount of landscaped and visually appealing vegetation in area around reservoirs	Inundation and or removal of vegetation for dam and pool. Selective clearing and landscaping will minimize effect on remainder of the area
c Physiographic Elements	No significant changes expected	No significant changes expected	Small amount of land change as restrictions are placed on land use of area	Significant change in water-land relationship. Replacement of several areas of free-flowing natural stream to small lake-like environments	Minimal channel widening would require conversion of a narrow strip of land to stream channel. Levees would require change of land along stream	Significant change in water-land relationship. Replacement of several miles of natural free-flowing stream by two lake-like environments	Significant change in water-land relationship. Replacement of 6.5 miles of free flowing natrual streams with a lake-type environment.
3 **Pollution Aspects**							
a Noise	No significant effects.	No significant effects	No significant effects	Temporary increase in noise during construction. Possible increase after completion from recreational use if small paths are added	Temporary increase in noise during construction	Temporary increase in noise during construction. Possible increase after completion from recreational use if two recreational areas are added.	Temporary increase in noise during construction period. Some increase after completion due to recreation use and related activities
b Air Quality	No significant effects	No significant effects	No significant effects	Some dust problems limited to construction period. Emissions from construction vehicles and possible increase due to increased use of area	Some dust and emission problems limited to construction period	Some dust and emission problems during construction. Possible increase in vehicle emissions due to increased use of area	Some dust and emission problems limited to construction period. Possible increase in vehicle emissions due to increased use of area

TABLE 23
Continued
ASSESSMENT OF EFFECTS SUMMARY

	Consideration	No Action (Profile w/o Improvements)	Non-Structural Control	Land Use Controls	System of Small Upstream Reservoirs	Levees, Floodwalls & Channel Improvement	Two Reservoirs System	Dam Reservoir Recommended Project
c.	Water Quality Quality	No significant effects	No significant effects	Possible improvement in quality if some residences and commercial establishments are removed	Temporary turbidity during construction *Improved water quality* below the reservoirs by the retention of sediment within the reservoirs	Temporary turbidity during construction Decrease in turbidity due to less bank erosion	Temporary turbidity during construction Improved water quality below the reservoirs by the retention of sediment within the reservoirs	Temporary turbidity during construction Improved water quality below reservoir by the retention of sediment within the reservoir Possible reduction in temperature of release water.
4	Visual Appeal-Aesthetic Values	No significant change from existing conditions.	No significant change from existing conditions.	Possible beneficial effects from restrictions imposed by land use regulations.	Earthfill dams would detract from the aesthetic values of the area Landscaping could improve this situation	Natural appearance of stream would be lost Levees and floodwalls would detract from aesthetic value of area	Earthfill dams would be visually dominant and intrusive structures. Landscaping could improve this situation	Earthfill dam would be a visually dominant and intrusive man-made structure Incorporation of existing topography and landscaping plans will assist in blending it with natural setting

1946 (Public Law 79-526). The current studies have also identified a need for municipal and industrial water supply and recreation, which has been included in the proposed plan of development.

124. The possible consequences of these alternatives have been studied according to environmental, social well-being, and economic effects, including regional and national development and engineering feasibility. An identified public need for the products of water resources development was a major factor in the review of these data. In evaluation, the following points were considered pertinent.

125. Environmental. Alternatives having a lesser environmental impact than the recommended plan were not selected because of their impracticality, excessive cost or inadequacy in meeting the water resource needs of the project area. The major environmental impacts of the project include the permanent inundation of 680 acres of land and 8.15 miles of Reddies River by the conservation pool and the temporary inundation of an additional 655 acres of land and 2.9 miles of Reddies River by the flood control pool. The environmental impact associated with building an impoundment on Reddies River is lessened by the fact of the existence of a low dam just below the project damsite.

126. Social well-being. The project will provide for human needs of area residents by the flood control and water supply benefits, and the recreational opportunities that will result from Reddies River Lake. The adverse social impact that will occur from the relocation of persons and property have been accepted.

127. Engineering. Through a comparative engineering and economic analysis, two alternative damsites were considered along with the recommended site. The selected site is the best location considering both engineering and cost comparisons. The quality of rock is essentially the same at all locations, however, the selected site has less severe weathering than the other sites. Several types of dams can be considered at the selected site, while only a compacted earthfill dam could be considered at the other sites.

128. Economic. From the viewpoint of economics, the selection of the damsite was based on the lower construction costs at the recommended site. The proposed dam is at the general location that was recommended in the Definite Project Report, and the other two sites are within 2,000 feet of this site. The Definite Project Report recommended a dam at this general location. Other damsites, more widely separated, were studied in the Definite Project Report, and a location about 1.7 miles above the confluence with Yadkin River was selected. The recommended damsite will require much less resettlement of homesites than either of the other two sites.

129. Other public interest. In addition to providing benefits from the included project purposes, secondary economic benefits will accrue to the region from development opportunities induced by the project and increased population and employment. It is concluded that the prospective regional benefits are far in excess of the upstream damage and

displacement inconveniences and that reasonable real estate and engineering remedies exist for these project occasioned damages and inconveniences without undue social and economic effects.

130. Conclusions. It is concluded that: the proposed action is based on thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objectives; the adverse effects found to be involved cannot be avoided by following reasonable alternative courses of action which would achieve the considered purposes; where the proposed action had an adverse effect, this effect is either ameliorated or substantially outweighed by other considerations of national policy; the recommended action is consonant with national policy, statutes and administrative directives, and, on balance, the total public interest would best be served by the implementation of the recommendations.

RECOMMENDATIONS

131. Recommendations. It is recommended that the multipurpose project plans for the authorized Reddies River Lake Project on Reddies River, a tributary of the Yadkin River, consisting of an earthfill dam, a gate controlled outlet works adjacent to the right abutment, an uncontrolled open cut spillway, and appurtenant facilities as outlined in this memorandum be approved as a basis for controlled planning, design, and construction of the project.

United States Department of the Interior
BUREAU OF OUTDOOR RECREATION
SOUTHEAST REGIONAL OFFICE
148 Cain Street
Atlanta, Georgia 30303

IN REPLY REFER TO:

OCT 25 1974

District Engineer
U.S. Army Engineer District,
Charleston
Post Office Box 919
Charleston, South Carolina 29402

Dear Sir:

We have reviewed Appendix II, Recreation Resources, for the Reddies River Lake Project, North Carolina, as requested by Mr. Lesemann, Chief, Engineering Division, in a letter of 26 September 1974. Our comments on the preliminary draft of this appendix were provided September 6, 1973. With reference to our comments on the preliminary draft, we evaluated that development of boat ramps as proposed, would encourage and facilitate overuse of the 680-water surface acres.

With ultimate development projected 16 boat ramps, boating (fishing) use on a weekend day as 10 percent of total use, four visitors per boat, and a turnover rate of 1.5, there will be approximately 0.65 percent of the 680 acres or 4.47 acres per boat (fishing). While this is not excessive, density problems might arise when this boating use occurs in conjunction with other use particularly water skiing. Two percent of use is projected for water skiing which is an activity requiring considerably more area of water surface. While the turnover rate for water skiing is considerably higher than that for boating (fishing), these are mutually exclusive uses of water surface. Moreover, the part of water surface excluded from use for boating for a small reservoir the size of Reddies Lake, that is shallow and areas close to the shoreline, is a considerable percent of total water surface area.

We are concerned that use based on the level of facility development proposed will result in a reduction of quality in the water based recreation opportunity provided. We suggest that development of boat ramps can be phased over a period to allow monitoring of actual use and if necessary modification of the extent of development of boat access to a level that would assure quality recreation experience for visitors.

Sincerely yours,

/s/ Robert M. Baker
Regional Director

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

EXHIBIT 1

United States Department of the Interior
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
17 EXECUTIVE PARK DRIVE, N.E.
ATLANTA, GEORGIA 30329

April 16, 1974

District Engineer
U.S. Army Corps of Engineers
Charleston, South Carolina

Dear Sir:

The Bureau of Sport Fisheries and Wildlife, in cooperation with the North Carolina Wildlife Resources Commission, has completed a reevaluation study of the authorized Reddies River Lake project, Wilkes County, North Carolina, as requested in your letter of July 28, 1972. The Bureau's original survey report was dated April 22, 1969. Authority for your present study is contained in the Flood Control Act of July 24, 1946, (P.L. 79-526, 79th Congress, 2d Session). This letter constitutes our detailed report, prepared and submitted under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and is intended to assist you in the preparation of a master plan for project lands and a general design memorandum for project structures.

The authorized project will consist of a dam and reservoir located within and just north of the city limits of North Wilkesboro, North Carolina, about 1.7 miles above the outlet of the Reddies River into Yadkin River. The present plan for the multipurpose project provides for flood control, water supply, and outdoor recreation. Pertinent engineering data, on which our current studies are based, are presented in the following table.

Reddies River originates on the eastern slope of the Blue Ridge Mountain Province in Wilkes County, North Carolina, and empties into the Yadkin River in the foothill region of the Piedmont Plateau Province. Its principal tributaries are the North Fork, Middle Fork, and South Fork Rivers. The headwaters of Reddies River are clear, cold, and turbulent, whereas the lower reaches are moderately swift, warmer, and oftentimes heavily laden with sand and other alluvial particles.

In the project area the Reddies River ranges in width from approximately 30 to 90 feet and consists of pools of various lengths and depths separated by rocky outcrops and riffle areas. Fishery resources are composed primarily of warm-water species such as smallmouth bass, redbreast and bluegill sunfish, catfishes, suckers, and carp. Fishing pressure is relatively light and there is no commercial fishery.

The project area consists mainly of woodlands with an occasional interspersion of cleared farmlands and pasturelands. Some of the major tree

EXHIBIT 2

Table 1

PERTINENT ENGINEERING DATA

GENERAL		
Stream	Reddies River	
Damsite Location (Miles Above Mouth)	1.7 Mi.	
Drainage Area Above Dam	94.5 Sq. Mi.	
Length of Main Channel Thru Project	8.5 Mi.	
Lake Shoreline Length	32.7 Mi.	
STREAMFLOW		
Average Annual Discharge	134	c.f.s.
Average Minimum Monthly Discharge	30.8	c.f.s.
Average Maximum Monthly Discharge	587	c.f.s.
Maximum Flow of Record	27,000	c.f.s.
7-Day,10-Year Low Flow	36	c.f.s.
WATER ELEVATIONS - LAKE		
Maximum Water Surface	2,020	Acres
Top of Flood Control Pool, Feet	1,110.0	El.Msl
Area of Flood Control Pool	1,335	Acres
Top of Conservation Pool, Feet	1,074.2	El.Msl
Area of Conservation Pool	680	Acres
Streambed, Feet	975	El.Msl
STORAGE CAPACITY		
Maximum Water Surface	99,740	Acre-Feet
Flood Control Pool	58,350	Acre-Feet
Conservation Pool	23,350	Acre-Feet
DAM AND APPURTENANCES		
Type	Earth and Rockfill	
Top Elevation, Feet	1,140	Msl
Maximum Height	165	Feet
Length	960	Feet
Type of Intake	Multi-level	
Conduit Diameter	9	Feet
Conduit Flow Capacity	3,440	c.f.s.

and shrub species found in the area include white oak, northern red oak, hickory, black gum, sycamore, yellow-poplar, American beech, red maple, yellow birch, shortleaf pine, Virginia pine, red cedar, witch-hazel, sassafras, hophornbeam, alder, mountainlaurel, and rhododendron.

Wildlife species indigenous to the area include both farm and forest game animals, furbearers, songbirds, birds of prey, and various reptiles, amphibians, and invertebrates. There are no endangered species known to inhabit the project area. Populations of white-tailed deer, bobcat, ruffed grouse, and mourning dove are low. Bobwhite quail, cottontail rabbit, gray squirrel, and gray fox occur in moderate numbers and support most of the local hunting pressure.

Furbearing species residing in the affected area include opossum, raccoon, skunk, muskrat, and mink. Suitable habitat for the muskrat and mink populations exists only in the narrow flood plains, whereas the opossum, skunk, and raccoon populations are found over the entire project area.

Due to habitat limitations, Reddies River does not support a wintering population of waterfowl. However, small groups of mallards, wood ducks, scaups, ring-necks, buffleheads, and mergansers do winter on the nearby Yadkin River. The only resident waterfowl species occurring in the general area is the wood duck.

Construction and operation of Reddies River Lake will completely destroy the existing wildlife habitat within the 680 acres to be inundated by the conservation pool. An additional 655 acres within the flood control pool will be periodically inundated, thus becoming less effective as productive upland wildlife habitat. Losses to wildlife populations will not only result from direct mortalities and habitat destruction within the project area, but also from the displacement of populations to adjacent lands. This displacement will increase population densities and competition for food, cover, and nesting sites in the adjacent land. In essence, the proposed project will result in an irretrievable commitment of upland wildlife habitat and associated fauna throughout the life of the project. Furthermore, the continuous urbanization of surrounding project lands will compound the loss of long-term wildlife productivity.

Implementation of the Reddies River Lake project will result in the transformation of 8.5 miles of warm-water stream habitat into a 680-acre warm-water reservoir. Although some lotic-adapted organisms will be unable to survive the change to a lentic community, the majority of existing populations will increase in numbers due to the increase in warm-water habitat. The reservoir will also provide more suitable habitat for some species such as the largemouth bass and crappie.

An update of fishery values associated with the Reddies River Lake project is contained in the report prepared by the Bureau's National Reservoir Research Program in Fayetteville, Arkansas. The total annual angler-days prediction for Reddies River Lake, as presented in the National Reservoir Research Program report, compares favorably with those values presented in the Bureau's April 22, 1969, report. The

predicted values in that report represent reservoir potential in the absence of pollution and without intensive management.

Although the proposed reservoir will increase the potential for fishing opportunity in the local area, it is likely that the fishing which will develop on Reddies River Lake will be done by fishermen who previously utilized existing reservoirs (for example, W. Kerr Scott Reservoir located just a few miles from the project site). There is already ample reservoir fishing opportunity in North Carolina on a statewide basis, as evidenced by the fact that North Carolina ranks fifth in the Nation in total surface water area within State boundaries. This is one of the criteria used in allocating Dingle-Johnson funds to the various States for fish restoration projects. Therefore, any increase in fishing opportunity resulting from the Reddies River Lake project can only be termed a convenience for residents of the immediate area rather than the satisfaction of a local or State need.

During preparation of the General Design Memorandum for this project several measures, previously discussed in our original report and expanded upon in this report, should be included to develop and preserve certain aspects of project-related fish and wildlife resources. These measures are discussed in the following section.

Fisherman Access. It is our understanding that minimum project facilities for public use, sanitation, and safety will be provided in the event local participation in cost-sharing under Public Law 89-72 is not forthcoming. In our review of the plans for project development with the North Carolina Wildlife Resources Commission, it was generally concluded that these minimum facilities will provide adequate fisherman access to project waters. We further understand that the commission has not provided a letter requesting more than minimum facilities.

Wildlife Mitigation. The Bureau's original impact report dated April 22, 1969, recommended the acquisition of approximately 275 acres of land outside the project area and adjacent to the North Carolina Wildlife Resources Commission's Thurmond Chatham Game Land. This recommendation was based on the computation of man-days of hunting opportunity that would be lost due to project implementation, and does not represent the actual mitigation of wildlife habitat in quantity and quality to those areas destroyed or degraded as a result of project construction and operation.

The exact location of the 275 acres of land adjacent to the Thurmond Chatham Game Land should be determined by this Bureau, the Corps, and the commission prior to preparation of the Detailed Design Memorandum.

Appropriate monetary allocations for this land acquisition should be included in the project planning of the General Design Memorandum. Upon purchase, this land should be made available to the North Carolina Wildlife Resources Commission for intensive wildlife management purposes under the provisions of a General Plan in accordance with Section 3 of the

Fish and Wildlife Coordination Act. Funds should then be made available to the Commission for the development and management of these lands. Furthermore, making available suitable project lands not inundated by the reservoir to the North Carolina Wildlife Resources Commission for management purposes, as provided for in the Flood Control Act of 1962, Section 207, Public Law 87-874, should be included in the General Design Memorandum.

Downstream Flows. It is our understanding that a multilevel intake structure has been included in project plans for the proposed dam to insure that water of sufficient quality and quantity for fishlife is released from the reservoir. The release of a continuous minimum flow to preserve downstream fishery habitat is now of high priority in view of the enactment of the Federal Water Pollution Control Act Amendments of 1972.

To determine a sufficient minimum instantaneous release which will preserve downstream fish habitat, this Bureau, in cooperation with the U.S. Geological Survey and the North Carolina Wildlife Resources Commission, made a low-flow channel characteristics study of Reddies River below the proposed damsite. The study was limited to that area immediately below North Wilkesboro's low-dam impoundment downstream to the outlet of Reddies River into the Yadkin River.

The study reach is composed primarily of two major habitats, riffles and pools. A third category is found where the distinction between riffle areas and pools has become less and less until "channel habitats" have developed. Three cross sections were surveyed with reference points established at each section. Water surface elevations at each cross section were determined at the time of the discharge measurements by taping from the reference points. Water quality tests were also conducted at this time.

Discharge measurements were taken from the U.S. Geological Survey gauge located just upstream from the proposed damsite. Three discharge readings and corresponding water surface elevations were determined and graphed, and a fourth reading of 36 c.f.s. (7-day, 10-year flow) was extrapolated by using plots of elevation versus discharge for each cross section.

Numerous factors influence the productivity and success of fish populations in natural streams including: (1) spawning requirements (such as water depth, bottom type, temperature, etc.) during the spring and early summer, (2) relationship between water temperature and dissolved oxygen in the summer months, (3) percent bottom coverage, (4) food production, (5) availability of cover and other spatial requirements, and (6) the frequency and duration of low flows. Upon studying the relationship of these biological requirements to the data graphically represented on the cross sections, we concluded that an instantaneous release of 36 c.f.s. (7-day, 10-year flow) would provide conditions necessary for the continuation of existing minimum productivity within the study area.

We wish to strongly emphasize that the continuous release of 36 c.f.s. assures only that minimum fish habitat conditions in the downstream area will be preserved. This in no way represents enhancement and therefore should not be included as a project benefit.

Timber Clearing. At later stages in project development, your timber clearing plan should provide for the retention of standing timber in embayments at tributary outlets and in other selected areas within the conservation pool. This would provide the opportunity for creating fish "hides and attractors" which can be of two types: (1) extensive areas of shrub growth submerged below the surface of the conservation pool and marked on the periphery by a few large, emergent, and topped trees, and (2) areas of emergent standing timber. The latter would not only serve as fish cover and refuge but would also encourage wood duck nesting and provide resting areas for migrant waterfowl. These standing timber areas should be selected in subsequent project planning stages by representatives of this Bureau, the Corps, the North Carolina Wildlife Resources Commission, and the North Carolina Department of Health.

Reservoir Impoundment and Operation. To favor establishment of a more valuable sport fishery, initial reservoir impoundment should occur during late fall or winter. When reservoirs are impounded during late spring or summer, spawning success and survival of more desirable species is discouraged while survival of less desirable species is encouraged. Impounding during this period also results in an overabundance of forage fish, particularly those species which grow rapidly and attain a size which prevents them from being utilized as forage. This allows them to compete with more desirable species for food and space, thus causing a loss in sport fish production.

Reservoir surface level fluctuations should be minimized as much as possible during the spring months. Excessive surface level fluctuations could dewater and thus destroy certain game fish (such as largemouth bass and bluegill sunfish) spawning sites and eggs during this period. Reservoir operation should avoid drawdowns in excess of 2 feet for a 30-day period after water temperatures reach 60°F. These procedures would favor development of a more desirable reservoir sport fishery.

Seasonal Maintenance of Maximum Conservation Pool. Maintenance of the maximum conservation pool during the recreational season would provide a larger, more valuable reservoir fishery, and the inundation of mudflat areas would improve the esthetic value of the reservoir. The maximum conservation pool acreage should also be maintained for the longest time possible when recreational use is high and flood expectancy is low. However, during excessively dry years, sizeable portions of the conservation pool may be exposed during the summer months. These occasions would offer an opportunity to manage the dewatered areas for waterfowl. The exposed areas could be seeded with waterfowl foods and, when flooded in the fall and winter months, would provide additional habitat for migrant waterfowl.

To minimize and mitigate potential project effects on public fish and wildlife resources, the Bureau of Sport Fisheries and Wildlife recommends that:

1. Adequate fisherman access be provided to project waters by installing minimum project facilities for public use under authority contained in Public Law 89-72.

2. Monies for acquiring 275 acres of wildlife mitigation lands adjacent to the Thurmond Chatham Game Land be included in the General Design Memorandum, and the exact location of these lands be determined in later detailed design stages of project planning. Upon purchase by the Corps, these lands should be made available to the North Carolina Wildlife Resources Commission for intensive management purposes under the terms of a General Plan in accordance with Section 3 of the Fish and Wildlife Coordination Act. Funds should then be made available to the commission for the development and intensive management of these lands. Also, suitable project lands not inundated by the reservoir should be made available to the North Carolina Wildlife Resources Commission for management purposes, as provided for in the Flood Control Act of 1962.

3. An instantaneous minimum release of 36 c.f.s. be provided at project cost to preserve minimum downstream fish habitat after project installation.

4. A multilevel intake structure be included in the design of the dam to ensure release of waters of desirable quality.

5. Standing timber and submergent fish shelters be retained in embayments at tributary outlets and in the upper part and other suitable areas of the conservation pool to provide more attractive fish and wildlife habitat. These areas should be selected by representatives from this Bureau, the Corps of Engineers, North Carolina Wildlife Resources Commission, and the North Carolina Department of Health during the detailed design stages of project planning.

6. Reservoir impoundment be initiated during late fall or winter and water level fluctuations be kept at a minimum during spring and early summer months.

7. The maximum conservation pool be maintained during the recreational season.

This report has been reviewed and concurred in by the North Carolina Department of Wildlife Resources. A copy of Assistant Executive Director Hazel's letter is attached.

If, at a future date, it is determined that the National Water Resources Council's recently established "Principles and Standards for Planning Water and Related Land Resources" will necessitate a reevaluation of the proposed Reddies River Lake Project, we request an opportunity to participate in the reevaluation studies.

We hope our comments will assist you in your preparation of the General Design Memorandum, and we request the opportunity to review it upon completion.

Sincerely yours,

Ray L. Vaughn

Regional Director

Attachment

State of North Carolina
Wildlife Resources Commission
RALEIGH, N. C. 27611

H. A. ANDERSON, Newland
Chairman
WALLACE E. CASE, Mocksville
E. JACK HOOPS, Burlington
BEN A. HONEYCUTT, Lenoir
DR. LATHAN T. MOOSE, Winston Salem

March 25, 1974

Regional Director
United States Department of the Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife
17 Executive Park Drive, N. E.
Atlanta, Georgia 30329

Dear Sir,

The Commission has reviewed the draft of your proposed report upon the Reddies River Lake Project, Wilkes County, North Carolina and fully concurs with all analyses, conclusions and recommendations made therein.

We appreciate the opportunity of reviewing this draft prior to its submission to the Corps of Engineers, Charleston.

Sincerely,

Robert B. Hazel
Assistant Executive Director

RBH.en

United States Department of the Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife

ESTIMATION OF FISH STANDING CROP, SPORT FISH HARVEST AND ANGLER USE FOR THE PLANNED REDDIES RIVER RESERVOIR, NORTH CAROLINA

Robert M Jenkins
Division of Fishery Research
National Reservoir Research Program
113 South East Street
Fayetteville, Arkansas 72701
August 15 1973

Director, BSFW (FR) (RBS)
Regional Director, Atlanta (RBS) 5 copies
Field Supervisor, RBS, Raleigh North Carolina (5 copies)

AUG 20 1973

EXHIBIT 3

FISH STANDING CROP AND HARVEST ESTIMATES
REDDIES RIVER RESERVOIR, NORTH CAROLINA

The predictions of fish standing crop and sport fish harvest are based on correlation and multiple regression analyses of data from reservoirs throughout the United States and from comparative information on other North Carolina impoundments. Regression formulas and partial correlation results used in the forecasts appear in the following publications:

Jenkins, R. M. 1968. The influence of some environmental factors on standing crop and harvest of fishes in U. S. reservoirs. Reservoir Fishery Resources Symposium, So. Div., Amer. Fish. Soc., Athens, Ga., Apr. 1967. p. 298-321.

Jenkins, R. M. and D. I. Morais. 1968. Effects of thirteen environmental variables on fish standing crop in reservoirs. Proc. 48th Ann. Conf. West. Assoc State Game and Fish Comm: 332-342.

Jenkins, R. M. 1970. The influence of engineering design and operation and other environmental factors on reservoir fishery resources. Water Resources Bulletin 6(1): 110-119.

Jenkins, R. M. and D. I. Morais. 1971. Reservoir sport fishing effort and harvest in relation to environmental variables. In Reservoir Fisheries and Limnology, Amer. Fish. Soc. Spec. Publ. No. 8, p. 371-384.

National Reservoir Research Program. 1972. A compilation of multiple regression formulas for use in estimating fish standing crop and angler harvest and effort in U. S. reservoirs. 10 p. (Attached)

The estimates are predicated on analysis of data from two groups of reservoirs with relatively similar mean physicochemical attributes. In comparison, Reddies River Reservoir would be smaller, shallower, with lower dissolved solids and a shorter growing season (Table 1). Tillery and Tuckertown Reservoirs were added to the analyses to provide comparison of existing impoundments downstream on the Pee Dee River and to test the efficacy of our calculations when compared to available crop and harvest data on Tillery and Tuckertown appearing in North Carolina Wildlife Resources

Table 1. Mean values of environmental variables in National fish standing crop and sport fish harvest samples compared to those in Reddies River, Tillery and Tuckertown Reservoirs

Environmental variable	National standing crop sample	National angler harvest sample	Reddies River Reservoir	Tillery Reservoir	Tuckertown Reservoir
Area (acres)	15,800	14,650	680	5,290	2,530
Mean depth (ft.)	28	35	34	31	17
Outlet depth (ft.)	49	61	94	50	45
Fluctuation (ft.)	17	25	20 est.	10	3
Storage ratio	0.45	0.67	0.24	0.042	0.01
Shore development	11.8	8.5	9.0	6.2	9.1
Dissolved solids	162	282	30 (50)*	60	55
Growing season (days)	190	192	180	200	200
Reservoir age (yrs)	19	20	-	-	-
Thermocline depth (ft.)	-	-	30	-	-
Morphoedaphic index	-	8.1	0.9	1.9	3.2

*Calculations were also made using a TDS value of 50 ppm, but are not presented. Primary difference in prediction between use of 30 and 50 ppm TDS was an increase of 1,000 angler-days per year over a 100-year period (i.e., 10,100 angler-days per year compared to 9,100 angler-days). See Table 7.

Commission Job Completion Reports, Federal Aid Projects F-5-R and F-6-R, (1957-1966). The predictions for Reddies River do not account for the detrimental effects of unanticipated pollutants or high turbidity.

PREDICTED STANDING CROP

Reddies River Reservoir is classified as nonhydropower, chemical type 1 (Ca-Mg, CO_3-HCO_3). Partial correlation analyses have shown that thermocline depth is negatively related and dissolved solids and reservoir age are positively related to total standing crop. A multiple regression using these parameters (Formula 1, Attachment A) explains 35 percent of the variability in total crop and indicates that fish biomass (as estimated by cove rotenone sampling) would increase from about 72 to 117 pounds per acre through 100 years of impoundment (Figure 1). The standing crops in unstratified Tillery and Tuckertown Reservoirs are predicted to remain relatively stable at about 150 and 200 pounds per acre, respectively (Table 2). Other regressions used to predict crops of sport fishes, clupeids and the remaining fishes, predicated on reservoir age 20, indicate that crops would be higher in Tillery and Tuckertown than in Reddies River Reservoir (Table 2).

The relative abundance of various fishes in Reddies River can be predicated on the influence of environmental factors (Jenkins, 1970). Comparison of its physicochemical characteristics with the National sample means indicates the following relative effects:

Characteristic in relation to National sample mean	Effect on species standing crops
Smaller surface area	Positive effect on redhorses, bullheads, sunfishes, black bass. Negative effect on pickerel.

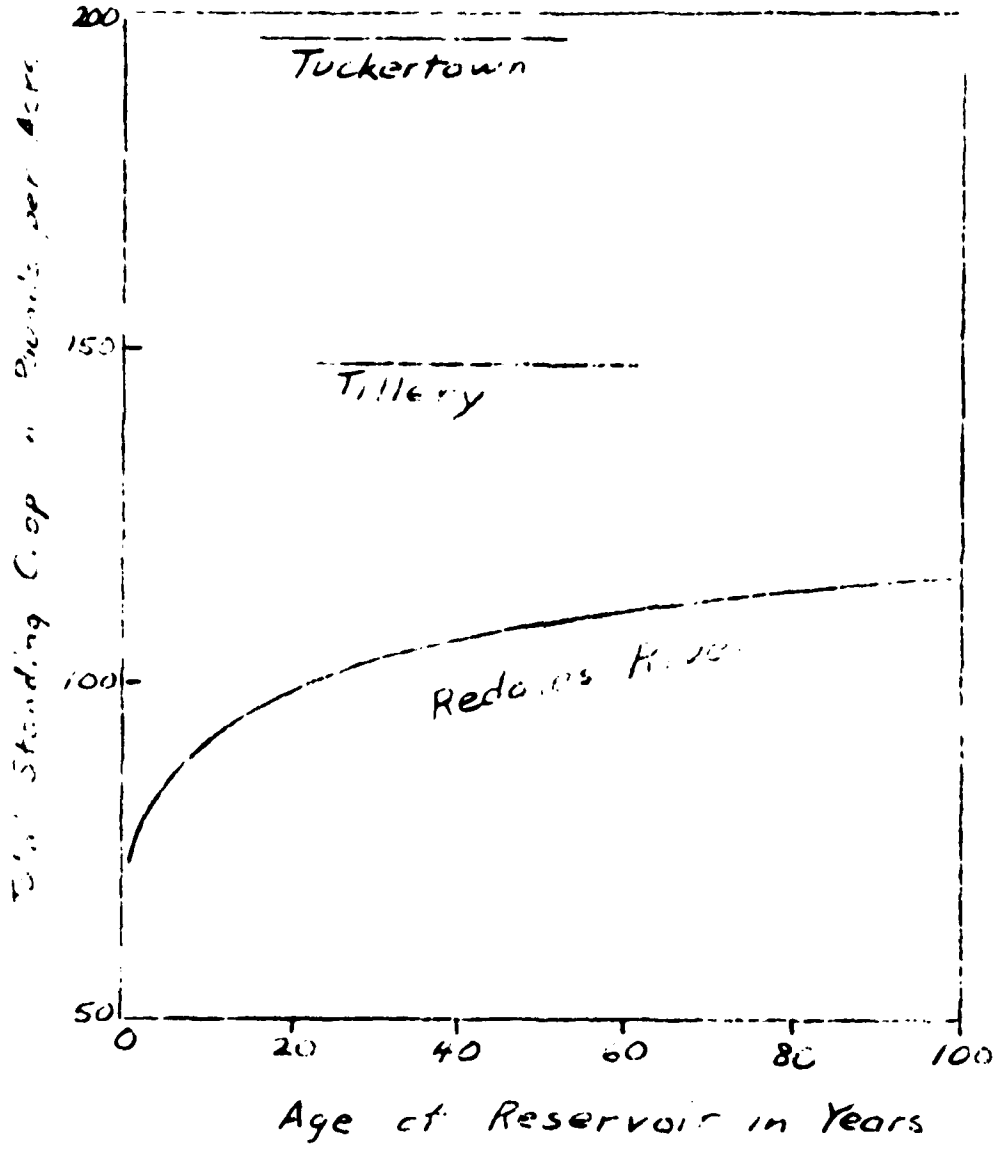


Figure 1. Comparison of predicted total standing crop in [illegible] River (Formula 3), Tillery and Tuckertown (Formula 1) Reservoirs.

Table 2. Comparison of predicted standing crop of sport, clupeid and other fishes in Reddies River, Tillery and Tuckertown Reservoirs, based on Formulas 1, 2, 3, 7, 17, 25 (Attachment A)

	Standing crop in pounds per acre		
Standing crop of -	Reddies River	Tillery	Tuckertown
Sport fishes	50	63	68
Clupeids	41	73	93
Other fishes	16	12	36
Total	107	148	197

Lower storage ratio	Positive effect on threadfin shad, redhorses, bluegill. Negative effect on bullheads, catfishes, largemouth and smallmouth bass and white crappie.
Deeper outlet depth	Positive effect on carp, buffalofish, bullheads, catfishes, green sunfish, largemouth bass, white crappie. Negative effect on spotted sucker.
Lower total dissolved solids	Positive effect on pickerel, spotted sucker, bluegill, warmouth, black crappie. Negative effect on longnose gar, gizzard shad, carpsuckers, catfishes, white bass, green sunfish, largemouth bass, white crappie

In sum, Reddies River Reservoir should support above average crops of carp, redhorses, bullheads, bluegill, and other sunfishes; and below average crops of catfishes and white crappie. Evidence to support some of these trends in relative abundance are available from rotenone samples taken in Tillery and Tuckertown Reservoirs (Table 3).

PREDICTED ANGLER HARVEST AND EFFORT

Analyses of the influence of ten environmental variables on angler effort and harvest (Jenkins and Morais, 1971) have revealed highly significant (0.01) level negative relationships between reservoir size and angler effort and harvest; between reservoir age and rate of harvest and total harvest; and a positive relation between length of growing season (frost-free days) and angling pressure and yield.

Table 3. Mean standing crop of fishes in Tillery (1965) and Tuckertown (1965) Reservoirs as determined by rotenone sampling. North Carolina Wildlife Resource Comm. Federal Aid to Fisheries Job Completion Reports. All species present in Tillery are listed

Species	Standing crop in pounds per acre	
	Tillery	Tuckertown
Longnose gar	0.3	
Gizzard shad	57.3	63.6
Threadfin shad	4.2	3.3
Redfin pickerel		
Chain pickerel		
Bigmouth buffalo		
Quillback	t	
Smallfin redhorse		
Suckermouth redhorse	14.1	1.1
V-lip redhorse		
Lake chubsucker		0.1
White sucker		
Carp		16.3
Golden shiner	0.1	
Minnows (Notropis sp.)	0.1	t
Channel catfish	2.1	0.1
White catfish	16.4	2.4
Yellow bullhead	6.6	3.6
Brown bullhead		
Tadpole madtom		
American eel		
Mosquitofish		
Pirate perch		
White perch	3.0	1.1
White bass	0.5	2.0
Warmouth	2.5	1.5
Bluespotted sunfish		
Redbreast sunfish	2.6	1.6
Green sunfish	1.2	3.4
Pumpkinseed	11.0	6.0
Bluegill	11.5	16.6
Redear sunfish	2.2	
Largemouth bass	3.2	3.1
White crappie	1.0	1.6
Black crappie	0.3	0.3
Johnny darter	0.1	
Yellow perch	9.2	2.1
Walleye		
Total	149.4	129.8
Sport fishes	73.2	45.4
Clupeids	61.5	66.9
Other fishes	14.7	17.5
NRRP prediction		
Total	148	197
Sport fishes	62	59
Clupeids	73	73
Other fishes	13	65

A multiple regression involving area, dissolved solids, growing season and age (Formula H, Attachment A) was chosen to calculate effort and harvest for the three reservoirs. Angler use estimates are based on Formula H predictions in pounds/acre divided by Formula M harvest predictions in pound/angler-hour (Tables 4 and 5).

Predicted annual sport fish harvests per acre through 100 years of impoundment are similar in all three reservoirs, ranging from about 50 pounds/acre to 12 pounds/acre at reservoir age 100, with means of 17-19 pounds/acre (Table 4). These predictions indicate that harvests will constitute from 80 percent to 20 percent of the sport fish standing crop (Table 2) through 100 years of impoundment with the mean harvest being about 38 percent of the crop in Reddies River.

When interpreting the harvest regression curves, it should be borne in mind that there is considerable fluctuation about the calculated means Reservoir angling harvests typically build to a peak in the third or fourth year of impoundment, with secondary peaks in the seventh or eighth year and irregularly in subsequent years. However, summations of calculated and actual harvests over 5 or 10-year periods should yield similar totals.

Predicted rates of harvest in pounds/hour are highest in Tuckertown, followed by Tillery and Reddies River -- all decreasing with reservoir age (Table 5). Rates in Reddies River are predicted to fall below the arbitrary standard for good fishing of 0.5 pounds per hour after reservoir age 2. However, daily harvests greater than 1.5 pounds/day are expected to continue through 20 years (with mean angler-day length of 4.0 hours).

Table 4. Predicated annual sport fish harvest in Reddies River, Tillery and Tuckertown Reservoirs through 100 years of impoundment (Formula H)

Age of reservoir (yrs.)	Predicted sport fish harvest in pounds per acre		
	Reddies River	Tillery	Tuckertown
1	52	49	54
2	42	40	44
5	32	30	33
10	26	24	27
20	21	20	22
50	16	15	16
100	13	12	13
100 yr. mean	19*	17	19

*Through 100 years, the mean annual harvest of sunfishes is predicted to be 5 pounds per acre, of black basses, 3 pounds per acre.

...d ... of direct ... from annual ... harvest ... in pounds of fish harvested per hour for Reddies River, Tillery, and Tuckertown Reservoirs through 100 years of impoundment (Formula 3, with variables of surface area, storage ratio and reservoir age)

Age of reservoir (yrs.)	Predicted harvest rate in pounds/hour		
	Reddies River	Tillery	Tuckertown
1	0.54	0.83	0.[illegible]
[illegible]	0.50	[illegible].75	0.[illegible]9
5	0.44	[illegible].68	0.7[illegible]
10	0.40	0.62	0.6[illegible]
20	0.37	0.57	[illegible].5[illegible]
[illegible]	0.33	0.50	0.[illegible]3
[illegible]0	0.30	0.46	0.[illegible]9
100 ye[illegible] mean	0.34	0.53	0.56

numbers of fish harvested per acre are predicted to drop sharply with age (Table 6). However, average weight of fish caught is expected to increase with age. For example, mean weight of fish harvested in Reddies River is estimated to increase from 0.19 pounds at age I to 0.24 pounds at reservoir age 10. This is a reflection of the expected net gain in biomass of sportfish as the reservoir ages, and should have occurred in Millers and Jamestown as well (Millers, 0.34 to 0.47 lb/fish; Jamestown, 0.29 to 0.40 lb/fish).

Total angler-days per annum predictions based on Formulae B and C and an angler-day length of 4 hours, indicates that total use should be highest on Miller, followed by Jamestown and Reddies River. Table 7. A comparison of our 100-year mean annual angler-day prediction with that of the Division of River Basin Studies on Reddies River shows relatively close agreement. On a 50-year period analysis basis our estimate of mean annual use would be about 10,600 angler-days.

The FPC predictions are based on 103 reservoirs where the mean year of annual census estimate was 1961 (range, 1946-1969), the relative adequacy of access and angler accommodations, the geographic pattern of angler populations in relation to reservoir location were not determined.

Reddies River Reservoir might be managed to improve the predicted average sport fish harvest (19 pounds per acre) by introduction of northern pike, striped bass or walleye, control of the fish population by planned drawdown and removal of undesired fishes, and construction of adequate numbers of fishing piers, launching ramps and camping facilities. If optimum management were attained, maximum catch rate would be controlled by the productive capacity of the environment. The predicted

Predicted annual sport fish harvest in number of fish per acre from Reddies River, Tillery and Tuckertown reservoirs through 100 years of impoundment (Formula K)

Reservoir age (yrs.)	Number of fish harvested per acre		
	Reddies River	Tillery	Tuckertown
1	258	145	187
2	199	112	144
5	141	79	102
10	108	61	79
20	84	47	61
50	59	33	43
100	46	26	33
100 yr. mean	73	41	53

Table 7. Predicted total annual angler-days in Reddies River, Tillery and Tuckertown Reservoirs through 100 years of impoundment, based on formulas H and M, with an assumed mean angler-day length of 4.0 hours

Age of reservoir (yrs.)	Predicted total angler-days per annum			
	Reddies River		Tillery	Tuckertown
		TDS = 50 ppm		
1	16,500	18,300	78,000	39,000
2	14,500	16,100	69,000	34,000
5	12,400	13,700	59,000	29,000
10	10,900	12,100	52,000	26,000
20	9,700	10,700	46,000	23,000
50	8,200	9,100	39,000	19,000
100	7,300	8,100	34,000	17,000
100-yr. mean	9,100	10,100	43,000	21,000
RBS prediction	13,600*	-	-	-

*50-year project analysis (20 angler-days/acre)

standing crop of sport fishes is 50 pounds per acre. Standing crop as measured by rotenone sampling in midsummer is hypothetically equal to carrying capacity. Based on a protein replacement theory advanced by D. H. Thompson (1941. In "A Symposium on Hydrobiology, p. 206-217, Univ. Wisc. Press, Madison), the maximum yield from Reddies (180-day growing season, Lat. 36°N) would equal about 50 percent of the carrying capacity. Maximum sustained yield potential would be about 25 pounds/acre. Thus, a potential exists to increase the predicted mean harvest by 6 pounds per acre, supporting an additional 3,000 angler-days per year.

Results from previous analyses (Jenkins and Morais, 1970, 1971) suggest that average annual Nationwide angler harvest equals about 35 percent of the total sport fish standing crop in the 20th year of impoundment. On this basis, the anticipated harvest would be about 18 pounds per acre in Reddies River -- 3 pounds per acre less than the estimate derived by Formula H (Table 5).

PREDICTED COMMERCIAL HARVEST

Estimation of potential commercial fish harvest in Reddies River Reservoir was derived from a multiple regression with variables of mean depth, water level fluctuation, storage ratio, growing season and age (Table 8). The regression was derived from a sample of 45 reservoirs where the commercial fishery was primarily gill nets and the species harvested were primarily buffalofish, carp, catfishes and drum. The potential commercial harvest is predicted to increase through 100 years of impoundment.

If the reservoir were fished intermittently (e.g., once every ten years), the potential annual harvest figures should be cumulative up to

Table 8. Predicted potential annual commercial fish harvest in Reddies River, Tillery and Tuckertown Reservoirs through 100 years of impoundment (Formula Q)

Reservoir Age (yrs.)	Annual commercial harvest in pounds/acre		
	Reddies River	Tillery	Tuckertown
1	1.6	2.2	5.2
2	2.3	3.1	7.3
5	3.5	4.8	11.4
10	4.9	6.7	15.9
20	6.9	9.4	22.2
50	10.7	14.7	34.5
100	15.0	20.5	48.7
100-yr. mean	10.1	13.8	32.5
Total pounds per year (100-yr. mean)	7,000	73,000	82,000

a value approaching carrying capacity (approximately 30 pounds/acre of marketable fish). At an average landed price of 10 cents/pound, the mean annual gross value of a fishery would be about $700.

ENV' ONMENTAL PROTECTION AG ICY
REGION IV
1421 Peachtree St., N.E., Atlanta, Georgia 30309

Mr. Jack E. Iveseman
Chief, Engineering Division
Charleston District
U. S. Army Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Mr. Iveseman:

This is in response to your letter of August 4, 1972, in which you requested a review of previous findings for adequacy of water quality needs and other areas of specific interest, for the Reddies River Lake project in North Carolina. Please be advised that we can no longer support the earlier recommendations of FWPCA which called for a total of 35,000 acre-feet of storage in the upper Yadkin River Basin. We recommend that the need for and value of water quality storage be redefined incorporating current data and EPA policy guidelines.

Because of other agency commitments it is not possible to provide a precise estimate of when this office could complete a reappraisal of the Reddies River project. However, considering our current workload, it is estimated that the study could possibly be completed sometime within the next eight to ten months. If this time frame is not acceptable to you, two alternative courses of action may be more desirable:

(a) Contract the study to a private firm. This office may be able to provide assistance in locating qualified contractors and providing contracting estimates.

(b) Corps of Engineers collect the raw data, perform the preliminary assessments and EPA Water Quality Planning Office will make the final computer analysis to determine augmentation needs. This approach would considerably reduce our manpower requirement and allow us to provide a simple letter report to you within a month of receiving your input.

In any case, we will be happy to discuss the studies which will be required, the data to be gathered, the analysis to be performed, and the assumptions underlying these studies which will be compatible with EPA policy. Our overall estimate of the time required to complete

EXHIBIT 4

the entire study is about one man-month, regardless of who performs the study. The final computer analysis, noted in (b) above will require only about five days, using existing EPA programs.

We have attached for your information, a summary of data which will be required to perform the water quality flow augmentation analysis. It may not be necessary to complete the full analysis if it is apparent from a preliminary check that no flow augmentation will be required. This can be discussed in greater detail if you select this approach. Feel free to call me or Mr. Paul Wagner of my staff if you require further information.

Sincerely,

Paul J. Traina
Director, Water Programs Branch

Attachments (1)

DATA REQUIRED AT ASSESS WATER QUALITY STORAGE
NEEDS AT THE REDDIES RIVER LAKE PROJECT

1. In-stream water quality data for streams tributary to the proposed impoundment and also for the mainstem system below and within the hydraulic influence of the project (to below Winston-Salem, N. C.). Information collected should include dissolved oxygen, biochemical oxygen demand and nitrogen concentrations as well as any other quality parameters which may be available (e.g., pH, coliform, phosphorus, etc.).

   Source: N.C. Department of Air & Water Pollution Control (NCDAWPC) and EPA Storet System.

2. Waste source data for all domestic and industrial inputs to the stream system described in 1 above. Flow, BOD, and nitrogen content of each source should be recorded, along with D.O. content at the outfall, if available. BOD removal efficiencies should be noted.

   Source: NCDAWPC

3. Stream system data should be collected and tabulated for each stream noted in 1 above. Information should include mileage to each major stream confluence and waste input point, approximate mean depth and cross-section of each river reach, and mean velocity of water travel under low flow characteristics for each reach. Seven-day, ten-year low flows for each reach should be tabulated.

   Source: U. S. Geological Survey (USGS) and Corps of Engineers (USCOE).

4. Population and economic growth projections, preferably broken down to the sub-county (township) level. Projections should be for 10 year increments to the year 2000. These projections should be translated into projected waste production, by township for each projection date.

   Source: U. S. Department of Agriculture, Economic Research Service (USDI-ERS) and EPA.

5. Water use projection for each community (township) within the study area for each projection date above.

   Source: USCOE and North Carolina Department of Natural & Economic Resources (NCDNER).

6. State and local plans proposed for waste treatment systems within the study area. This information should be utilized in projecting future service areas and effluent points as well as anticipated treatment efficiency.

   Source: NCDAWPC and local communities.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
SOUTHEAST REGION, P. O. BOX 10008
FEDERAL BUILDING, RICHMOND, VA 23240

IN REPLY REFER TO:

L7423 SER(CP)

SEP [illegible] 0

Colonel Burke W. Lee, District Engineer
Charleston District, Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Lee:

We have reviewed the Reddies River Reservoir Project in North Carolina as requested in your letter of August 31, 1970.

Archeological sites have been recorded within the project area. In conjunction with project development, a program of survey and salvage should be planned to recover archeological data. The Director, Southeast Region, should be kept informed in order to plan and program the necessary work.

The National Historic Preservation Act of 1966, P. L. 89-665, requires that any Federal or federally assisted undertaking in any State take into account its effect on any historic site or structure listed in the National Register of Historic Places. The National Register of Historic Places is a list of properties significant to the nation, to the States, and to local areas because of significance in history, architecture, archeology, and culture. It was published in the "Federal Register," Part II, February 25, 1969. Supplements announcing additions, deletions, and corrections are published in the "Federal Register" on the first Tuesday of each month.

Because many properties are nominated to the National Register by State Liaison Officers appointed by the Governors, it is suggested that you consult the State Liaison Officer for North Carolina (Dr. H. G. Jones, Department of Archives and History, North Carolina 27602) for information on this matter.

We have no further comments on the environmental impact.

When we may be of further assistance, please let us know.

Sincerely yours,

Vincent Ellis
Acting Director, Southeast Region

cc:
Regional Coordinator, Southeast Region (Mr. Lorentzson)
Chief, Southeast Archeological Center
Supt., Cape Lookout

EXHIBIT 5

United States Department of the Interior

NATIONAL PARK SERVICE

Southeast Archeological Center
P. O. Box 1294
Tallahassee, Florida 32302
September 1, 1971

IN REPLY REFER TO:

District Engineer
Wilmington District, Corps of Engineers
P. O. Box 1890
Wilmington, North Carolina 28401

Dear Sir:

We have recently completed the annual coordination meeting with members of your staff to discuss archeological investigations needed in Wilmington District projects.

For fiscal year 1972, [illegible] projects were scheduled for investigation in the National Park Service budget.

For fiscal year 1973, we will recommend that the investigations listed in the Service budget for the following:

Little River, Jackson County, N. C.	- Survey
Bethel River Lake, Wilkes County, N. C.	- Survey-test
Eagle River (Wilmington District) N. C.	- Survey-test
[illegible] River, [illegible]	- Survey

The coordination meeting of your office with the Inter-Agency Archeological Salvage Program is greatly appreciated.

Sincerely yours,

[signature]
Richard B. Faust, Acting Chief
Southeast Archeological Center

EXHIBIT 6

FEDERAL POWER COMMISSION
REGIONAL OFFICE
730 Peachtree Building
Atlanta, Georgia 30308
June 18, 1973

District Engineer
Corps of Engineers
Department of the Army
Post Office Box 919
Charleston, S. C. 29402

Dear Sir:

This is in response to your letter of April 17, 1973, your file number SANGE, transmitting design information and general data on the Reddies River Lake project on the Reddies River at North Wilkesboro, North Carolina, and inviting our comments on the hydroelectric power potential of the project.

The Reddies River Lake project, authorized by the Flood Control Act of July 24, 1946, was originally for flood-control purposes. Other purposes now being studied are water supply, water quality, and recreation.

The proposed site for the Reddies River Lake project is located 1.7 miles above the confluence of the Reddies and Yadkin Rivers. The project includes a 250-foot long uncontrolled chute spillway; a 960-foot long, rolled earth dam across the riverbed; and outlet works with a multi-level intake.

The project reservoir has an area of 680 acres and a capacity of 23,350 acre-feet at conservation pool elevation 1074.2. The project reservoir also has a capacity of 99,740 acre-feet at flood-control pool elevation 1110.0. Flood control, water supply, and water-quality storage allocations are 35,000, 8,200, and 10,800 acre-feet, respectively.

A study was made to determine the feasibility of adding hydroelectric power to the project at the dam. We have analyzed the economics of a 5,000-kilowatt installation based on a 10 percent load factor use during an adverse period. This installation would

EXHIBIT 7

generate about 8,500 megawatt-hours of energy per year. Our economic study shows that the 5,000-kilowatt hydroelectric plant would not be economically feasible at this time. If hydroelectric power installation should become economical in the future, there is sufficient space at the project for its construction.

Pumped-storage development is not adaptable at the Reddies site because of low head, insufficient forebay and afterbay storage, and urban development in the vicinity of the Reddies site.

We conclude that the installation of hydroelectric power at the project is *not feasible at this time*. *However*, the installation of hydroelectric power facilities should be considered if found to be economical in the future.

Very truly yours,

C. L. Fishburne

C. L. Fishburne
Regional Engineer

2cc: Div. Engr.
Atlanta, Ga.

United States Department of the Interior

GEOLOGICAL SURVEY
P. O. Box 2857
Raleigh, North Carolina 27602

Your reference:
SANGE-S

August 4, 1972

Mr. Jack J. Lesemann
Chief, Engineering Division
U. S. Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Mr. Lesemann:

This refers to your letter of August 3, advising that the Reddies River Lake Project is in Phase I of General Design.

We have no views or comments to express on the project. You noted that the gaging station No. 02111500 would be inundated by the project. As in similar cases, it is assumed that relocation of the station may be considered as part of the cooperative stream-gaging program when construction of the project is scheduled.

Sincerely yours,

Ralph C. Heath
District Chief

NOT:rr

EXHIBIT 8

State of North Carolina
Department of
Natural and Economic Resources
Raleigh 27611

November 26, 1974

Colonel Harry S. Wilson, Jr.
District Engineer
Charleston District
U. S. Army Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

This letter is furnished to signify the intent of the State of North Carolina to assume the role of sponsor for water supply storage in the Reddies River Lake Project. We understand that anticipated water supply storage for the project is 18,400 acre-feet, and that this will provide a firm yield of 50.5 cfs or 32.6 mgd.

In accordance with the provisions of the Water Supply Act of 1958 (Title III of Public Law 85-500), for the purposes of your current GDM Study and subject to further detailed analysis of the results of your study, I hereby give assurance of the State of North Carolina's intent to fulfill the following:

> "Repay all costs allocated to water supply presently estimated at $10,339,000 for construction and $86,000 annually for operation, maintenance, and replacements."

No commitment of funds can be made at this time for the State's participation in the project. The Department of Natural and Economic Resources intends to request through regular budgetary procedures, in a timely and appropriate manner, the State funds required to support the provision of water supply storage in this project.

Yours truly,

James E. Harrington

EXHIBIT 9

State of North Carolina
Department of
Natural and Economic Resources
Raleigh 27611

September 23, 1974

Colonel Harry S. Wilson, Jr.
District Engineer
Charleston District
U.S. Army Corps of Engineers
Post Office Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

This letter is furnished to signify the intent of the State of North Carolina to assume the role of sponsor for recreational development of the Reddies River Lake project.

In accordance with the provisions of the Federal Water Project Recreation Act, PL 89-72, the State of North Carolina hereby gives assurance of intent to fulfill the following:

a. Administer project lands, facilities, and water areas for recreation, and assure access to such development to all on equal terms.

b. Contribute in kind no less than one-half of the separable first costs allocated to recreation, presently estimated at $ 2,100,000.

c. Bear all separable costs of operation, maintenance, and major replacements for the recreational features, presently estimated to be $ 135,000 annually.

d. Items a., b., and c. above refer to recreation costs and do not include fish and wildlife enhancement.

EXHIBIT 10

No commitment of funds can be made at this time for the State's participation in the project. The Department of Natural and Economic Resources agrees to include in its Department's budget a request for funds at such times as it appears that an appropriate budget item is timely and can be justified.

Yours truly,

James F. Harrington

JFH/mrl

cc: Arthur W. Cooper
Dan E. McDonald

State of North Carolina

Department of Archives and History

Raleigh 27602

H. G. JONES
Director

FRED P. HARBIN
Assistant Director

DIVISION ADMINISTRATORS

C. F. W. COKER
Archives and Records

MRS. JOYE E. JORDAN
Historic Sites and Museums

MRS. MEMORY F. MITCHELL
Publications

14 September 1972

Jack J. Lesemann, Chief
Engineering Division
Corps of Engineers
P.O. Box 919
Charleston, South Carolina 29402

Dear Chief Lesemann:

Thank you for sending us the letter and map regarding the proposed Reddies River Lake Project in Wilkes County, North Carolina. As far as we can determine, no historic sites will be affected by the project. Since our files are not complete, we will keep your letter and map on file and contact you if we learn of any significant property near the proposed project.

As you know, this does not include Dr. Joffre L. Coe's review of possible aboriginal archaeological sites which was made to the National Park Service some time ago.

Sincerely yours,

John G. Zehmer, Jr., Director
Division of Historic Sites and Museums

EXHIBIT 11

STATE OF NORTH CAROLINA

STATE HIGHWAY COMMISSION

ROBERT W SCOTT, Governor

D McLAUCHLIN FAIRCLOTH, Chairman

June 5, 197[illegible]

Mr. Jack J. Iesemann
Chief, Engineering Division
Corps of Engineers
Charleston, South Carolina 2940[illegible]

Subject: Reddie River Lake Project
Wilkes County, North Carolina

Dear Mr. Iesemann:

In response to your letter of [illegible], our staff has reviewed the project and has prepared preliminary cost estimates for road changes in the area of the subject dam. Suggested changes and estimates of cost are tabulated on an attached sheet. If the [illegible] you may wish to confer with our office in Wilkesboro.

1. SR 1541 (map reference [illegible]) Raise to two feet above flood control pool elevation 1110, provide 20-foot pavement and 8-foot shoulders. Estimated cost is $128,000 including $60,000 for roadway grading and surfacing, $5,000 for culvert construction, and $58,000 for rip rap.

2. SR 1540 (map reference [illegible]) We do not have data to support or refute your belief that the existing bridge beams are more than two feet above the flood control pool.

3. SR 1540 (map reference [illegible]) Raise to two feet above flood control pool elevation 1110, provide 20-foot pavement and 8-foot shoulders. Estimated cost is $134,000 including $60,000 for roadway grading and surfacing, $10,000 for culvert construction, and $58,000 for rip rap.

EXHIBIT 12

4. SR 1534 (map reference E). Relocate, raising to two feet above flood control pool elevation 1110; provide 20-foot pavement and 8-foot shoulders. It is recommended that fill material be used across the lake at this location. Estimated cost is $832,000 including $472,000 for roadway grading and surfacing, $105,000 for culvert construction, $250,000 for rip-rap, and $10,000 for guardrail.

In 1969, the State Highway Commission approved the construction of a SC 268 bypass of North Wilkesboro. Our current studies of the project indicate that the SC 268 relocation alignment will involve several crossings of the planned reservoir. Our planning staff is completing a reanalysis of the proposed project and we hope to be able to advise you of our recommended alignment at an early date.

Please advise if further assistance can be provided by this agency.

Sincerely,

John H. Davis
Chief Engineer

JHD/mc
Attachment
cc: Mr. J. J. Doughton
Mr. J. L. Norris
Mr. C. R. Edgerton
Mr. Billy Rose
Mr. R. W. McGowan
Mr. L. H. Berrier, Jr.
Mr. W. E. Caddell, Jr.

STATE OF NORTH CAROLINA

STATE HIGHWAY COMMISSION

ROBERT W. SCOTT, Governor — D. McLAUCHLIN FAIRCLOTH, Chairman

July 19, 1972

Mr. Jack J. Iesemann
Chief, Engineering Division
Corps of Engineers
Charleston, South Carolina 29402

Dear Mr. Iesemann:

Subject: Reddies River Lake Project
Wilkes County, North Carolina

In response to your letter of June 20, 1972 relating to the revision of SR 1534 (reference 1 on the attached map), our staff has reevaluated our previous recommendation for retention of the route and now concurs in your proposal that it be abandoned. Our position is based on the estimated cost of over $800,000 to raise the road through the reservoir and on the fact that reasonable alternative access to the area served is possible via other routes. In addition, current average daily traffic along the affected portion of SR 1534 is estimated to be less than 50 vehicles.

Where required, rip rap should be placed to an elevation two feet above the 25 year flood pool and should extend to an elevation two feet below the maximum drawdown. In addition, rip rap should be placed on the end of bridge approach embankments between an elevation two feet above the 25 year flood pool and the toe of the fill to provide slope protection during construction.

Please advise if additional information can be provided.

Sincerely,

John H. Davis
Chief Engineer

JMG/JHD/gs
Attachment
cc: Messrs: Billy Rose, J. L. Doughton, J. L. Davis, C. R. Edgerton, R. W. McGowan, L. H. Berrier, Jr., W. F. Caddell, Jr.

EXHIBIT 13

STATE OF NORTH CAROLINA

STATE HIGHWAY COMMISSION

ROBERT W. SCOTT, Governor — D. McLAUCHLIN FAIRCLOTH, Chairman

RALEIGH, N. C. 27611

August 14, 1972

Subject: Reddies River Lake Project - Wilkes County

Mr. Arthur P. Crouse, Jr.
Acting Chief, Engineering Division
Charleston District, Corps of Engineers
P. O. Box 919
Charleston, S. C. 29402

Dear Mr. Crouse:

Reference our previous correspondence and your most recent letter of August 10, 1972 pertaining to the above subject, by my letter to Mr. Lesemann of June 5, 1972 you were advised that the North Carolina State Highway Commission had programmed a NC 268 bypass of North Wilkesboro and that in all probability the alignment would involve several crossings of the planned reservoir.

On July 10, 1972 our Planning Board approved the alignment of this project as generally shown in the project report dated June 15, 1972, a copy of which is attached for your information and use. You will note that several locations were studied with the approved alignment being based on the assumption that the Reddies River Lake would be constructed.

Quite frankly, we cannot predict which project will materialize first; however, we have given consideration to the Reddies River Lake in our studies and feel that the Corps should participate in the increased cost of constructing section B on alternate 1 in lieu of section B on alternate 2.

Our next logical step in the pursuit of this project will be the preparation of a draft environmental statement. The

EXHIBIT 14

preparation of this statement has not been started; therefore, we have no adopted schedule for the project.

Since the Reddies River Lake project has advanced to the degree indicated, the FHWA has advised that they will not participate in the cost differential between Alternate 1, Section B and Alternate 2, Section B. Therefore, the Commission is requesting that the agreement for the contemplated relocation of the existing roads in connection with the Reddies River Lake also include provision for cost sharing in the construction of NC 268 bypass around North Wilkesboro. I would appreciate your early response to this matter.

Yours very truly,

John H. Davis
Chief Engineer and
Asst. State Highway Administrator

JHD af

Cc- Mr. G. S. Willoughby, Jr.
Mr. Billy Rose
Mr. W. F. Caddell, Jr.
Mr. R. W. McGowan
Mr. W. A. Wilson, Jr.
Mr. J. L. Norris
Mr. J. E. Doughton
Mr. W. M. Ingram

STATE OF NORTH CAROLINA

STATE HIGHWAY COMMISSION

May 15, 1973

Mr. Joan Sabee
Department of the Army
Charleston District, Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Mr. Sabee:

I am enclosing the recent studies of our Roadway Design Department on the alternate alignments for the proposed NC 18 and 268 North Wilkesboro Bypass. As indicated in the attached copy of a memorandum from W. A. Wilson, Jr. to Mr. W. F. Caddell, Jr., these studies were recommended at a meeting on November 13, 1972 of Corps of Engineers and Highway Commission officials.

Enclosed are topographic maps of each of the three alignments studied, plus an enlarged topo map of Alternate L4, a profile sheet for L4, and a typical cross section. It is emphasized that the cost estimates are preliminary and subject to more detailed studies.

Alternate L4, crosses the proposed Reddies River dam. To complete the cost studies for L4, we need estimates for the earthwork (etc.) involved in revising the dam to provide for the highway alternates along L4 as follows:

1. Two lane roadway.

2. Four lane roadway divided by a 68 foot median.

3. Four lane roadway divided by a 22-foot median.

Our estimates already include paving across the dam and bridging the spillway, so your estimate will not include any pavement or bridge costs. We have not included any earthwork costs in the section involving the spillway and dam (approximately station 101 + 00 to 116 + 00).

EXHIBIT 15

Inclosed is a typical cross section for a four lane facility with a 68 foot median. The total width from outside to outside shoulder edge is 144 feet. For the 22 foot median, the total roadway width is 98 feet. For a two lane roadway only, this width would be 52 feet.

Our standard maximum fill slope for this type of project on the side adjacent to water is 2 1/2:1. Borrow material for embankment should be based on a unit price of $.70 per cubic yard.

I would like to point out that Alternate L4 appears to have very serious right of way problems. The estimated damages and relocations involved in L4 will definitely lessen the feasibility of this alternative for the proposed bypass. Alternate L3 would be much less disruptive, but has the very high structure costs over the river. Also I understand that L3 would interfere with the Corps' planned recreational areas bordering the lake.

In view of the above, it appears that consideration should be given to the feasibility of an alternate damsite located north of Alternate L. This would make line L, by far the cheapest alignment, a very feasible project. From an overall perspective of these two projects, it is felt the consequences of a more northern damsite should be explored.

Your views on the alternate damsite would be appreciated. If you need more information for your estimate of the L4 dam crossing, I will be glad to cooperate with you.

Sincerely,

T. L. Waters
Manager of Planning and Research

GLS/IIw/pl

Attachment

cc: Mr. Billy Rose
Mr. R. W. McGowan
Mr. W. F. Caddell, Jr.
Mr. W. A. Wilson, Jr.

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION AND HIGHWAY SAFETY
RALEIGH 27611

DIVISION OF HIGHWAYS

October 25, 1973

U. S. Army Engineer, District
P. O. Box 919
334 Meeting Street
Charleston, South Carolina 29402

Dear Sir:

This is to advise our staff has completed a review of the Environmental Statement, dated September 17, 1973 concerning the Reddies River Dam and Reservoir.

The Environmental Statement noted that approximately 0.75 miles of secondary state roads will require relocation and it is the policy of the Division of Highways to require agencies requesting relocation of roads in the vicinity of reservoirs to replace these roads with a comparable facility at no cost to the Division of Highways.

The Environmental Statement also noted that the Division of Highways is planning to build the NC 18 and NC 268 bypass through the project area. An estimated $2,000,000 is included in the reservoir costs for revising the alignment of the bypass due to the reservoir.

Planning studies and coordination have been underway for several years to determine the best alternative; however, these studies are not complete. The North Carolina Board of Transportation at a recent meeting adopted a continuing seven year improvement program. The NC 18-268 bypass was not included in this program, but the program will be reviewed on an annual basis for updating and further consideration will be given to this project at that time in the light of our

EXHIBIT 16

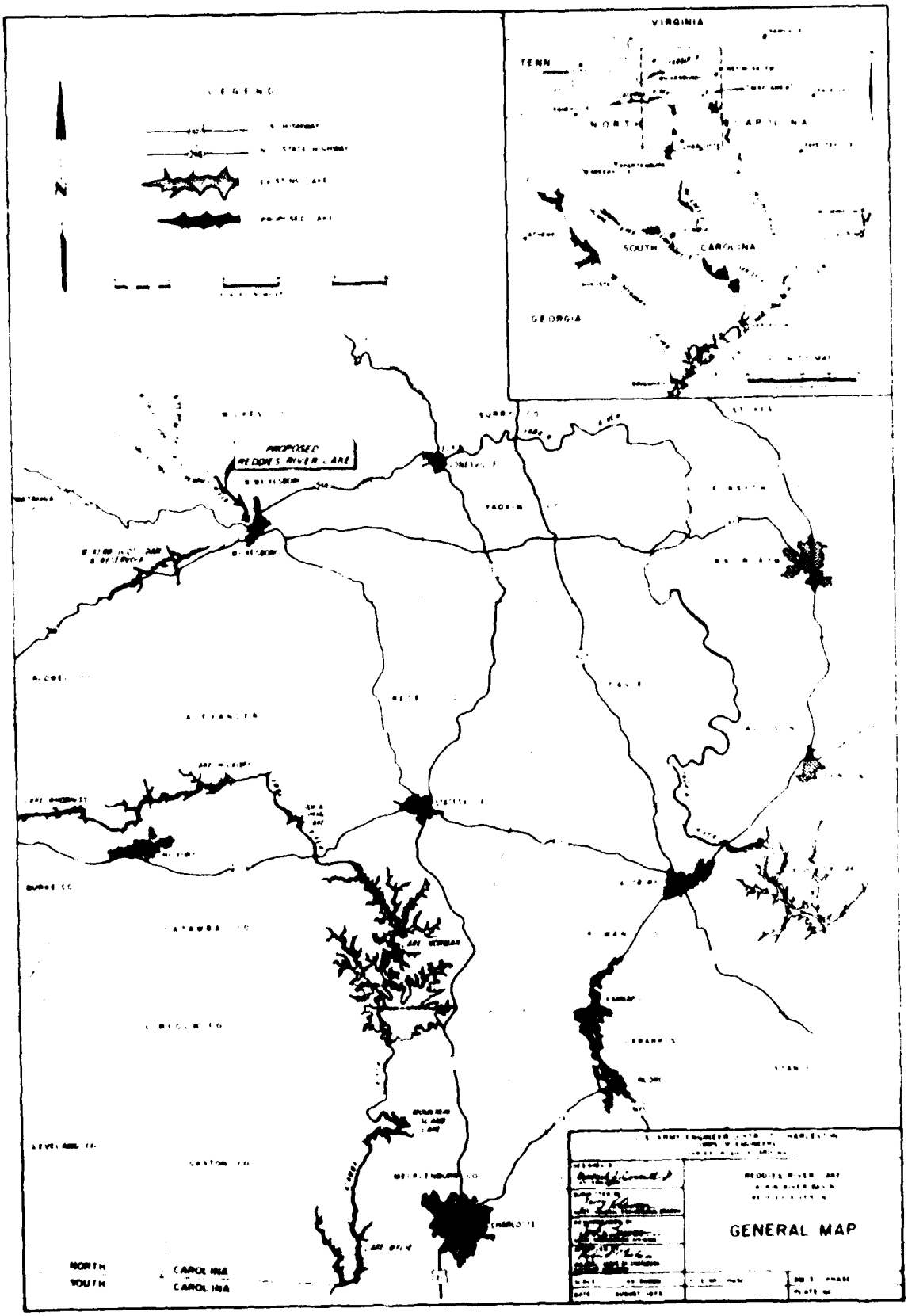
overall statewide needs and the status of the Reddies River Reservoir.

Our staff considers the report to be an adequate evaluation of the environmental impact of the proposed project.

Sincerely,

Billy Rose
State Highway Administrator

NBB/BR/gs


VIRGINIA
TENN.
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PROPOSED
REDDS RIVER LAKE
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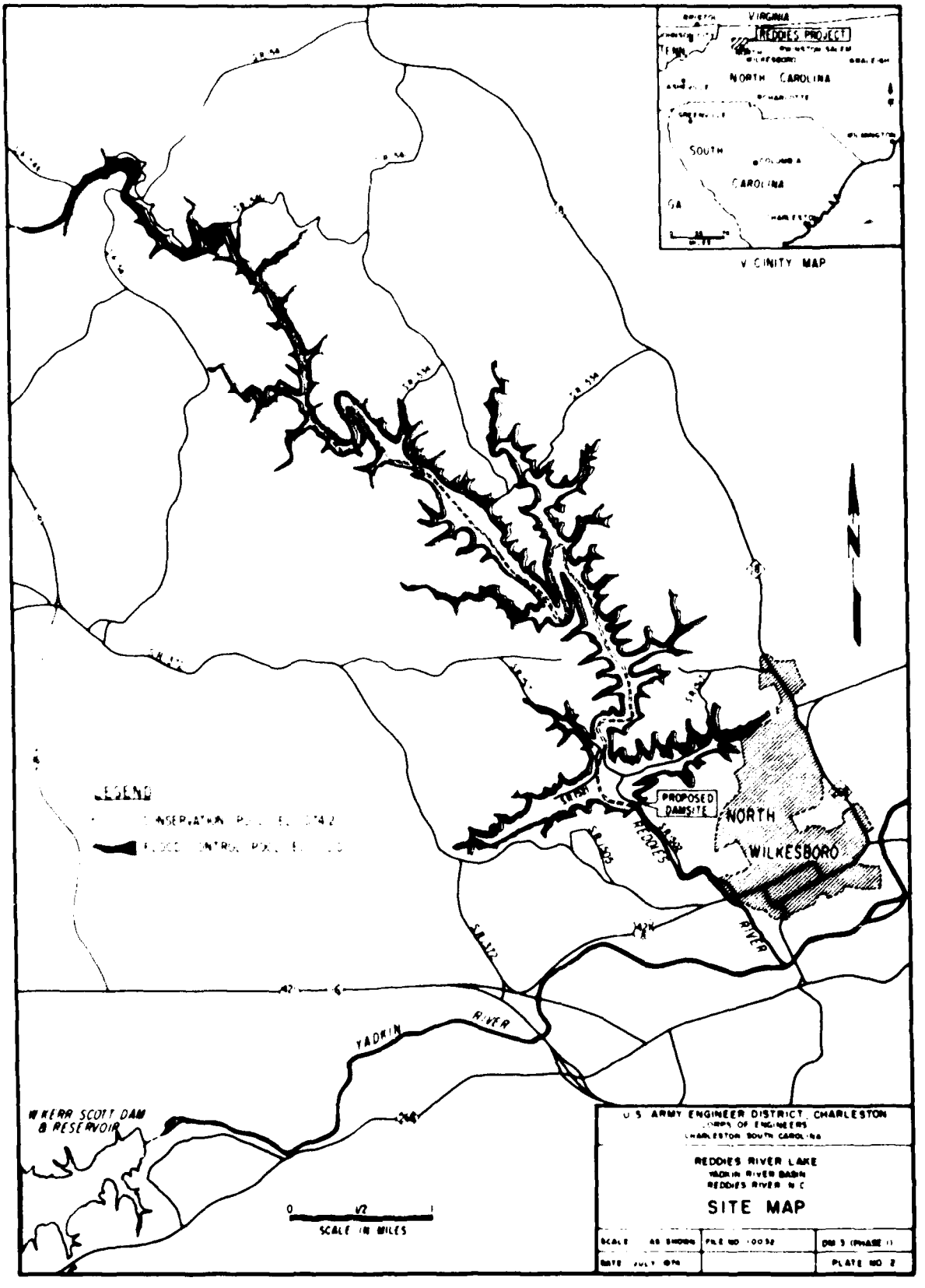
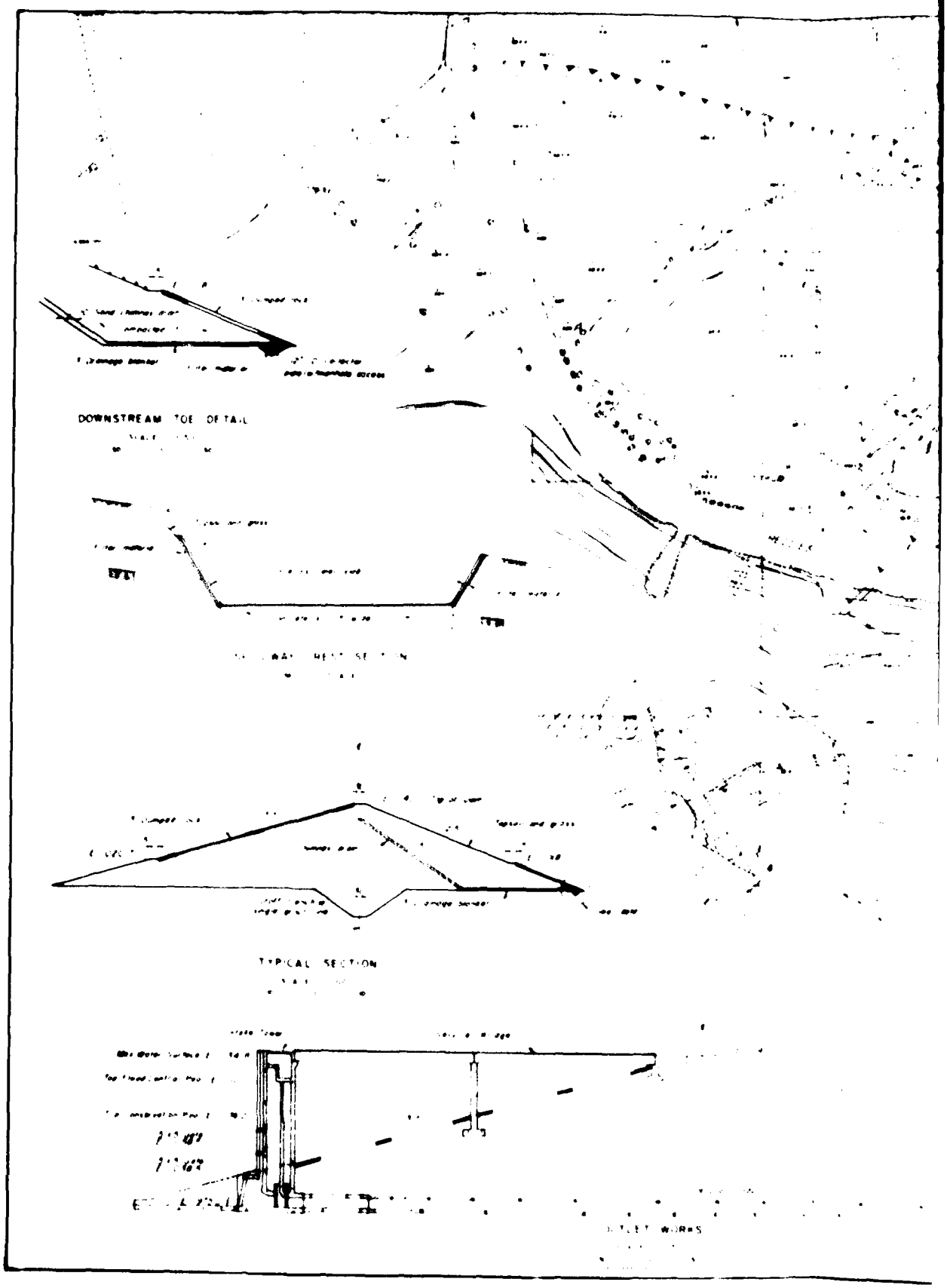
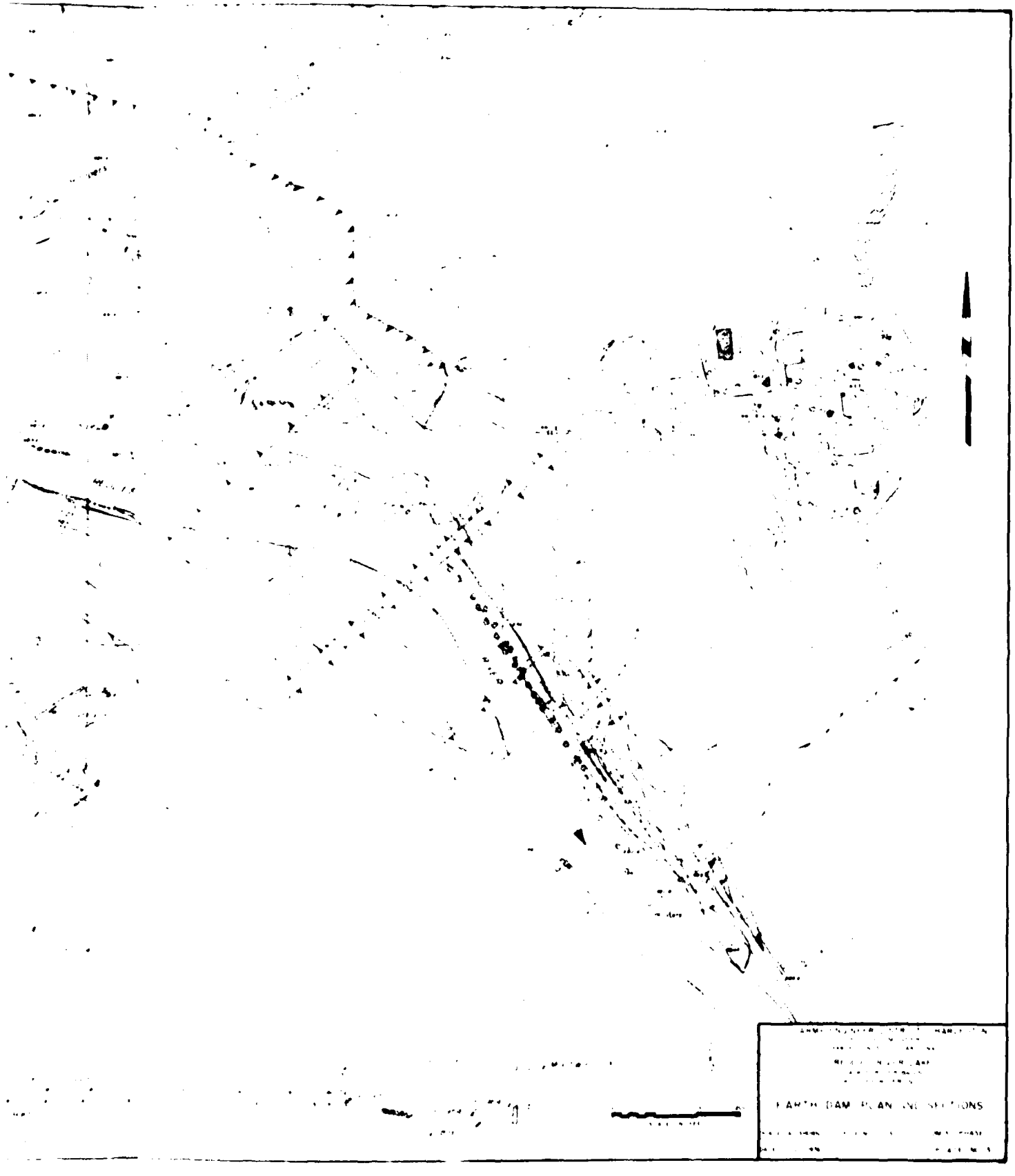
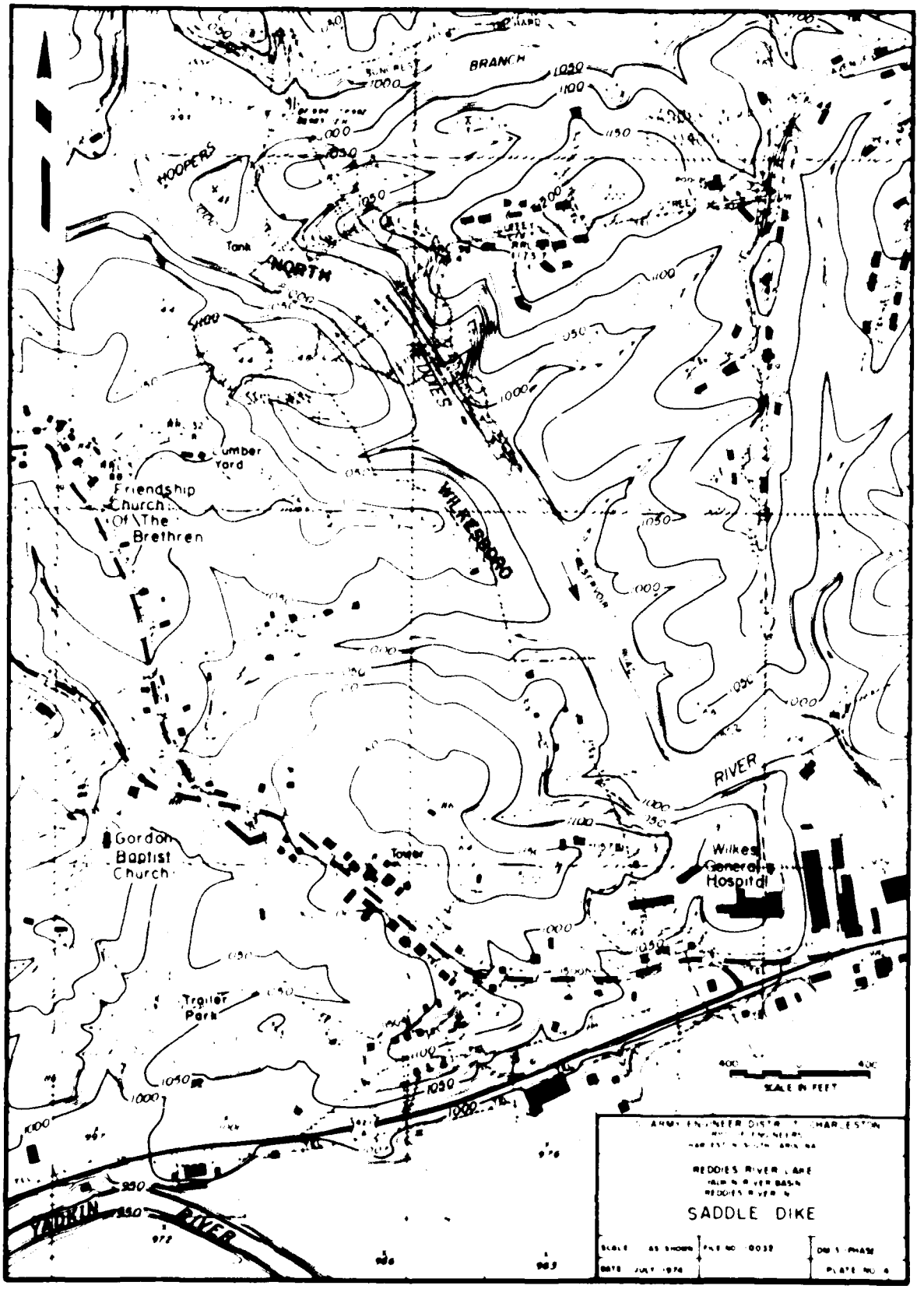
SOUTH
CAROLINA
GENERAL MAP


VIRGINIA
REDDIES PROJECT
NORTH CAROLINA
SOUTH CAROLINA
GA
VICINITY MAP
PROPOSED DAMSITE
NORTH WILKESBORO
REDDIES RIVER
YADKIN RIVER
WILKERR SCOTT DAM & RESERVOIR
SCALE IN MILES
U S ARMY ENGINEER DISTRICT, CHARLESTON
CORPS OF ENGINEERS
CHARLESTON SOUTH CAROLINA
REDDIES RIVER LAKE
YADKIN RIVER BASIN
REDDIES RIVER N C
SITE MAP
PLATE NO 2


DOWNSTREAM TOE DETAIL
TYPICAL SECTION


EARTH DAM PLAN AND SECTIONS


BRANCH
HOOPERS
NORTH
Tank
Lumber Yard
Friendship Church Of The Brethren
WILKESBORO
RIVER
Gordon Baptist Church
Tower
Wilkes General Hospital
Trailer Park
YADKIN
RIVER
SCALE IN FEET
REDDIES RIVER LAKE
SADDLE DIKE

APPENDIX I

FLOOD DAMAGES AND FLOOD CONTROL BENEFITS

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APPENDIX I

FLOOD DAMAGES AND FLOOD CONTROL BENEFITS

GENERAL

1. General. This appendix presents estimates of flood damages occurring along the main stem flood plains of the upper Yadkin River Basin, defined as the river reach between W. Kerr Scott Dam and the head of High Rock Lake, about 135 river miles downstream (see Figure I-1). It also presents estimates of potential flood control benefits expected to result from additional development of water resource conservation projects and programs in this basin. The estimates are based on detailed flood damage appraisals of urban development and a thorough sampling of losses in the rural areas. Data were obtained from interviews with farmers and landowners within the flood plain, County Extension Chairmen, State and Federal Government agricultural workers, industrial plant owners and managers, real estate agents, and city and county officials whose jurisdiction or interests are affected by the problem. Data obtained from field studies included establishment of high watermarks, on-site inspection of flood damageable areas, and measurements of typical flood plain cross sections.

ECONOMIC DEVELOPMENT

2. Population and income. The six counties whose economy will influence the water resource conservation and development needs of the main stem of the upper Yadkin River are Davie, Davidson, Forsyth, Surry, Wilkes, and Yadkin, North Carolina. These six counties with a 1970 population of 454,368 are expected to have a 2020 population of 978,000, based on OBERS projections. About 68 percent of the 1970 population was concentrated in Forsyth and Davidson counties. Average per capita personal income of these counties has increased from about 78 percent of the national average in 1950 to about 89 percent or slightly over $3,500 in 1970. It is expected that per capita personal income of the six-county area will approximate the national average by 2020 to 2030.

3. Dependence of the economy of the area on agriculture is declining, though projected total agricultural output is expected to about double in the next 50 years. Manufacturing, nonagricultural, and nonmanufacturing activities are growing rapidly. Population is shifting from rural to urban areas as a result. Urban population in 1970 was about 44 percent of the total. The trend towards urbanization is expected to continue over the next 50 years. About 66 percent of the basin population are expected to live in urban areas by 2020. However, of the projected 34 percent, 2020 rural population, only about two percent are expected to live on farms and only about one percent are expected to be employed in agriculture.

4. Employment. Total employment in the six-county area increased from about 105,000 in 1940 to about 204,000 in 1970. Employment is expected to more than double by 2020. The employment mix in the basin has undergone considerable change since 1940 when employment in agriculture was about 23 percent and in manufacturing about 40 percent of the total. By 1970, agricultural employment had declined to about 5 percent of total employment, a decrease of about 15,000 jobs in this sector, while manufacturing still accounted for about 40 percent of total employment, but representing an increase of over 40,000 jobs in this sector. Manufacturing employment is expected to continue to increase but its relative share is expected to decline to about 32 percent of total employment by 2020.

5. Agriculture. Approximately 45.6 percent of the total land area of 2,862 square miles in the six-county area is in farms according to the 1969 U. S. Census of Agriculture. There were 10,348 farms with an average size of 80.8 acres and an average value of $380 per acre. Table I-1 depicts data on farms in the six-county area from the 1959, 1964, and 1969 U. S. Census of Agriculture. The number of and total land area in farms decreased during the 10-year period, but the average size and value of farms increased.

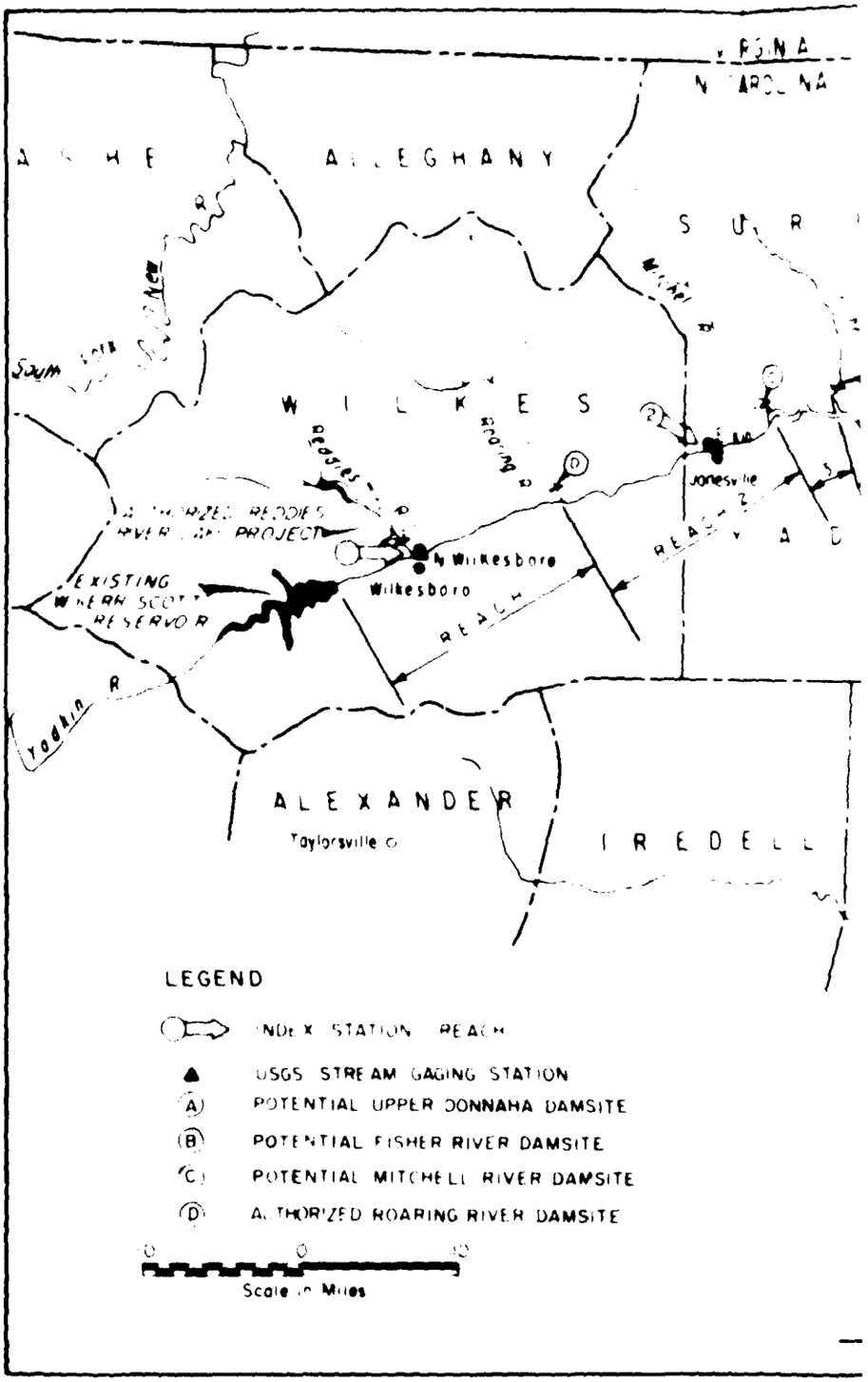
TABLE I-1

FARM STATISTICS OF THE UPPER YADKIN RIVER SIX-COUNTY AREA 1/

Year	1959	1964	1969
Number of farms	14,041	11,667	10,348
Land in farms (1,000 acres)	1,056	937	836
Average size farm (acres)	75.2	80.4	80.8
Average farm value	$13,830	$21,629	$30,678
Average value of farm per acre	$ 184	$ 269	$ 380

1/ Data from U. S. Census of Agriculture, U. S. Department of Commerce, Bureau of the Census.

6. Though the relative importance of agriculture in this basin is declining, it still plays an important role in basin economic development. Approximately 27.5 percent of the farmland in the area is in cropland; 14.5 percent is in pasture; and 58 percent is in woodlands and other uses such as house lots, roads, water, and wastelands. The


ASHE
ALLEGHANY
WILKES
ALEXANDER
IREDELL
Wilkesboro
Jonesville
Taylorsville
EXISTING
REACH
REACH
LEGEND
INDEX STATION - REACH
USGS STREAM GAGING STATION
(A) POTENTIAL UPPER DONNAHA DAMSITE
(B) POTENTIAL FISHER RIVER DAMSITE
(C) POTENTIAL MITCHELL RIVER DAMSITE
(D) AUTHORIZED ROARING RIVER DAMSITE
Scale in Miles

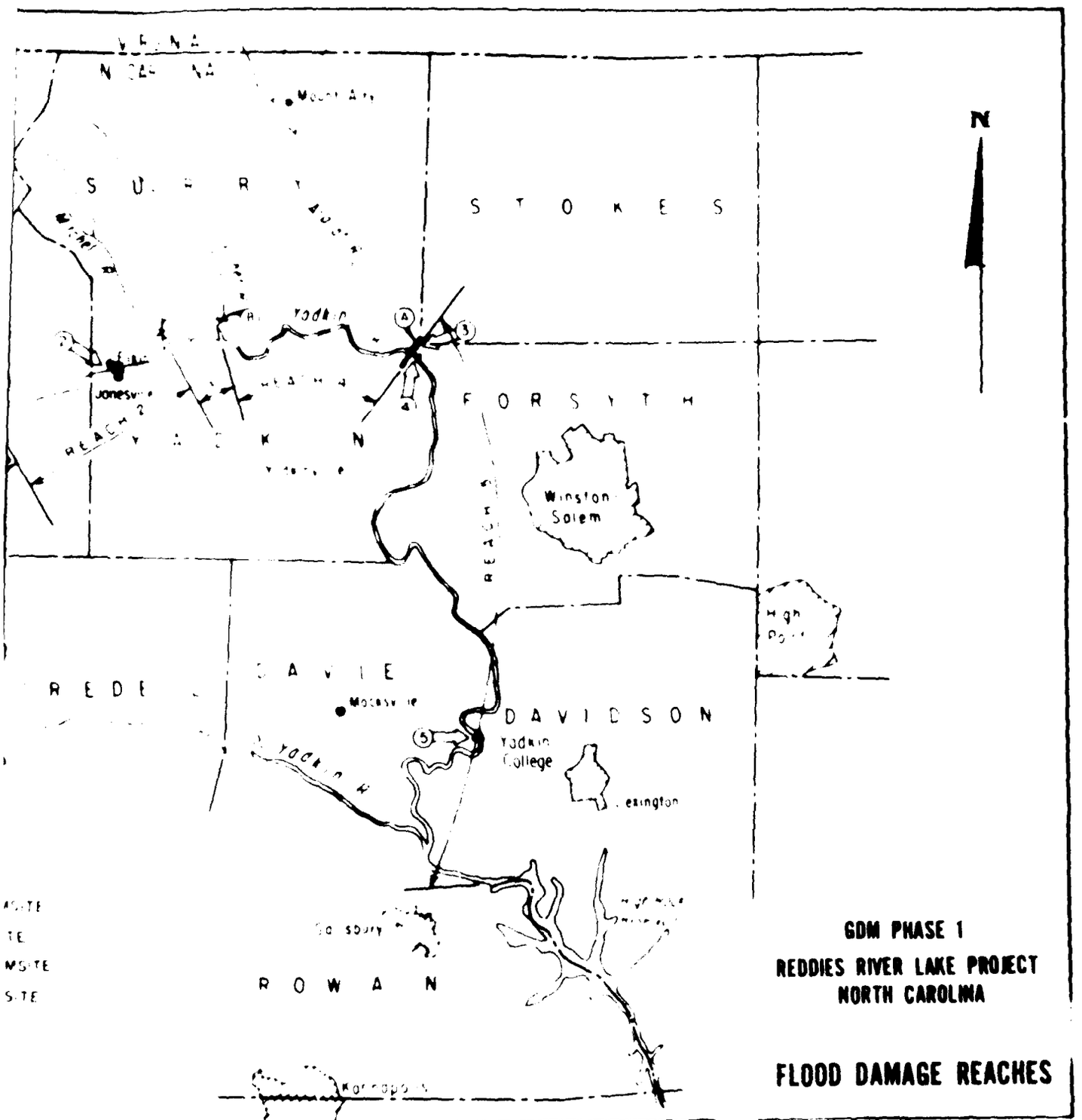

N
STOKES
FORSYTH
Winston
Salem
DAVIDSON
Yadkin
College
Lexington
DAVIE
ROWAN
Jonesville
REACH 2
GDM PHASE 1
REDDIES RIVER LAKE PROJECT
NORTH CAROLINA
FLOOD DAMAGE REACHES

FIGURE I-1

frequency of flood peak stages. On the other hand, the severity of crop damage is dependent upon the season of the year in which the flood occurs, with the greatest damage being caused by those floods occurring during the period between planting and harvesting. Spring floods that destroy growing crops necessitate replanting operations, and the replanted crops generally produce inferior yields due to the shortened growing period and usually more severe insect attacks. The susceptibility of the replanted crop to later damage from floods results in the possibility that a given acre of cropland may suffer flood damages in excess of the normal gross annual value of the crop. In order to properly consider the seasonal variation of flood damage to crops, the probability of flooding by month was evaluated in conjunction with the varying damageable value of each crop considered by month and the distribution of crops on the flooded lands.

10. Division of the flood plain. The upper Yadkin River is divided into five flood damage reaches in order to facilitate flood damage evaluation. Flood conditions for each reach are related to measurements at a reach index station. Division of the damage reaches is made in such a way as to provide an accurate and practical relationship of topographic, hydrologic, and flood damage factors between the index stations and their corresponding reaches. The limits of these flood damage reaches and the location of the index gaging stations are shown on Figure I-1. A summary of unregulated flood plain areas by reaches is given in Table I-2.

11. Flood damage categories. Flood losses, for estimating purposes, are grouped into two major categories; rural losses and urban losses. Rural losses considered, include losses to crops and pastures; farm buildings and contents; other on-the-farm fixed improvements, such as on-the-farm roads, wells, fences, and ditches; and rural nonagricultural losses such as transportation facilities, churches, schools, nonfarm residential properties, industrial, and commercial establishments. Urban losses considered, include damages to residential, industrial, and commercial properties; transportation facilities; utilities; and emergency losses. Tangible physical and tangible business losses were estimated for each type of damage.

12. Working curves and tables. Working curves or tables were developed to aid in the computation of each category and type of damage for all reaches evaluated. These curves or tables are described in the following paragraphs and curves or tables of each type are shown.

13. Stage versus area flooded curves. These curves indicate present land use of flood plain lands which would be inundated by floods of various magnitudes. The areas subject to inundation were determined for each reach by plotting high water profiles on topographic maps. These areas were plotted against stages at the reach index station which was considered to be representative of conditions in the reach as a whole. Figure I-2 through I-6 show the stage versus area flooded curves for all reaches.

principal crops produced are corn for grain and silage, soybeans, tobacco, small grain, hay, and pastures. The raising of beef cattle, hogs, chickens, egg production, and dairying are also of importance in this area. The gross value of the principal field crops produced in 1969 was over $36 million, about 4.5 percent of the state's total production of these crops.

7. Extent and character of the flooded area. The flood plain area downstream from the existing W. Kerr Scott Dam and the authorized Reddies River Lake contains the urban areas of Wilkesboro and North Wilkesboro at the mouth of Reddies River and Elkin and Jonesville, approximately 26 miles downstream. There is agricultural activity in the flood plains of all reaches but major agricultural activities are located in Reach 5 in which are the Yadkin River flood plains of Davie, Davidson, Forsyth, and the eastern portion of Yadkin Counties. The major crops include corn, soybeans, and small grain. Other crops include tobacco, truck, and pastures for grazing and hay production. The record 1940 flood inundated about 29,000 acres of land and would cause about $33.5 million damage to present development if it were unregulated. The existing W. Kerr Scott Dam and Reservoir would have reduced the area inundated by this flood to about 19,500 acres and would reduce its damage to present development to about $12.7 million. A 200-year frequency flood, if unregulated, would inundate about 33,600 acres of land, and would cause about $32.7 million damage to present development. The protection afforded by the existing W. Kerr Scott Dam and Reservoir would reduce the area flooded to about 25,600 acres and damages to present development to about $14.3 million.

8. The principal economic activities of Reach 1, Wilkesboro and North Wilkesboro, North Carolina, and Reach 2, containing the towns of Elkin and Jonesville are the manufacturing of furniture, wood products, textiles, and poultry processing. Wholesale and retail merchandise are of great importance as a source of income. The majority of farm operators in the two urban reaches depend upon off-the-farm employment in industrial or commercial establishments to supplement their income from agriculture. Below Elkin (Reaches 3, 4, and 5) there is very little urban development or industrial activities in the flood plains. Agriculture is the major economic activity in the flood plains of these reaches.

FLOOD DAMAGES

9. Damage estimating methods used. Damages to urban and industrial developments; public roads and railroads; and some classes of rural property, such as buildings, ditches, farm roads, and fences do not vary significantly with the seasons of the year. For this reason, flood damages to these properties were evaluated by the "Flood Peak-Damage Integration Method," which correlates nonseasonal flood damages to the

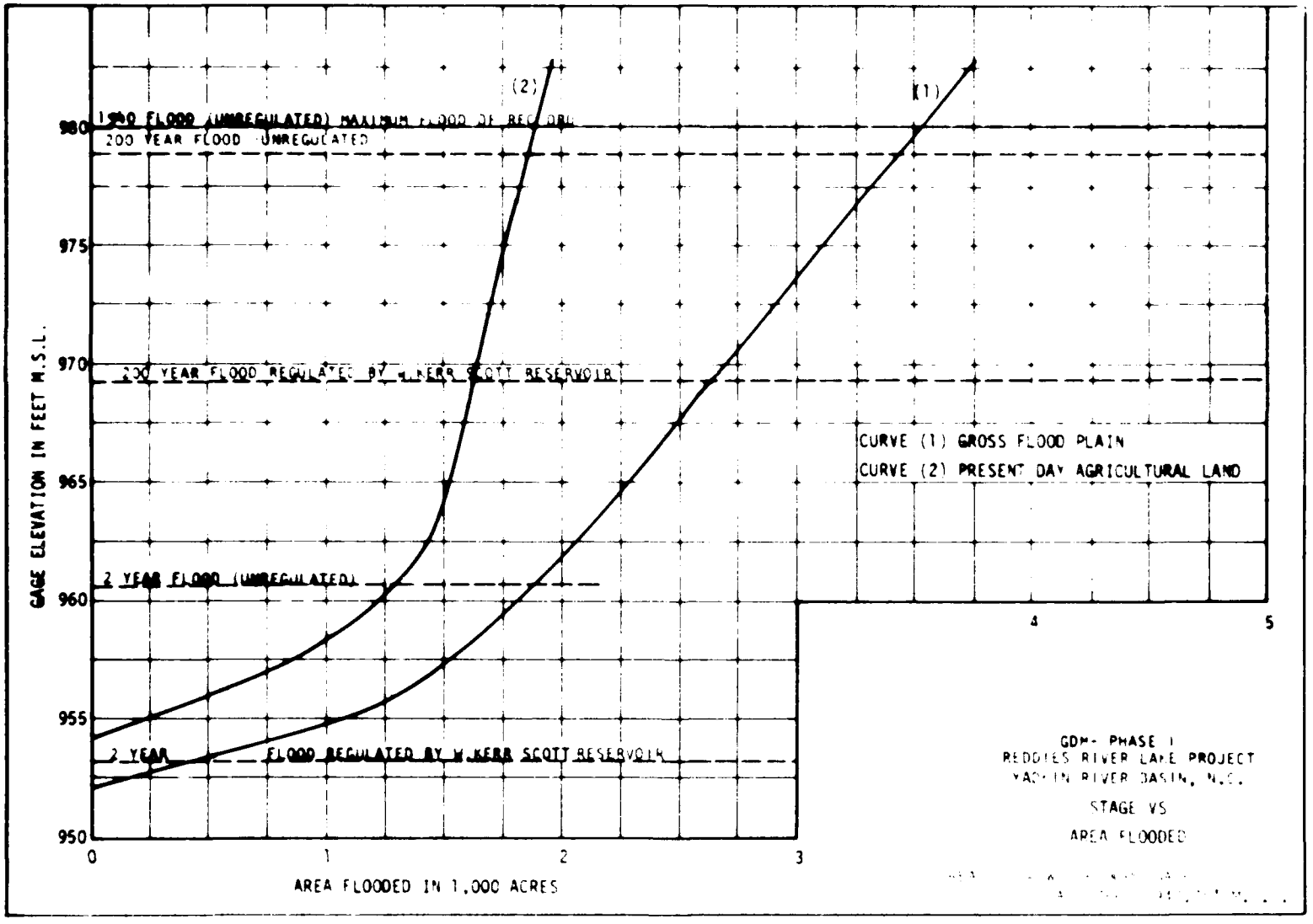

(2)
(1)
1,000 FLOOD (UNREGULATED) MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD UNREGULATED
100 YEAR FLOOD REGULATED BY W.KERR SCOTT RESERVOIR
2 YEAR FLOOD (UNREGULATED)
2 YEAR FLOOD REGULATED BY W.KERR SCOTT RESERVOIR
CURVE (1) GROSS FLOOD PLAIN
CURVE (2) PRESENT DAY AGRICULTURAL LAND
GAGE ELEVATION IN FEET M.S.L.
980
975
970
965
960
955
950
0
1
2
3
4
5
AREA FLOODED IN 1,000 ACRES
GDM- PHASE I
REDDIES RIVER LAKE PROJECT
YADKIN RIVER BASIN, N.C.
STAGE VS
AREA FLOODED

FIGURE I - 2

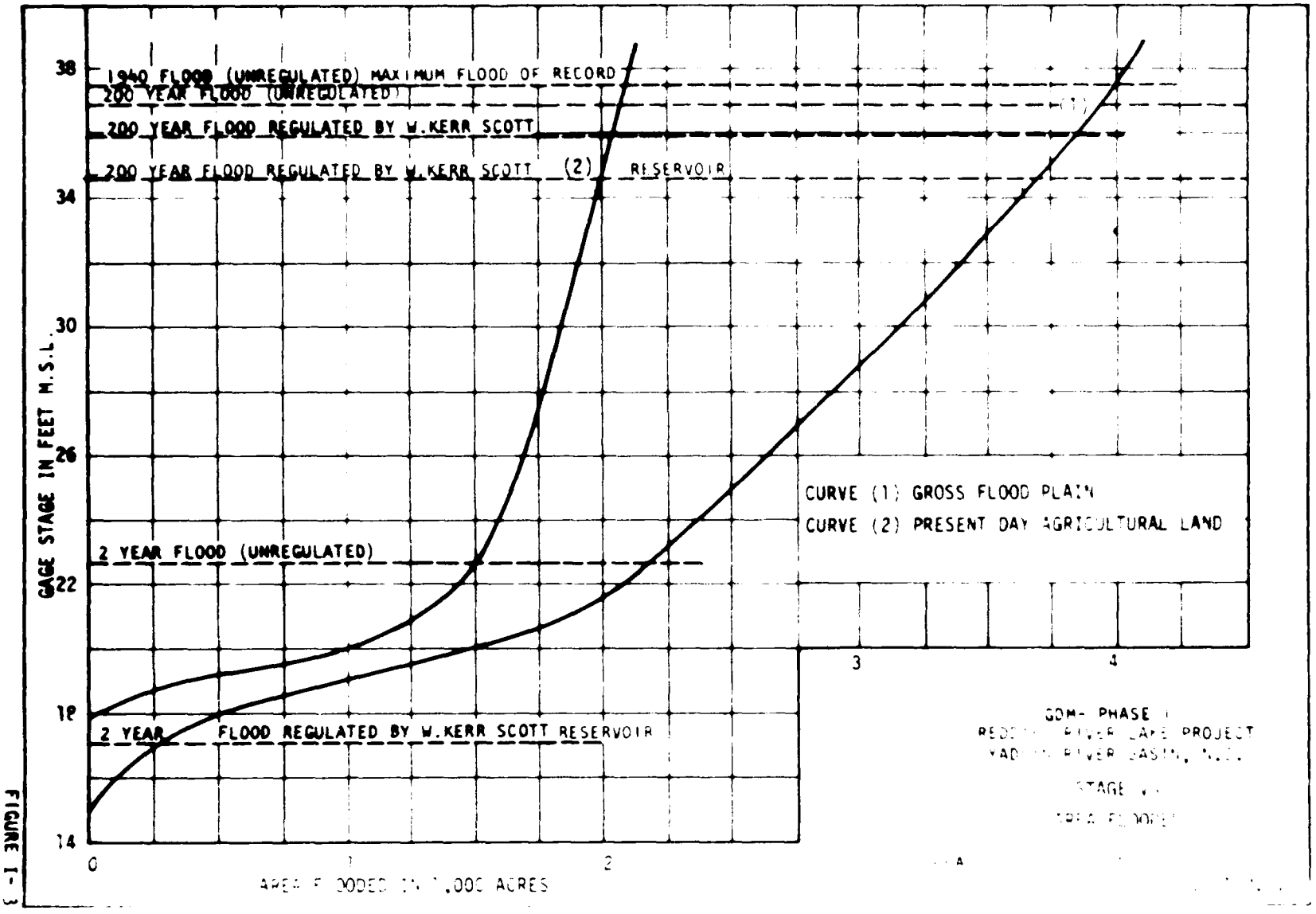

1940 FLOOD (UNREGULATED) MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD (UNREGULATED)
200 YEAR FLOOD REGULATED BY W.KERR SCOTT
200 YEAR FLOOD REGULATED BY W.KERR SCOTT (2) RESERVOIR
2 YEAR FLOOD (UNREGULATED)
2 YEAR FLOOD REGULATED BY W.KERR SCOTT RESERVOIR
CURVE (1) GROSS FLOOD PLAIN
CURVE (2) PRESENT DAY AGRICULTURAL LAND
GAGE STAGE IN FEET M.S.L.
38
34
30
26
22
18
14
0
1
2
3
4
AREA FLOODED IN 1,000 ACRES

FIGURE I-3

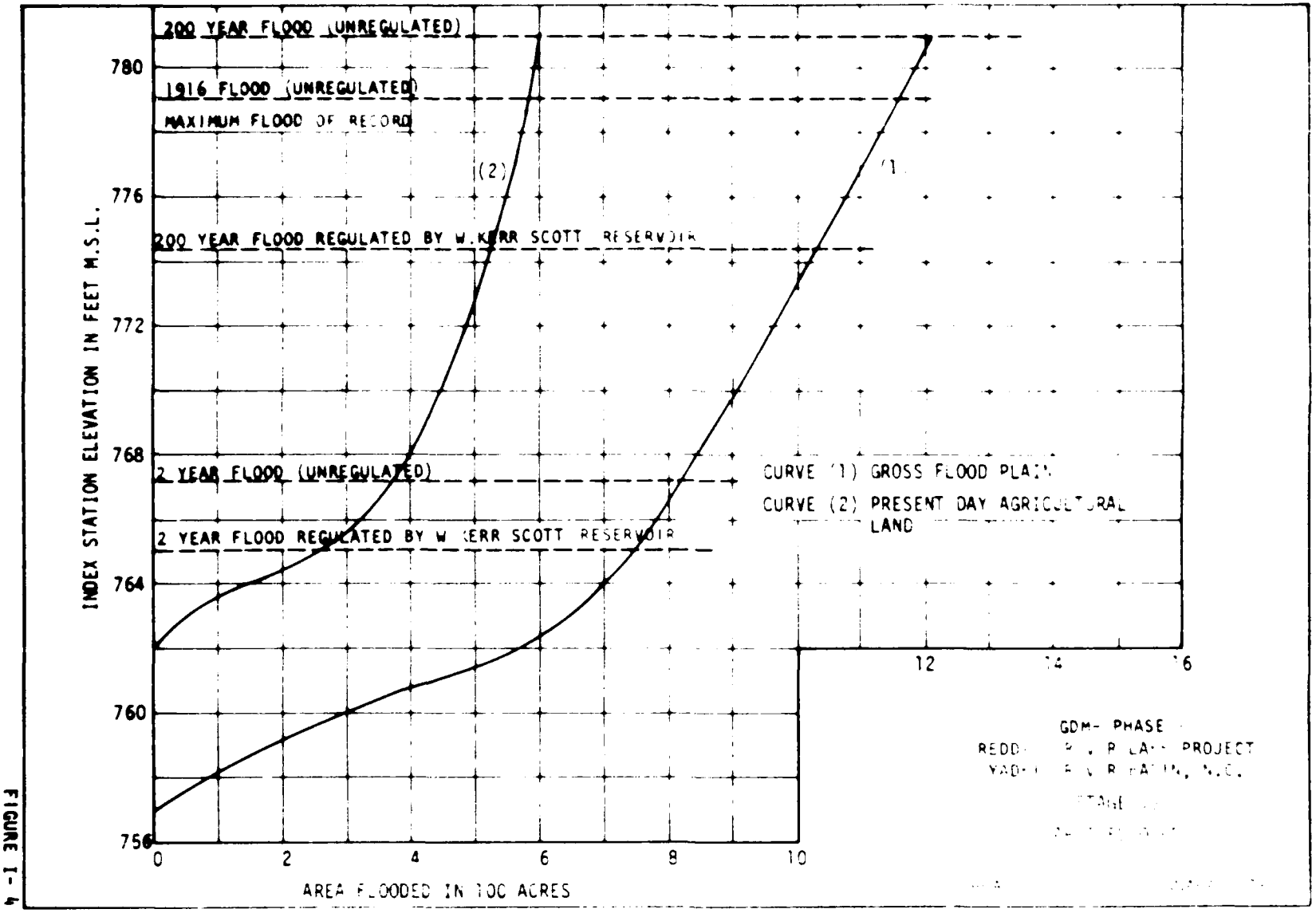

200 YEAR FLOOD (UNREGULATED)
1916 FLOOD (UNREGULATED)
MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD REGULATED BY W.KERR SCOTT RESERVOIR
2 YEAR FLOOD (UNREGULATED)
2 YEAR FLOOD REGULATED BY W KERR SCOTT RESERVOIR
(2)
(1)
CURVE (1) GROSS FLOOD PLAIN
CURVE (2) PRESENT DAY AGRICULTURAL LAND
INDEX STATION ELEVATION IN FEET M.S.L.
780
776
772
768
764
760
756
0
2
4
6
8
10
12
AREA FLOODED IN 100 ACRES
GDM- PHASE
PROJECT

FIGURE I-4

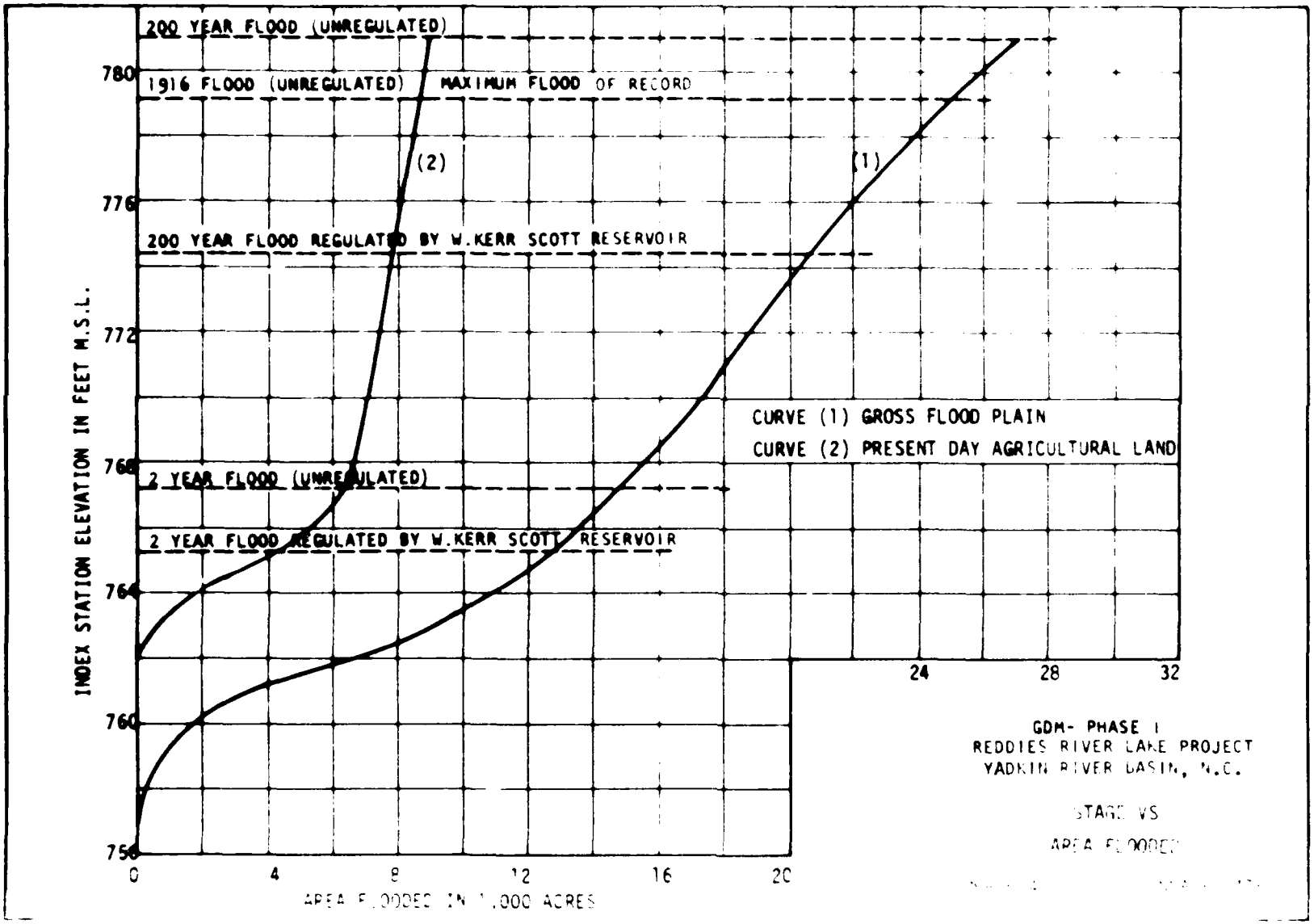

200 YEAR FLOOD (UNREGULATED)
1916 FLOOD (UNREGULATED) MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD REGULATED BY W.KERR SCOTT RESERVOIR
2 YEAR FLOOD (UNREGULATED)
2 YEAR FLOOD REGULATED BY W.KERR SCOTT RESERVOIR
(1)
(2)
CURVE (1) GROSS FLOOD PLAIN
CURVE (2) PRESENT DAY AGRICULTURAL LAND
INDEX STATION ELEVATION IN FEET M.S.L.
780
776
772
768
764
760
756
0
4
8
12
16
20
24
28
32
AREA FLOODED IN 1,000 ACRES
GDM- PHASE I
REDDIES RIVER LAKE PROJECT
YADKIN RIVER BASIN, N.C.
STAGE VS
AREA FLOODED

FIGURE I-5

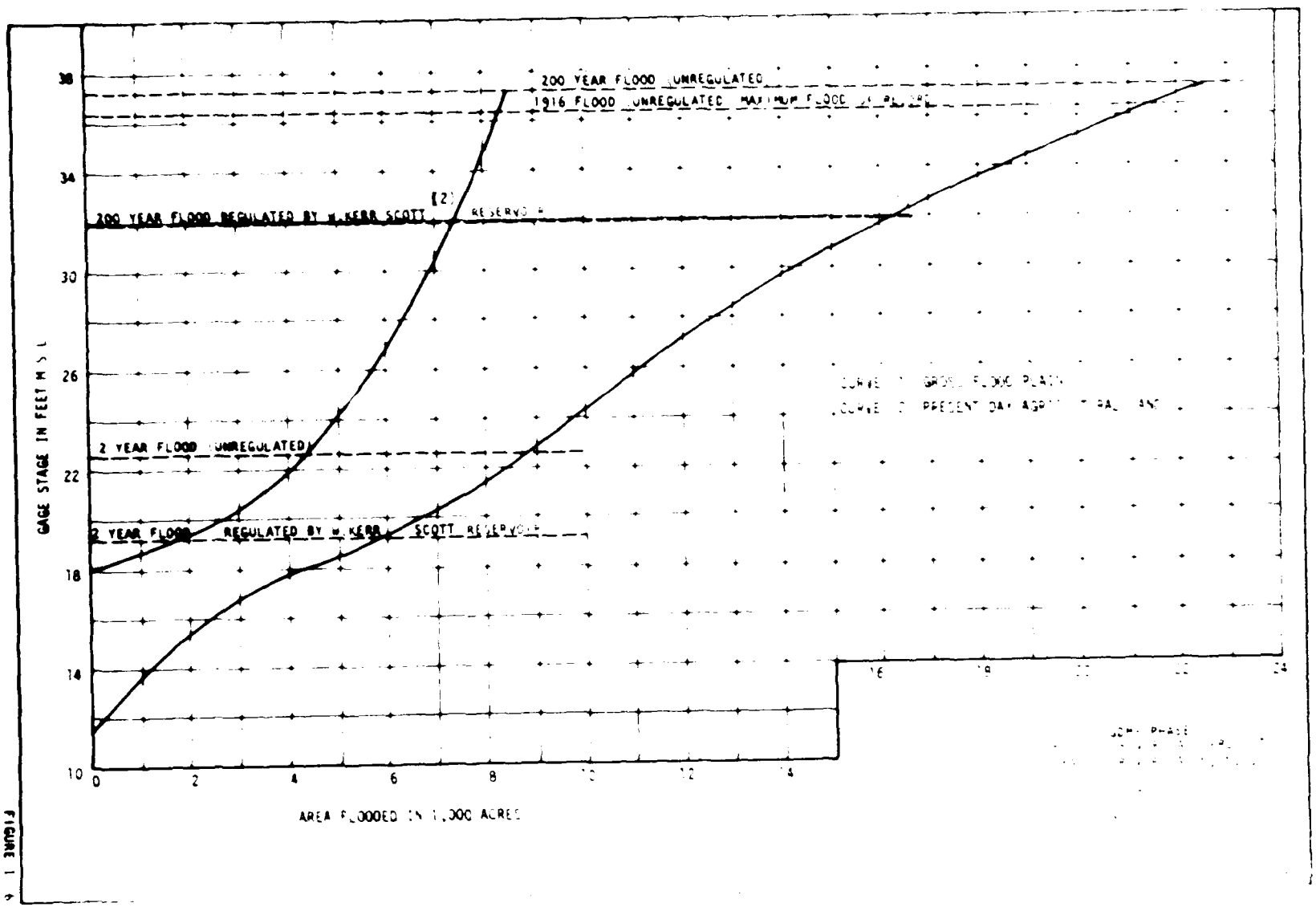

200 YEAR FLOOD UNREGULATED
1916 FLOOD UNREGULATED MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
2 YEAR FLOOD UNREGULATED
2 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
GAGE STAGE IN FEET M S L
AREA FLOODED IN 1,000 ACRES
38
34
30
26
22
18
14
10
0
2
4
6
8

FIGURE 1-6

TABLE I-2

FLOOD-PLAIN AREAS, BY REACHES-UPPER YADKIN RIVER BASIN, N. C.
(200-Year Unregulated Flood Plain-Area in Acres)

Reach No.	Index Station	Stream-Mile From	Stream-Mile To	Reach Description	Agricultural Land	Urban Land	Other Non-Agricultural Land	Total
1	USGS Gage at Wilkesboro	404	388	W. Kerr Scott Reservoir to Roaring R.	1,850	520	1,050	3,420
2	USGS Gage at Elkin	388	367	Roaring River to Mitchell River	2,060	475	1,415	3,950
3	Upper Donnaha Site	367	359	Mitchell River to Fisher River	600	0	600	1,200
4	Upper Donnaha Site	359	341	Fisher River to Upper Donnaha Site	850	0	1,850	2,700
5	USGS Gage at Yadkin College	341	275	Upper Donnaha Site to head of High Rocks Lake	8,500	0	13,825	22,325
	TOTAL				13,860	995	18,740	33,595

14. Estimates of future land use. There are presently about 14,000 acres of agricultural land in the 200-year unregulated flood plain of the stream reaches considered. It was estimated after consulting with County Extension Chairmen and other agricultural professionals that there will be essentially no future change in the acreage of flood plain lands devoted to agriculture, either without or with additional flood protection. Therefore, no future change in agricultural land use is projected.

15. Stage or discharge frequency curves. Natural or unregulated discharge frequency curves for each of the reach index stations are shown on Plates 4 through 7 of "Design Memorandum No. 2, Hydrology and Hydraulic Analysis." Methods and procedures used to develop these curves are discussed in DM2. Shown also in DM2, on plates 4-A through 7-A, are the rating curves for each index station that were used in computing project flood control benefits. Using these rating curves (stage vs. discharge) and the discharge-frequency curves, a stage-frequency curve can be developed.

16. Probability of floods by month. The estimated probability of a flood occurring during any given month is based on an analysis of floods by month recorded at the U.S.G.S. Wilkesboro and Yadkin College gages. Values adopted are summarized in Table I-3.

TABLE I-3

DISTRIBUTION OF FLOOD EVENTS BY MONTH
(in percent chance of occurrence)

Month	Percent Chance
January	5
February	4
March	6
April	7
May	5
June	5
July	5
August	19
September	14
October	22
November	4
December	4
TOTAL	100.0

17. Distribution of cropland and value of crops. Data on distribution of crops were obtained from county agents, interviews with farmers in the flood plain, and aerial photographs. Values of crops were obtained from "Agricultural Price Standards for Water and Related Land Resource Planning" dated February 1974 published by the Water Resources Council. Crop distribution percentages, yields, values, and costs are shown in Table I-4 for Reach 1. Similar tables were prepared for each reach considered.

18. Values of crops by months. Each crop has a total damageable value that varies by month. Total crop value in any month consists of three items of worth; direct production investment (DPI), fixed annual charges (FAC), and potential net profit (PNP).

a. Direct production investment. The seasonal variation of direct production investment in labor and materials involved in the production of crops that are subject to loss from floods was computed to reflect the accumulated total monetary value of investments made from the beginning of a particular crop season to time of harvesting. Direct production investments are those made in (1) the preparation of land for crop planting and replanting; (2) planting operations, including labor, plants, seeds, and fertilizers, and (3) cultivation and care operations.

b. Fixed annual charges are overhead costs, which consist of the annual investments required to operate and maintain a farming establishment, and include interest on capital investments in land, buildings, and equipment; taxes; insurance premiums; and the costs of annual maintenance of land, equipment, farm buildings, fences, ditches, etc. These charges are prorated to land on an acreage basis, and are considered flood losses to the extent a crop is destroyed or damaged by floods.

c. Net returns are the normal net income to which the farmer is entitled because of his managerial function, his assumption of general risks related to farming, and all other services except labor performed in the direct production phase of farming. Net returns are considered as flood losses only to the extent that floods reduce the normal net return to be expected from specific croplands during a flood free year.

d. A summary of the damageable value of crops in the field by months is shown in Table I-5.

19. Loss of income. When flood occurrences prevent a farmer from realizing the full "normal income" to be expected from specific lands in the absence of flooding, the deficiency is considered a flood loss, which is estimated as equal to normal gross income minus the actual gross income. Included in these losses are those items considered as fixed annual charges, direct production investment, and net returns.

TABLE I-4

CROP DISTRIBUTION AND CROP VALUES
REACH 1 WILKESBORO

Crop	Crop Distribution (Percent) Low 1/	Medium 2/	High 3/	Normal Yield Per Acre	Unit Value	Gross Value Per Acre	Harvesting and Marketing Costs Per Acre	Net Value Per Acre	Direct Production Investment Per Acre	Overhead Costs and Net Returns Per Acre
Soybeans	1.2	1.6	4.2	35 Bu.	$ 3.69	$ 129.15	$ 14.40	$ 114.75	$ 40.93	$ 73.82
Corn	51.8	33.0	30.0	90 Bu.	1.53	137.70	23.50	114.20	74.75	39.45
Small grain	1.1	1.1	2.0	60 Bu.	1.61	96.60	17.28	79.32	43.04	36.28
Tobacco	1.3	2.0	2.5	2100 lbs.	.983	2,064.30	627.69	1,436.61	415.84	1,020.77
Hay	3.3	2.4	5.0	3.0 Ton	44.00	132.00	31.36	100.64	64.19	36.45
Pasture: 4/										
Improved	13.8	32.5	30.0							
Native	24.2	25.3	25.0							
Idle:	3.3	2.1	1.3							
TOTAL	100.0	100.0	100.0							

1/ Cropland below 2-year flood-frequency elevation.
2/ Cropland between 2-year and 10-year flood-frequency elevation.
3/ Cropland above 10-year flood-frequency elevation.
4/ Losses due to flooding of pasture computed on basis of furnishing equivalent supplementary feed for period of time pasture is out of use.

TABLE I-5

DAMAGEABLE VALUES PER ACRE OF CROPS IN FIELD[1/]

Crop	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Corn	$ 0	$ 0	$ 0	$ 0	$28.03	$103.33	$ 113.89	$ 113.89	$113.89	$75.16	$37.57	$ 0
Soybeans	0	0	0	0	52.39	109.82	109.82	113.68	114.82	57.41	0	0
Hay	0	0	0	0	0	0	47.00	59.53	75.83	92.14	46.06	0
Tobacco	23.61	156.51	159.32	189.97	1,215.94	1,366.11	1,436.61	976.66	488.19	11.80	23.61	23.61
Pasture:												
Improved	45.33	45.33	45.33	45.33	45.33	45.33	45.33	45.33	45.33	45.33	45.33	45.33
Native	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Small Grain:	67.53	72.15	78.05	79.31	79.31	39.65			15.62	67.53	67.53	67.53

1/ Harvesting and marketing costs excluded.

20. Computation of average annual crop damages. The seasonal crop damage method of computing agricultural flood damages was used for all crop and pasture losses. Flood damages to crops were computed in terms of average annual values by first evaluating flood losses for various unregulated frequency floods by considering the variables having an effect on total crop damage. These variables are: (1) distribution of crops on land (Table I-4); (2) damageable value of crops in field by months (table I-5); (3) percent probability of a flood occurring in a particular month (Table I-3); (4) acres of cropland inundated, Figures I-2 through I-6. Stage versus average annual crop damage curves for Reaches 1-5 are shown on Figures I-7 through I-11, respectively. Average annual flood damages to crops were then computed using standard damage integration tables in which average values of losses sustained due to floods of diminishing magnitudes were multiplied by appropriate incremental probability of occurrence factors, and the products accumulated. A summary of these values by reach is shown in Table I-6.

21. Nonseasonal flood damage. Stage versus flood damage curves for properties not susceptible to seasonal variation were computed for each urban and rural category. Composite urban stage-damage curves are shown on Figure I-12 and I-13, respectively, for Wilkesboro-North Wilkesboro, and Elkin-Jonesville, North Carolina. Rural stage-damage curves for all reaches are shown on Figures I-14 through I-19. Average annual flood damages to these properties were computed using standard damage integration tables in which average values of losses sustained due to floods of diminishing magnitudes were multiplied by appropriate incremental probability of occurrence factors, and the products accumulated. A summary of these values by category and reach is shown in Table I-6. A sample computation is shown in Exhibit I-2.

22. Future flood damages. Future annual damages were estimated assuming conditions based on expected changes in flood plain development, without projects. Estimates of future urban damages are based on expected future land use as determined from future land use plans for Wilksboro, North Wilksboro, Elkin, and Jonesville; interviews with knowledgeable people; projected future populations; and other factors which would influence land use. Adequate land, excluding that for which land enhancement benefits were claimed in paragraph 28.b(2), is available to support future development either by more extensive use of the flood plain as predicted in the future land use plans cited above or further lateral expansion in the flood plain. Future estimates of crop and noncrop damages are based on yields of crops which are expected to approach those presently attainable at agricultural research stations under the auspices of the U. S. Department of Agriculture and North Carolina State University. Nonagricultural rural damages are based on estimates of facilities required by the projected increased population. Growth of future annual damages was assumed to increase uniformly for the first 50 years of the 100-year project evaluation period and remain constant thereafter for the last half of the evaluation period. Estimated future stage-damage curves for each reach and damage category are shown on the appropriate figures, previously discussed. A summary of estimated future flood damages is shown in Table I-6.

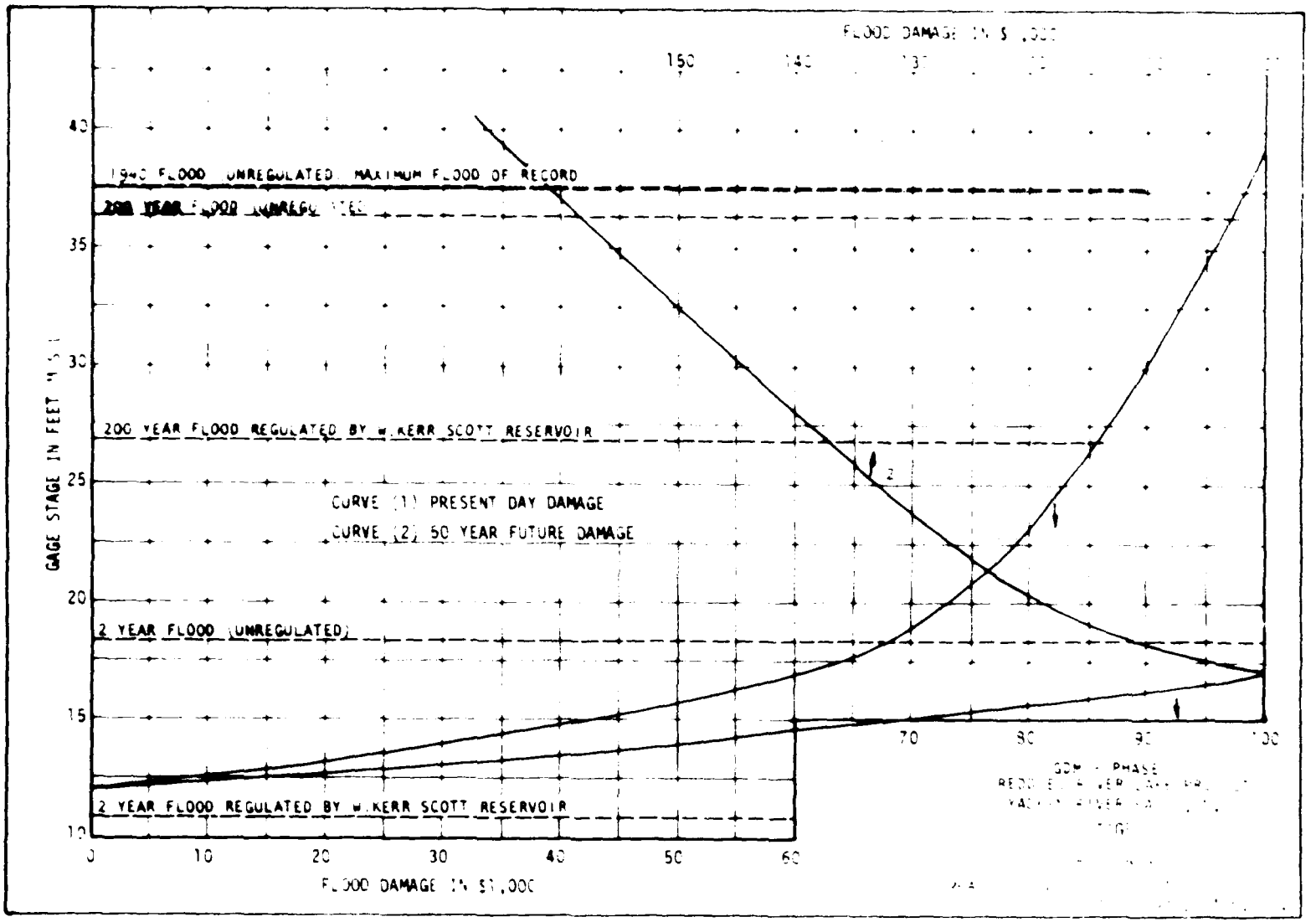

FLOOD DAMAGE IN $,000
150
140
40
35
30
25
20
15
10
1940 FLOOD UNREGULATED MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD UNREGULATED
200 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
CURVE (1) PRESENT DAY DAMAGE
CURVE (2) 50 YEAR FUTURE DAMAGE
2 YEAR FLOOD (UNREGULATED)
2 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
GAGE STAGE IN FEET
0
10
20
30
40
50
60
70
80
90
100
FLOOD DAMAGE IN $1,000

FIGURE 1-7

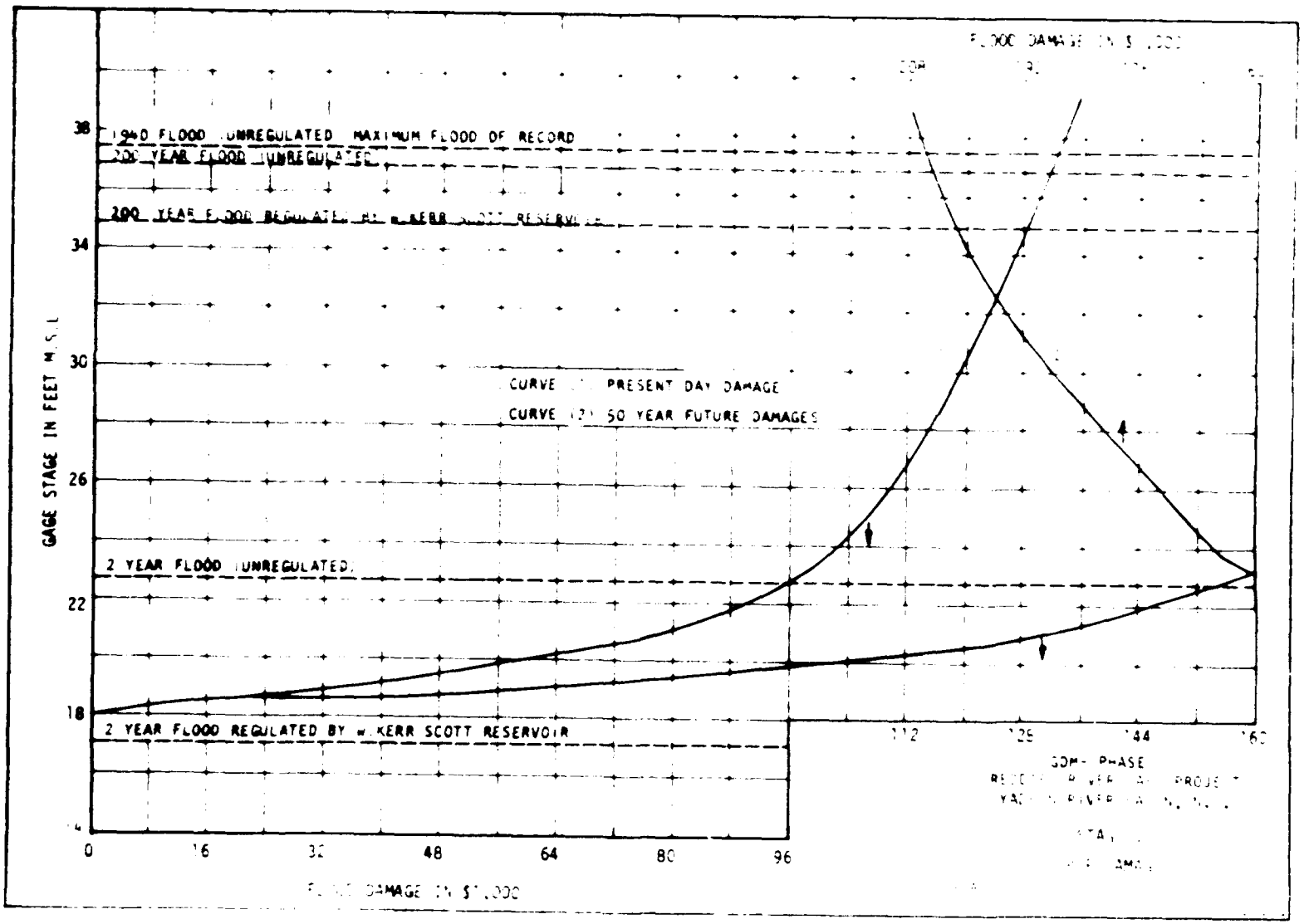
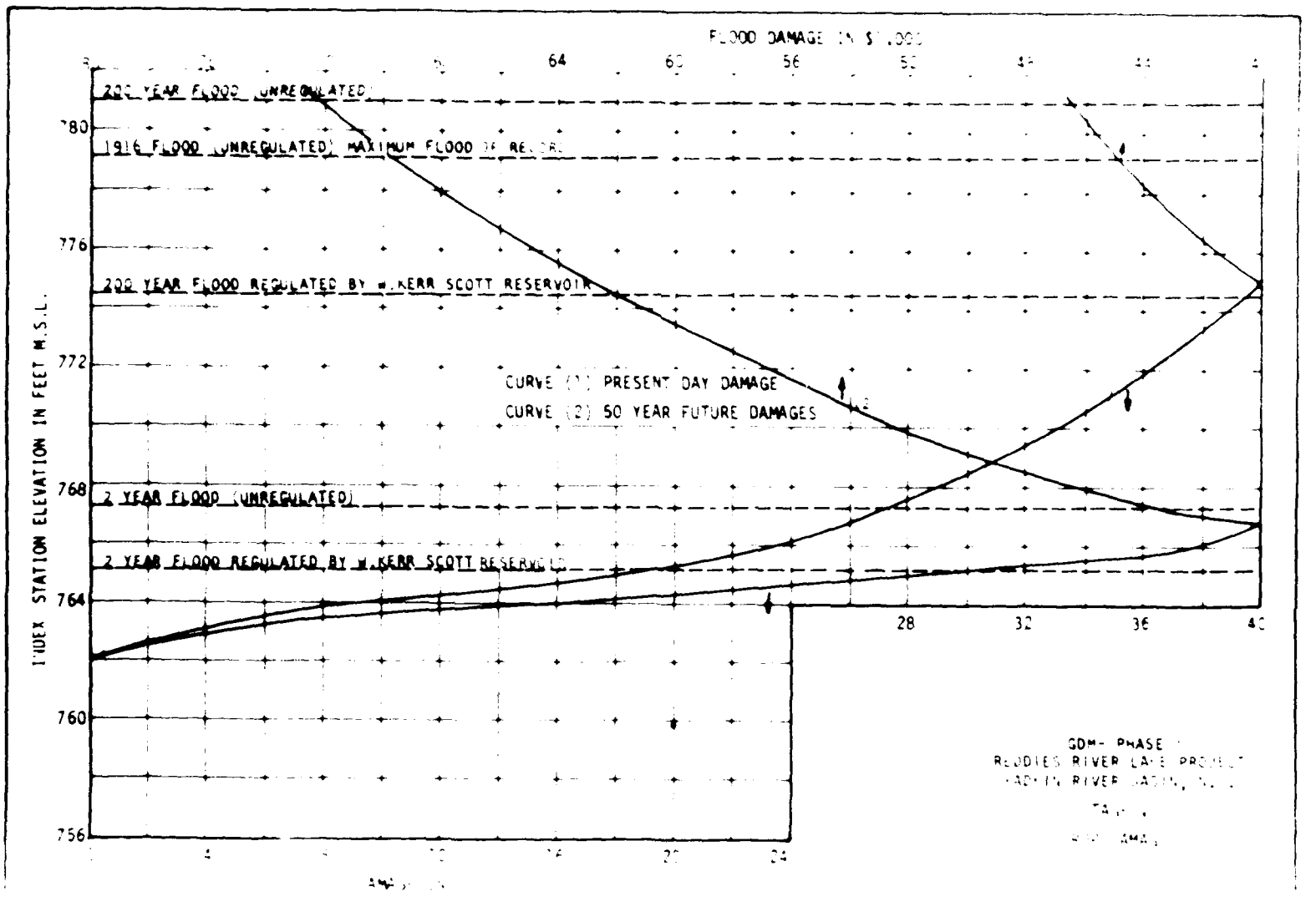

1940 FLOOD UNREGULATED MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD UNREGULATED
200 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
CURVE (1) PRESENT DAY DAMAGE
CURVE (2) 50 YEAR FUTURE DAMAGES
2 YEAR FLOOD UNREGULATED
2 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
GAGE STAGE IN FEET M.S.L.
38
34
30
26
22
18
0
16
32
48
64
80
96
112
128
144
160

FIGURE 1 - 8


FLOOD DAMAGE IN $1,000
64
60
56
52
48
44
40
200 YEAR FLOOD UNREGULATED
780
1916 FLOOD UNREGULATED MAXIMUM FLOOD OF RECORD
776
200 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
772
CURVE (1) PRESENT DAY DAMAGE
CURVE (2) 50 YEAR FUTURE DAMAGES
768
2 YEAR FLOOD UNREGULATED
2 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
764
760
756
INDEX STATION ELEVATION IN FEET M.S.L.
28
32
36
40
GDM- PHASE
REDDIES RIVER LAKE PROJECT
YADKIN RIVER BASIN, N.C.

FIGURE

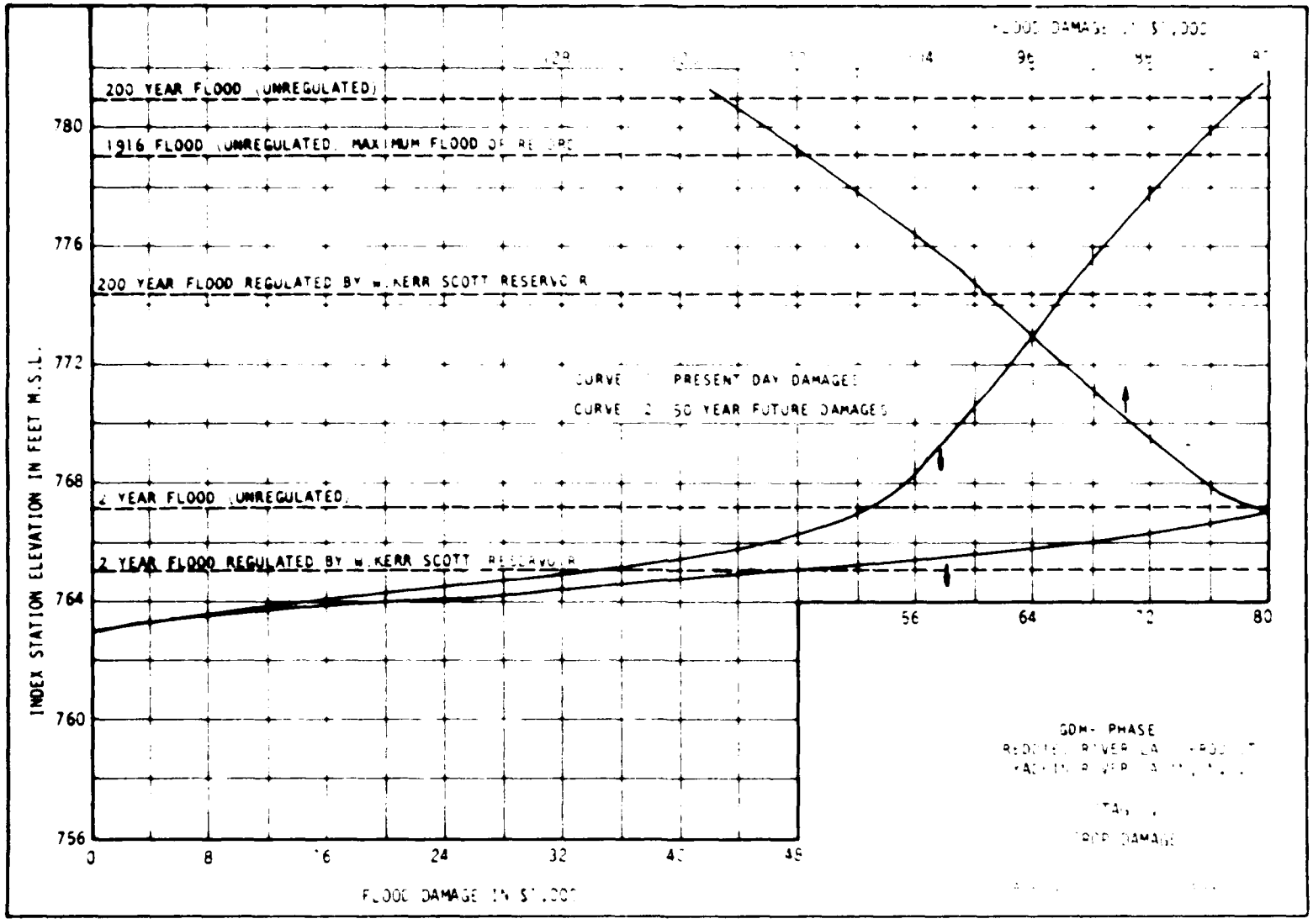

200 YEAR FLOOD (UNREGULATED)
1916 FLOOD (UNREGULATED, MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
2 YEAR FLOOD (UNREGULATED)
2 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
CURVE 1 PRESENT DAY DAMAGES
CURVE 2 50 YEAR FUTURE DAMAGES
INDEX STATION ELEVATION IN FEET M.S.L.
780
776
772
768
764
760
756
0
8
16
24
32
40
48
56
64
72
80
FLOOD DAMAGE IN $1,000
GDM- PHASE

FIGURE I-10

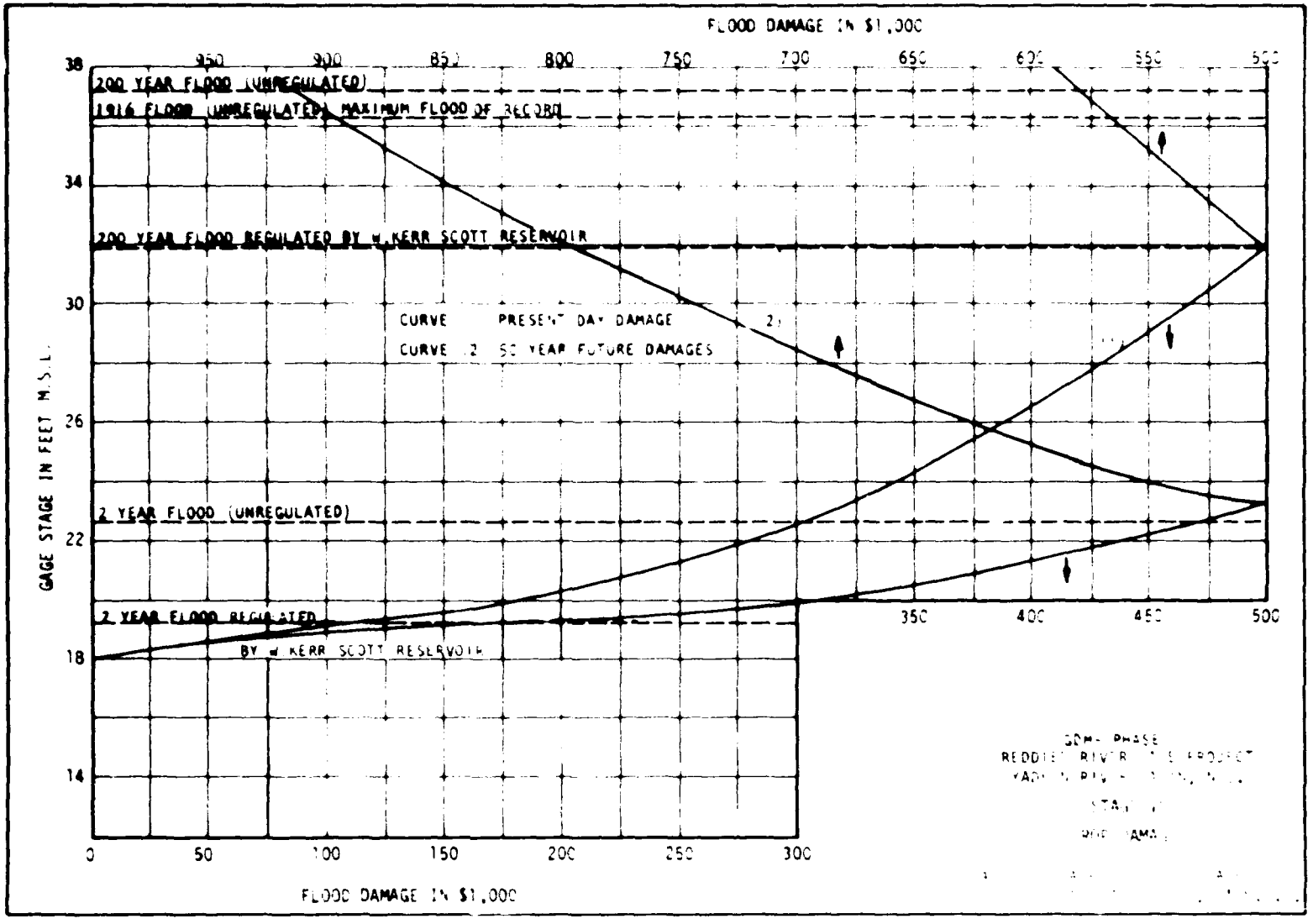

FLOOD DAMAGE IN $1,000
950
900
850
800
750
700
650
600
550
500
38
34
30
26
22
18
14
200 YEAR FLOOD (UNREGULATED)
1916 FLOOD (UNREGULATED) MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
CURVE 1 PRESENT DAY DAMAGE
CURVE 2 50 YEAR FUTURE DAMAGES
2 YEAR FLOOD (UNREGULATED)
2 YEAR FLOOD REGULATED
BY W. KERR SCOTT RESERVOIR
GAGE STAGE IN FEET M.S.L.
0
50
100
150
200
250
300
350
400
450
500
FLOOD DAMAGE IN $1,000

FIGURE 1 - 11

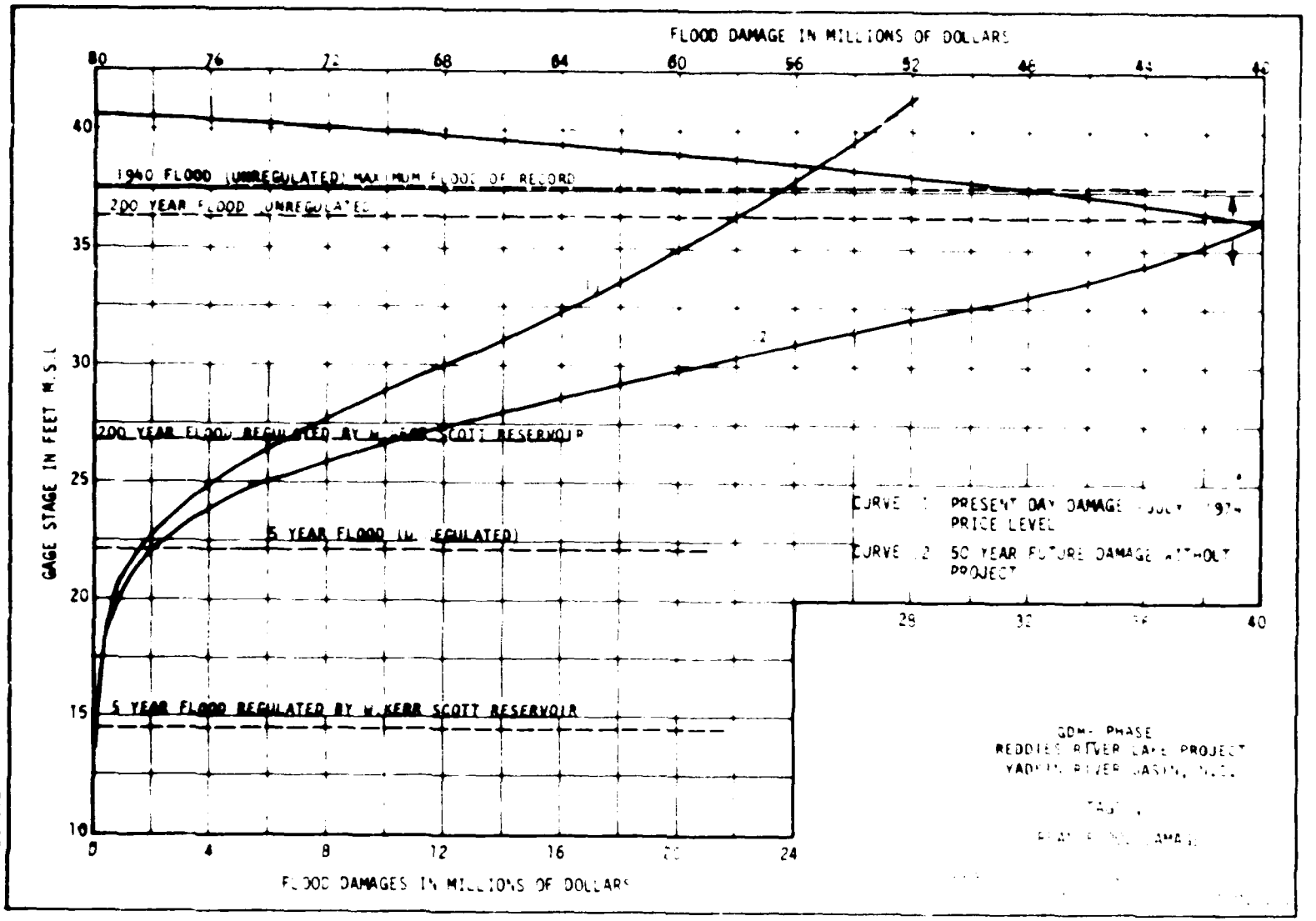

FLOOD DAMAGE IN MILLIONS OF DOLLARS
80
76
72
68
64
60
56
52
48
44
40
40
35
30
25
20
15
10
1940 FLOOD (UNREGULATED) MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD UNREGULATED
200 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
5 YEAR FLOOD (UNREGULATED)
5 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
GAGE STAGE IN FEET M.S.L.
CURVE 1 PRESENT DAY DAMAGE JULY 197- PRICE LEVEL
CURVE 2 50 YEAR FUTURE DAMAGE WITHOUT PROJECT
28
32
36
40
0
4
8
12
16
20
24
FLOOD DAMAGES IN MILLIONS OF DOLLARS
GDM- PHASE
REDDIES RIVER LAKE PROJECT
YADKIN RIVER BASIN, N.C.

FIGURE I-12

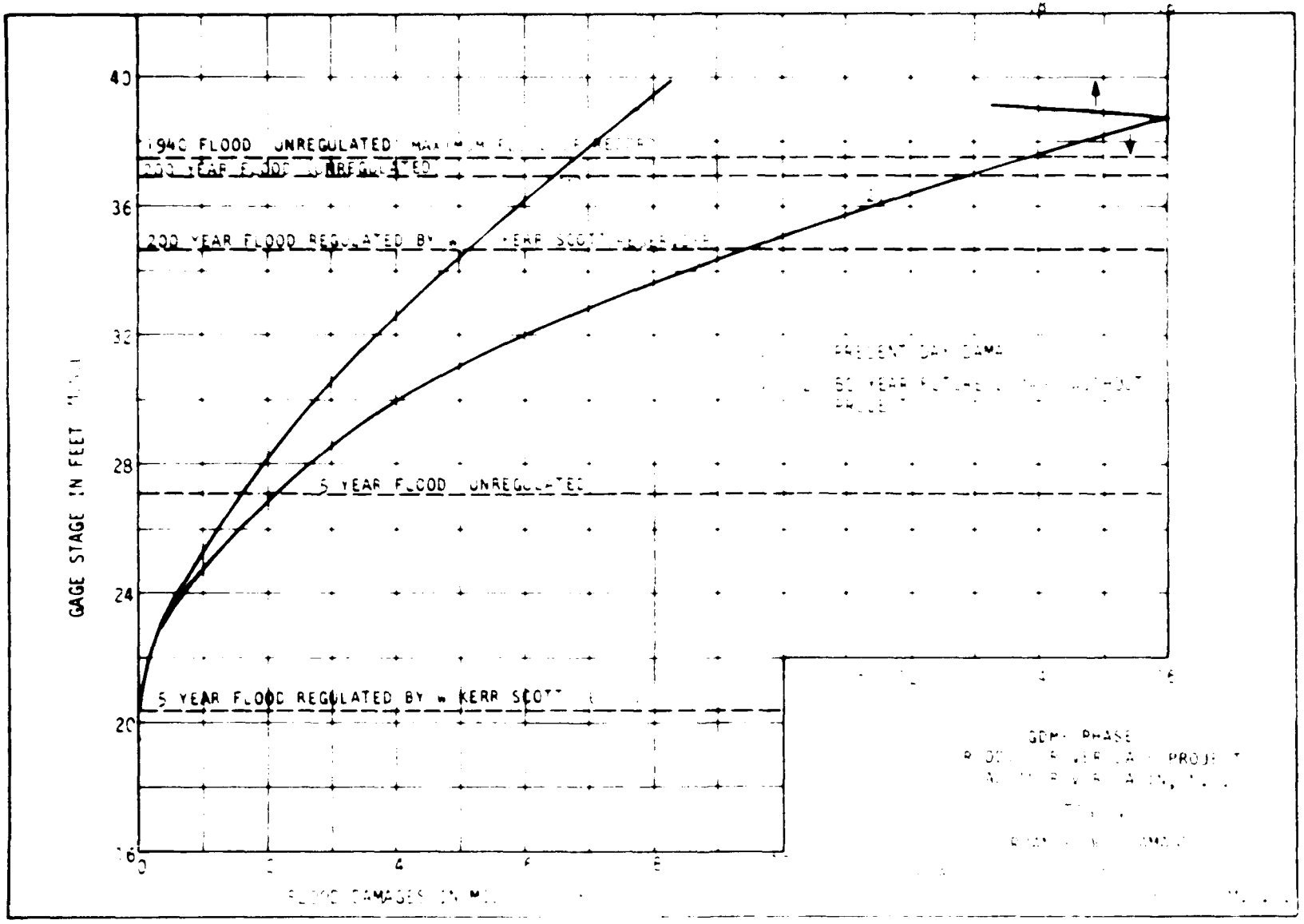

40
36
32
28
24
20
16
0
1940 FLOOD UNREGULATED
200 YEAR FLOOD UNREGULATED
200 YEAR FLOOD REGULATED BY
5 YEAR FLOOD UNREGULATED
5 YEAR FLOOD REGULATED BY
GAGE STAGE IN FEET
PRESENT DAY DAMS
50 YEARS FUTURE
DRAFT

FIGURE 1-13

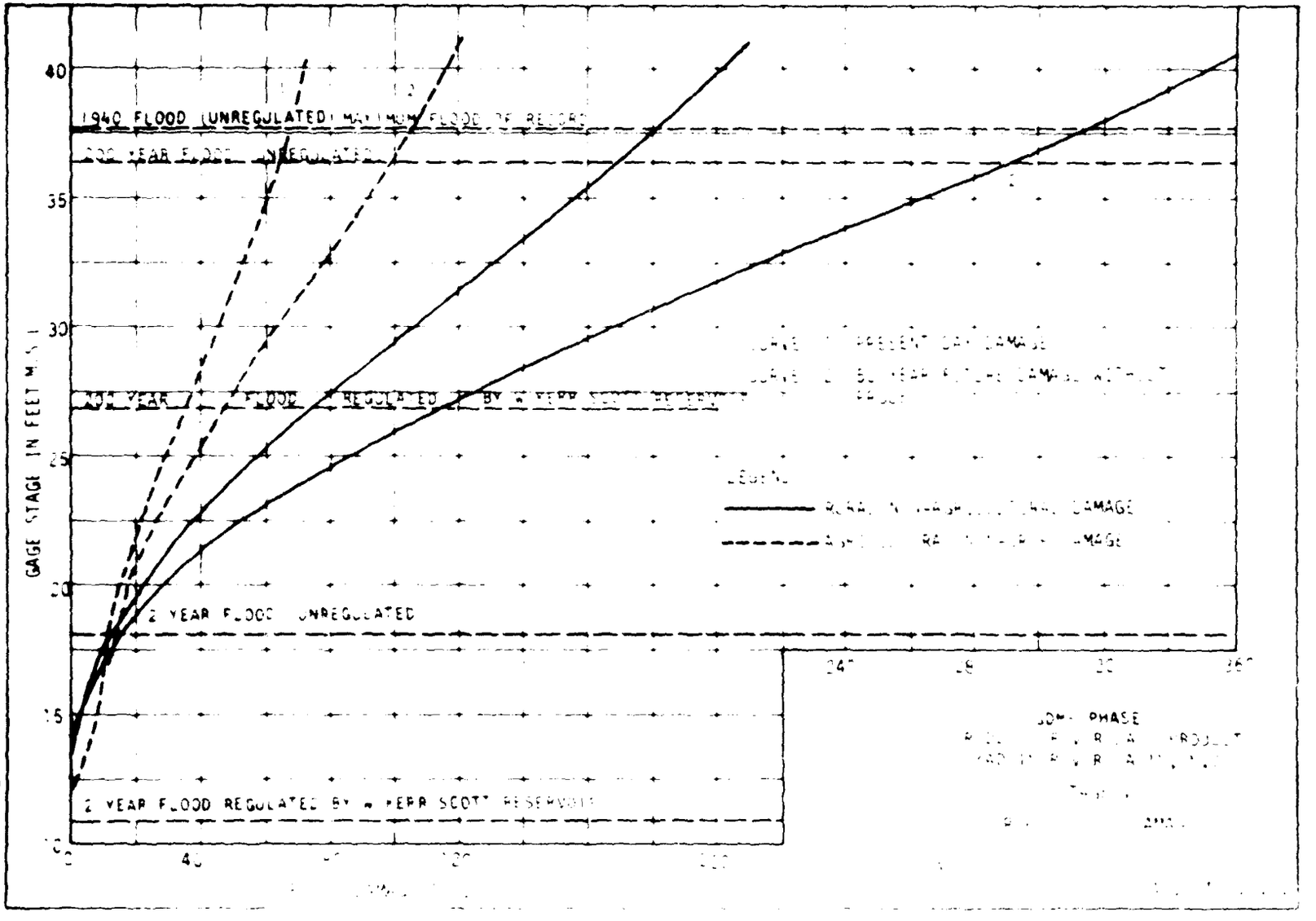

GAGE STAGE IN FEET M.S.L.
40
35
30
25
20
15
1940 FLOOD (UNREGULATED) MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD UNREGULATED
100 YEAR FLOOD REGULATED BY W. PERR SCOTT RESERVOIR
2 YEAR FLOOD UNREGULATED
2 YEAR FLOOD REGULATED BY W. PERR SCOTT RESERVOIR
LEGEND
DAMAGE
DAMAGE
24"
28
32
36"
PHASE

FIGURE 1-14

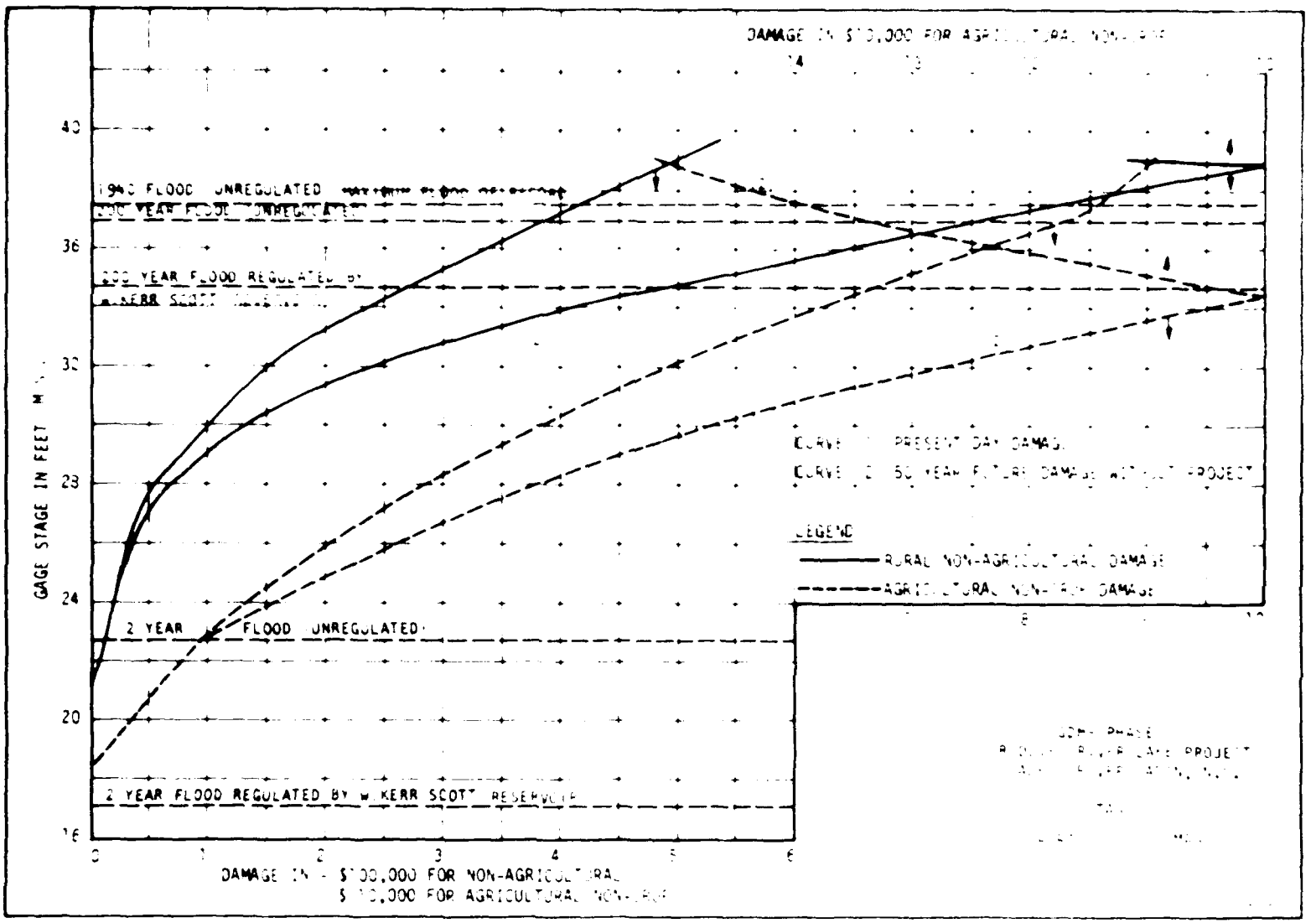

GAGE STAGE IN FEET
40
36
32
28
24
20
16
0
1
2
3
4
5
6
1940 FLOOD UNREGULATED
100 YEAR FLOOD UNREGULATED
100 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
2 YEAR FLOOD UNREGULATED
2 YEAR FLOOD REGULATED BY W. KERR SCOTT RESERVOIR
LEGEND
RURAL NON-AGRICULTURAL DAMAGE
AGRICULTURAL NON-AGR DAMAGE
DAMAGE IN - $100,000 FOR NON-AGRICULTURAL
$ 10,000 FOR AGRICULTURAL NON-AGR

FIGURE I - 15

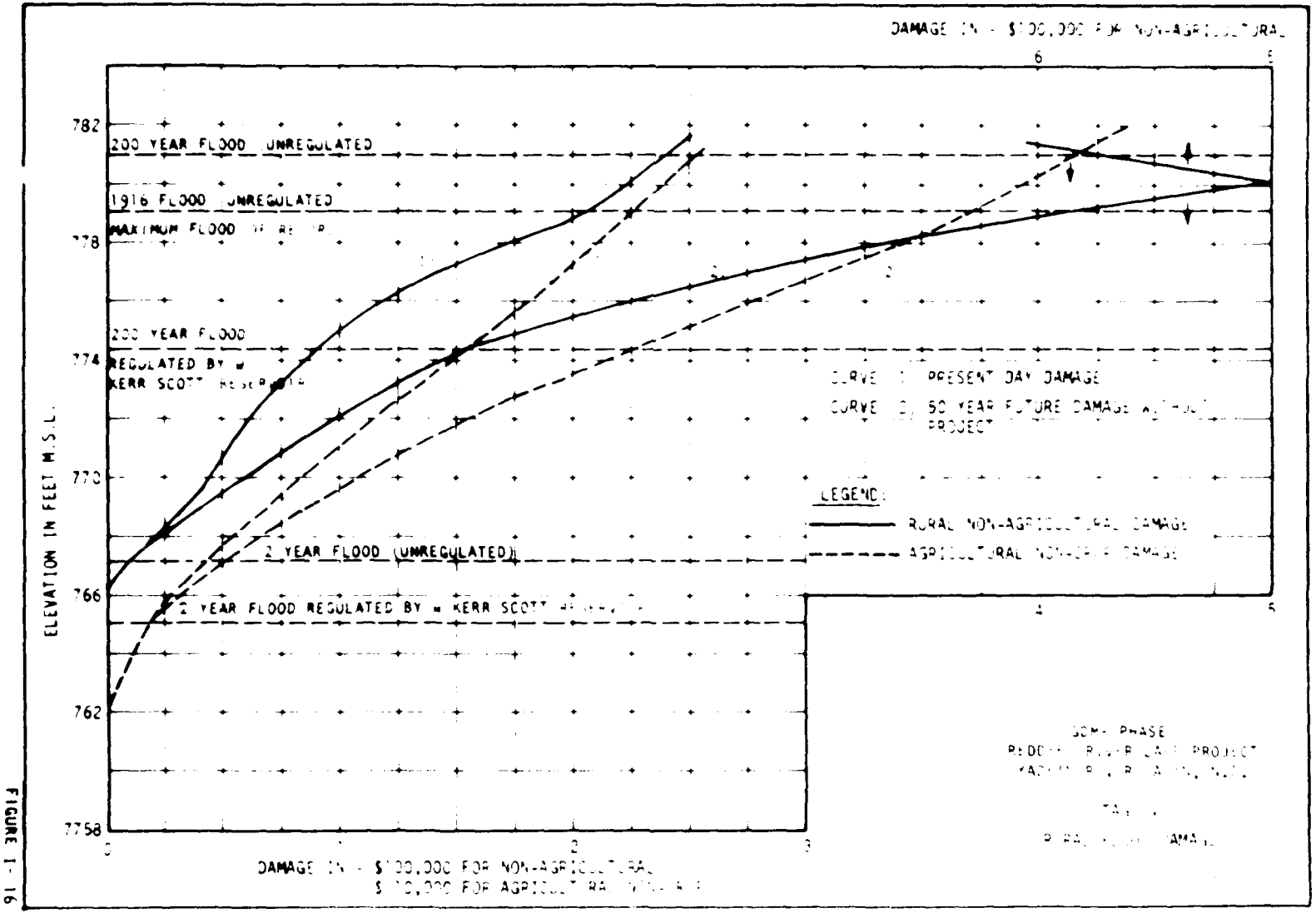

DAMAGE IN - $100,000 FOR NON-AGRICULTURAL
782
778
774
770
766
762
758
200 YEAR FLOOD UNREGULATED
1916 FLOOD UNREGULATED
MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD
REGULATED BY W KERR SCOTT RESERVOIR
2 YEAR FLOOD (UNREGULATED)
2 YEAR FLOOD REGULATED BY W KERR SCOTT RESERVOIR
ELEVATION IN FEET M.S.L.
CURVE 1 PRESENT DAY DAMAGE
CURVE 2 50 YEAR FUTURE DAMAGE WITHOUT PROJECT
LEGEND:
RURAL NON-AGRICULTURAL DAMAGE
AGRICULTURAL NON-AGRICULTURAL DAMAGE
DAMAGE IN - $100,000 FOR NON-AGRICULTURAL
$10,000 FOR AGRICULTURAL

FIGURE I - 16

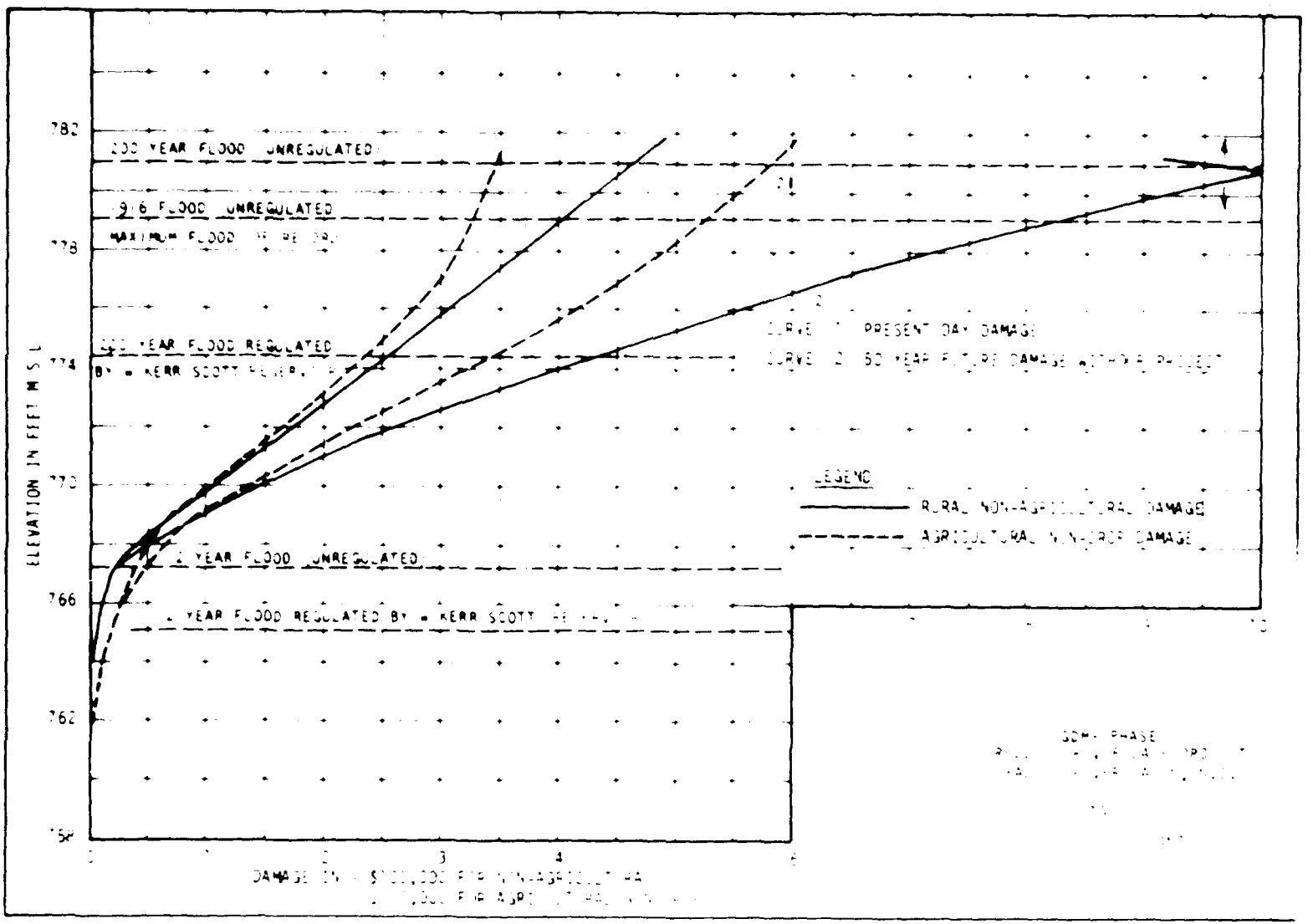
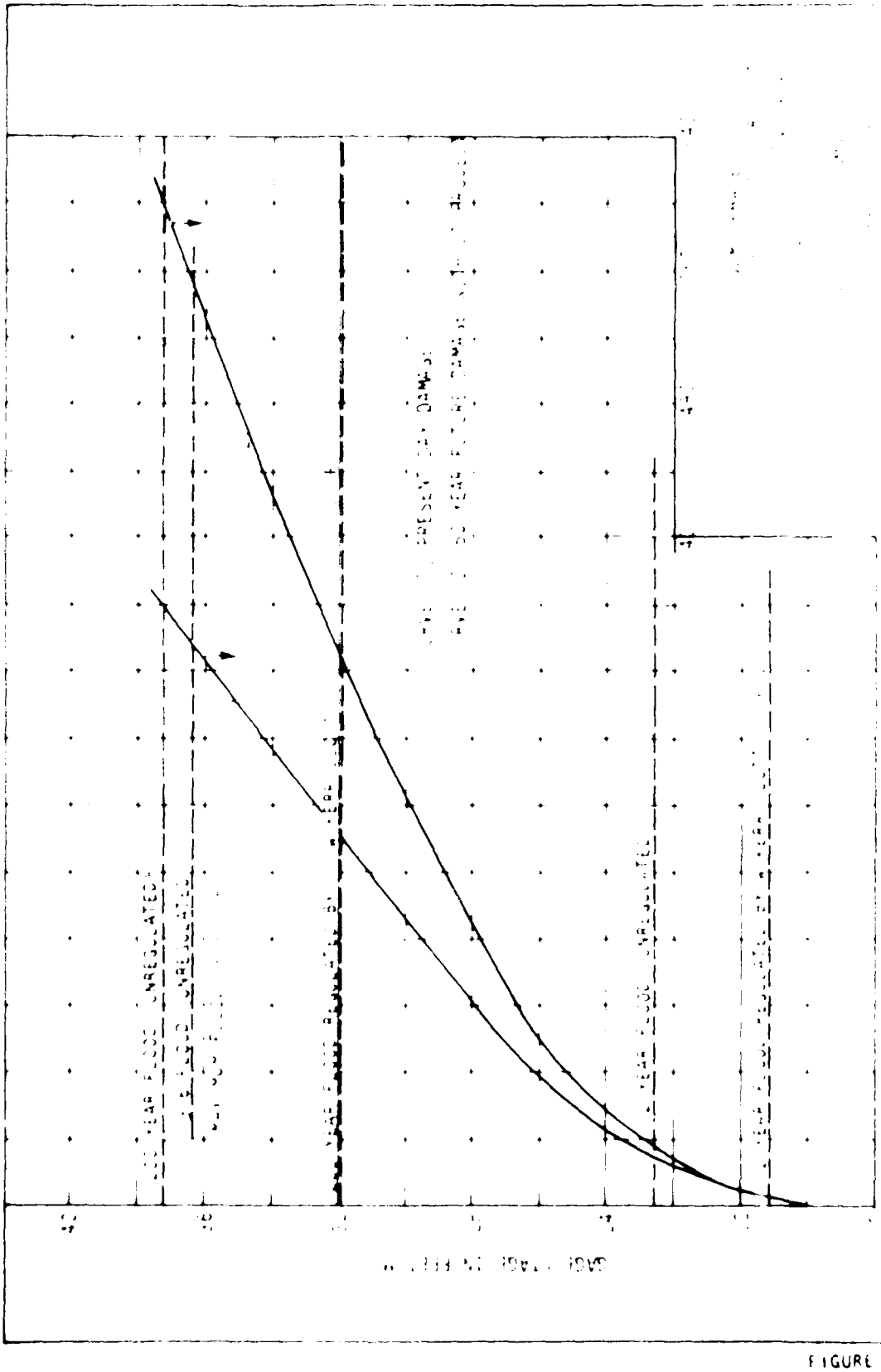

782
778
774
770
766
762
ELEVATION IN FEET M S L
200 YEAR FLOOD UNREGULATED
9.6 FLOOD UNREGULATED
100 YEAR FLOOD REGULATED
2 YEAR FLOOD UNREGULATED
2 YEAR FLOOD REGULATED BY = KERR SCOTT
LEGEND
RURAL NON-AGRICULTURAL DAMAGE
AGRICULTURAL NON-CROP DAMAGE
3
4

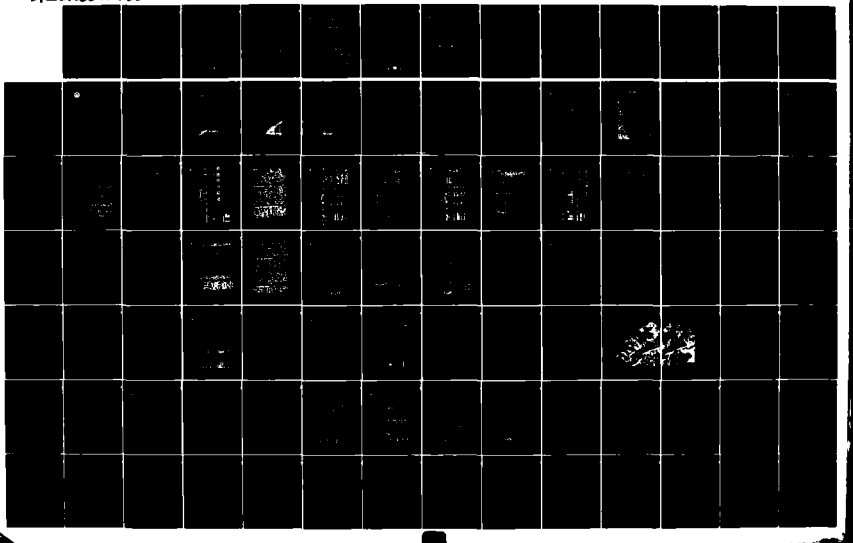
FIGURE 1

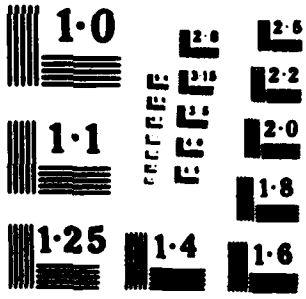


FIGURE

AD-A150 012 REDDIES RIVER LAKE YADKIN RIVER BASIN REDDIES RIVER NORTH CAROLINA GENERA..(U) CORPS OF ENGINEERS CHARLESTON SC CHARLESTON DISTRICT MAR 75 3/4

UNCLASSIFIED F/G 13/2 NL




1·0
1·1
1·25
1·4
2·5
2·2
2·0
1·8
1·6

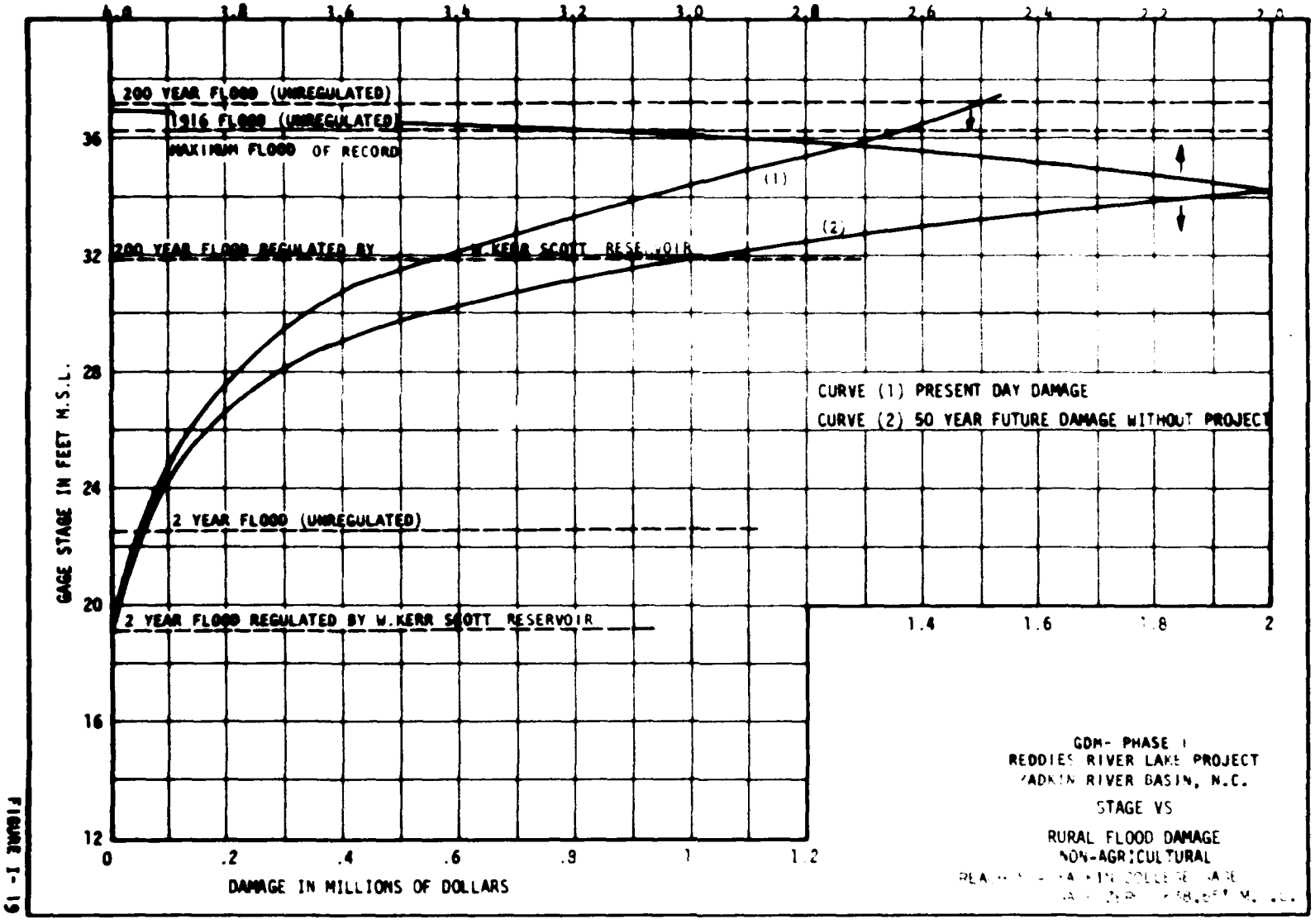

200 YEAR FLOOD (UNREGULATED)
1916 FLOOD (UNREGULATED)
MAXIMUM FLOOD OF RECORD
200 YEAR FLOOD REGULATED BY W.KERR SCOTT RESERVOIR
2 YEAR FLOOD (UNREGULATED)
2 YEAR FLOOD REGULATED BY W.KERR SCOTT RESERVOIR
(1)
(2)
CURVE (1) PRESENT DAY DAMAGE
CURVE (2) 50 YEAR FUTURE DAMAGE WITHOUT PROJECT
GAGE STAGE IN FEET M.S.L.
DAMAGE IN MILLIONS OF DOLLARS
36
32
28
24
20
16
12
0
.2
.4
.6
.9
1
1.2
1.4
1.6
1.8
2
GDM- PHASE I
REDDIES RIVER LAKE PROJECT
YADKIN RIVER BASIN, N.C.
STAGE VS
RURAL FLOOD DAMAGE
NON-AGRICULTURAL

FIGURE I-19

TABLE I-6

[illegible] ANNUAL [illegible] BENEFITS BASED
WITH U. [illegible] COAST [illegible] AND [illegible]

(Values in $1,000) (July 1974 Price Level)

[illegible]	Flood Plain Management												100-Year Discounted 1/					
	Structure Use						Content Use											
	Reach Number					Total	Reach Number					Total	Reach Number					Total
[illegible]	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5	
[illegible]	16.1	27.0	20.0	33.0	209.	305.5	26.2	42.0	33.1	69.5	271.2	422.0	19.5	32.3	25.0	39.1	208.6	318.5
[illegible]	3.3	3.7	3.3	2.8	20.3	33.5	3.8	4.7	3.4	3.4	24.3	39.6	3.3	4.0	3.3	3.0	21.8	35.4
[illegible]	3.0	3.6	3.3	26.2	23.4	59.5	3.8	13.8	8.3	58.2	46.2	88.0	3.3	3.6	3.6	26.2	32.9	73.0
[illegible]	22.5	34.1	26.4	32.3	252.6	368.9	33.8	58.5	42.8	73.1	342.2	550.4	26.2	44.9	32.9	58.8	262.3	426.1
[illegible]	142.6	92.2				234.8	144.5	149.6				294.1	128.8	130.9				259.7
[illegible]	98.8	58.1				98.9	36.3	100.4				136.9	97.5	95.8				193.3
[illegible]	5.6	5.0				8.4	2.4	3.4				5.8	2.0	2.9				4.9
[illegible]	5.0	4.8				7.1	6.2	3.0				9.2	3.4	3.4				7.8
[illegible]	3.7	2.6				28.1	2.0	27.0				29.9	2.0	22.3				24.3
[illegible]	255.8	158.4				368.8	188.6	286.3				467.0	138.3	223.5				360.0
[illegible]	280.3	193.5	26.4	32.3	252.6	868.9	222.4	344.8	42.8	73.1	342.2	1088.3	169.7	268.4	32.9	58.8	262.3	894.1

[illegible] With [illegible] Management [illegible] [illegible].

23. Summary of average annual flood damages. The value of future annual damage was discounted to present worth and redistributed over the evaluation period as an average annual equivalent damage by appropriate compound interest methods. A summary of average annual remaining flood damages by category and reach with W. Kerr Scott Dam and Reservoir is shown in Table I-6.

FLOOD CONTROL BENEFITS

24. Rural benefits considered. Rural benefits are derived from both agriculture and nonagricultural improvements. Benefits accruing to nonagricultural improvements are derived from the prevention or reduction of flood damages to rural transportation facilities, nonfarm residential properties, schools, churches, industrial, and commercial establishments. Agricultural benefits accrue to activities involving the production of agricultural commodities, and consist of benefits derived from the prevention or reduction of flood damages to annual crops and pastures, rural buildings and contents, and on-the-farm fixed improvements.

25. Urban benefits considered. These benefits are derived from the reduction or prevention of urban flood damages to industrial, commercial, and residential properties; utility installations, transportation facilities; and the reduction or elimination of costs incurred in providing precautionary and emergency measures warranted by flood or impending flood conditions. Land enhancement benefits to urban lands were also evaluated. These benefits were considered to accrue only in those areas where the effects of the project or the existing W. Kerr Scott Dam and Reservoir and the project would greatly decrease the flood threat.

26. Ability of considered projects to reduce peak flood stages and discharges. Reduced or regulated discharge-frequency curves [illegible] reductions anticipated by the considered projects, individually or in combination, are shown on Plates 4 through 7 in [illegible]. The degree to which each project can reduce downstream stages was determined by routing reservoir holdouts to each stream gaging index station for all floods of record and for synthesized flood up to the 500-year flood. The methods and procedures and routing constants used are discussed in detail in [illegible].

27. Remaining flood damages with considered projects in operation. The remaining flood damages expected to occur with the projects in operation were computed using the same methods as outlined in the flood damage portion of this appendix, but in accordance with the revised conditions with stages or peak discharge frequency curves. The remaining flood

[illegible]

damages with projects in operation were computed for both present day and 50 year future stages of flood plain development, and were obtained from the damages under existing conditions to determine annual flood damage reduction benefits. Future flood damage reduction benefits were appropriately discounted and added to average annual flood damage reduction benefits based on the present stage of flood plain development. A summary of average annual remaining flood damages by category and reach with the existing W. Kerr Scott Dam and Reservoir and authorized Reddies River Lake is given in Table I-7.

28. Computation of average annual flood control benefits. In continuous computation, flood control benefits are considered under the assumption; i.e. flood damage reduction benefits and land enhancement benefits.

a. Flood damage reduction benefits. Figure I-28 illustrates assumptions made relative to expected growth of future benefits and the basis for discounting computations.

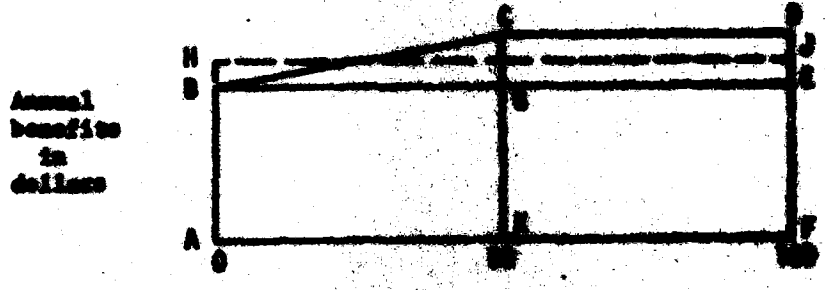
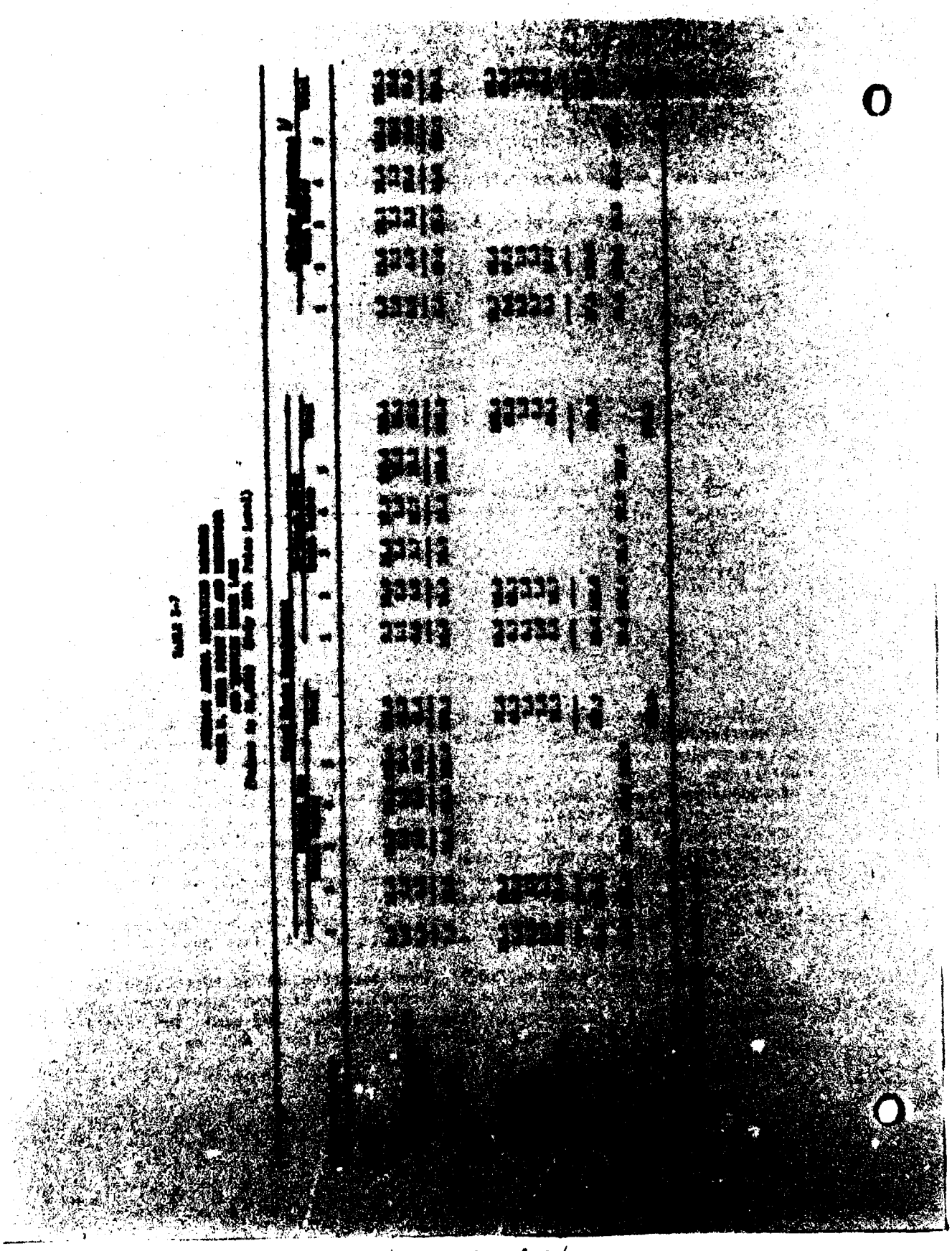


Figure I-28. Project Evaluation Graph, No Name

The value of annual benefits, based on progressive flood plain development, is represented by line AB. These are plotted to cover project life during the entire project evaluation period. [illegible] during the life of the project. [illegible] of additional future annual benefits, [illegible] flood plain, is indicated by line BC. The [illegible] future benefits is shown by line CD. The average annual value of these benefits, line EF, was determined by planning [illegible] evaluation was made by using the [illegible] discount factor. A discount rate of [illegible] the value of the total average annual flood damage reduction benefits for the 50-year evaluation period is represented by line EF.

b. Land enhancement benefits. [illegible]



(1) Agricultural land enhancement benefits. After consulting with County Extension Chairmen and other agricultural professionals, it was estimated that there would be no major change in the utilization of flood plain agricultural lands due to additional flood protection that would be afforded by any considered project. Therefore, no agricultural land enhancement benefits are estimated for any considered project.

(2) Urban land enhancement benefits. These benefits accrue to urban and industrial areas, due to the flood damage reduction effects of upstream reservoir projects. It is anticipated that such benefits would be produced only at Wilkesboro, North Wilkesboro, Elkin, and Jonesville, North Carolina, from the effects of Reddies River Lake. A study of potential land enhancement benefits expected to accrue to Reddies River Lake was made by the Appraisal Branch, Real Estate Division, Savannah District. A report of their findings is included as Exhibit I-1 of this appendix. It is estimated that these benefits would accrue in the flood plain area in the vicinity of Wilkesboro and North Wilkesboro and would entail an area of about 170 acres and in the vicinity of Elkin and Jonesville would entail an area of about 124 acres. Land values for the 170 acres at Wilkesboro, North Wilkesboro are estimated to increase from $3,965 per acre to about $7,574 per acre with the high degree of flood control provided by Reddies River Lake. The 124 acres at Elkin and Jonesville are estimated to increase from $3,965 per acre to about $4,136 per acre with the high degree of flood control provided by Reddies River Lake. Average annual land enhancement benefits for Wilkesboro and North Wilkesboro are estimated to amount to $40,000 annually, and for Elkin and Jonesville are estimated to amount to $20,000 annually, based on a 100-year evaluation period, and a non-Federal interest rate of 8 percent.

20. Summary of flood control benefits. A summary of average annual flood damage reduction benefits by category and area, applicable to Reddies River Lake is given in Table I-8. A summary of flood control benefits applicable to Reddies River Lake and Roaring River Lake is given in Table I-9.

TABLE I-6

[redacted]

(Values in $1,000) (July 1976 Price Level)

[redacted]	United States Investment												10-Year Alignment 1/					
	Direct Air						Direct Naval											
	Basic	Basic Follow-on				Total	Basic	Basic Follow-on				Total	Basic	Basic Follow-on				Total
[redacted]	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5	
[redacted]	105.6	115.0	4.1	7.1	30.3	66.6	35.9	54.8	6.5	11.6	30.6	132.4	12.8	16.7	4.9	8.7	37.1	80.0
[redacted]	2.0	1.7	0.8	0.8	0.1	21.7	3.7	2.3	0.8	0.8	7.3	14.1	3.5	1.9	0.8	0.8	6.6	12.6
[redacted]	2.6	2.6	2.3	2.3	0.3	22.3	3.3	4.0	2.6	7.3	16.3	36.6	3.7	3.7	2.6	6.1	12.1	26.8
[redacted]	10.1	20.3	7.3	10.3	30.7	110.5	20.0	31.0	9.9	19.9	30.0	110.3	17.0	26.3	8.1	15.6	36.8	120.6
[redacted]	55.5	49.0				107.3	107.7	68.0				175.7	107.1	48.3				155.4
[redacted]	10.0	10.3				40.3	20.0	45.1				65.9	21.9	33.1				55.0
[redacted]	1.0	1.1				2.0	2.3	1.6				3.9	2.0	1.4				3.4
[redacted]	4.1	2.0				5.1	3.2	1.4				4.6	4.3	1.1				3.4
[redacted]	1.0	0.3				0.6	1.6	12.2				13.8	1.4	9.6				11.0
[redacted]	123.3	68.8				156.3	102.0	118.3				220.9	126.9	93.3				220.4
[redacted]	133.6	101.3	7.3	10.3	30.7		122.4	139.3	9.9	19.9	30.0		134.7	117.6	8.1	15.6	36.8	
[redacted]						356.1						440.0						351.0

1/ [redacted]

TABLE I-9

SUMMARY OF AVERAGE ANNUAL FLOOD
CONTROL BENEFITS FROM CONSIDERED PLANS
(100 Year Evaluation Period-July 1974 Price Level)
(Values in $1,000)

Project	Flood Control Storage (inches)	Present Development	Future Development 1/	Land Enhancement 2/	Total Benefits
Beddies River Lake	4.97	295	45	73	413
	6.95	305	46	73	424
	8.93	311	47	73	431
Roaring River Lake	7.00	232	31	29	292
Beddies River Lake and Roaring River Lake	6.95 7.00	472	66	110	648

1/ Discount interest rate 5 7/8%

2/ Non-Federal interest rate 8%

U. S. ARMY ENGINEER DISTRICT, CHARLESTON
NORTH CAROLINA AREA REAL ESTATE OFFICE
Cary, North Carolina

Potential Land Enhancement Study
Wilkesboro-North Wilkesboro, and [illegible]-Jonesville, N. C.

1. PURPOSE:

This report is made for the purpose of determining the potential enhancement of land values, in designated areas, in Wilkesboro, North Wilkesboro, Elkin, and Jonesville, N. C., which would be attributed to the construction of the Reddies River.

2. DISCUSSION AND VALUATION:

Reach 1 - Wilkesboro-North Wilkesboro, N. C.

Land Description:

The subject land consists of 170 acres, [illegible] less six large tracts. These are low, undeveloped tracts [illegible] for industrial or commercial use. Most tracts would require [illegible] partial filling to make them useable.

Valuation:

The estimated value of the land [illegible] consideration that it is low, undeveloped open land in large tracts [illegible] and [illegible] utilities. The potential land [illegible] is [illegible] is estimated at 90%. This is based on the difference [illegible] land which is subject to flooding, and land sales not [illegible].

Reach 1 - Wilkesboro, N. C.

Indicated Value Without Reddies and with W. Kerr Scott Lakes:

Map No. 1	15 acres	@ $4,000/acre	$ 60,000
Map No. 2	80 acres	@ $5,000/acre	400,000
Map No. 3	30 acres	@ $4,000/acre	120,000
Map No. 4	10 acres	@ $4,000/acre	40,000
Map No. 5	10 acres	@ $4,000/acre	40,000
Map No. 6	5 acres	@ $3,500/acre	17,500
	170 acres	Total Land	$ 677,500

Indicated Value With Reddies and W. Kerr Scott Lakes:

Map No. 1	15 acres	@ $7,000/acre	$ 105,000
Map No. 2	80 acres	@ $10,000/acre	800,000
Map No. 3	30 acres	@ $7,000/acre	210,000
Map No. 4	10 acres	@ $7,000/acre	70,000
Map No. 5	10 acres	@ $7,000/acre	70,000
Map No. 6	5 acres	@ $6,500/acre	32,500
	170 acres	Total Land	$1,287,500

Summary:

With Lakes	$1,287,500
Without Lakes	[illegible]
	$ [illegible]

Potential Land Enhancement Rate = 90%

LAND SALES

HILLSBORO-NORTH HILLSBORO AREA

Sale No.	Date	Zoning	Floodable	DB/PG	Price	Acres	Cost/Acre
1	5/73	C	Yes	524/630	$ 19,000	0.172	$10,465
2	4/73	C	Yes	524/162	35,000	2.3	15,217
3	4/73	-	No	524/94	517,500	350.66	1,476
4	12/72	I	No	521/1008	42,000	9.65	4,352
5	11/72	I/R	Low Part	521/631	200,000	80.6	2,481
6	11/72	I	Part	521/1072	41,500	6.0	6,917
7	6/72	I	No	521/647	10,000(bin	3.0	3,335
7	6/71	I	No	520/718	15,000	6.0	2,500
8	5/72	C	No	513/1768	40,000	0.99	40,404
9	5/72	C/I	No	518/628	225,000	43.09	5,222
10	5/72	I	Yes	517/515	150,000	37.8	3,968
11	12/71	C	No	518/576	7,000	0.729	9,602
12	11/71	C	No	515/822	80,090	5.68	14,085
13	4/13/71	C	No	515/364	34,000	1.68	20,238
13	6/23/71	C	No	513/84	36,000	1.68	21,429
14	5/71	I	Yes	513/2045	6,000	5.1	1,176
15	1971	C	No	513/1247	15,000	1.668	3,993
16	3/15/71	C	No	512/2758	30,000	3.88	7,732
16	3/24/71	C	No	519/355	12,500	1.31	9,542
17	1/71	I	Part	513/524	6,000	5.0	1,200
18	4/70	C	Yes	512/2274	50,000	73.0	2,055
19	1970	C	No	512/2233	10,000	1.185	8,439
20	1969	C	No	507/144	18,500	6.869	2,693
21	9/69	I	Part	493/551	9,000	9.67	931
22	8/68	C	No	491/48	22,000	1.04	21,154
23	6/67	I	No	490/145	5,500	0.84	6,548
24	6/69	C	No	472/539 501/16	24,000	1.03	23,300

Reach 2 - Elkin - Jonesville, N. C.

Land Description:

The subject land consists of 114 acres separated into tracts of two acres or more. The total acreage would include many small tracts located on the fringe or in developed areas and zoned for residential, commercial, and industrial use. Most tracts would require partial filling to make them useable.

Valuation:

The estimated value of the total takes into consideration the size of the tracts. The potential land enhancement in this area is estimated at approximately 75%. The market is not strong and there doesn't seem to be a big demand for land along the river front. This is probably caused by the availability of suitable substitute sites away from the river. Only a few comparable land sales could be located for this valuation.

Indicated Value Without Reddies and with W. Kerr Scott Lakes:

Residential (Jonesville)	10.7 acres	@ $3,500/acre	$ 37,450
Commercial (Elkins)	18.1 acres	@ $6,000/acre	109,600
Commercial (Jonesville)	35.1 acres	@ $6,000/acre	210,600
Industrial (Elkins)	50.1 acres	@ $1,000/acre	50,100
	114.0 acres	Total Land	$ 406,750

Indicated Value With Reddies and W. Kerr Scott Lakes:

Residential (Jonesville)	10.7 acres	@ $6,500/acre	$ 69,550
Commercial (Elkins)	18.1 acres	@ $10,000/acre	181,000
Commercial (Jonesville)	35.1 acres	@ $10,000/acre	351,000
Industrial (Elkins)	50.1 acres	@ $2,000/acre	100,200
	114.0 acres	Total Land	$ 701,750

Summary:

With Lakes	$ 701,750
Without Lakes	406,750
	$ 295,000

Potential Land Enhancement Rate = 75%

Recapitulation:

Reach 1 - Appreciation 90%
Reach 2 - Appreciation 75%

14 June 1973

JACK D. PYLE Appraiser

[redacted] Appraiser

LAND SALES

ELKIN - JONESVILLE AREA

Sale No.	Date	Zoning	Floodable	MB/PG	Price	Acres	Cost/Acre
24	1/73	R	Yes	301/985	$ 11,000	3.25	$ 3,692
24	6/72	R	Yes	299/118	10,000	3.25	3,077
24	10/70	R	Yes	290/187	9,500	3.25	2,923
25	8/72	R	Part	300/963	3,500	Lot	3,500
26	8/71	I	No	107/630	10,000	5.8	3,100
27	5/70	R	Part	287/155	8,000	1.29	6,200
28	10/69	R	No	104/518	6,000	0.63	10,317
29	6/69	R	No	104/675	1,500	0.25	6,000
30	3/69	R	Yes	280/631	2,000	2.85	702
31	12/68	I	Yes	279/413	6,250	12.5	500
32	11/68	I	Yes	278/38	12,000	19.24	624
33	1/68	R	No	272/320	90,000	430.75	241
34	6/71	C	No	107/783	8,000	0.88	28,571
35	11/66	C	No	109/180	22,500	.50	45,000
36	1/71	C	No	106/369	32,000	.90	35,555
37	11/69	C	No	104/579	16,000	.35	45,714
38	10/68	C	No	103/[illegible]	25,000	7.00	10,714
39	6/70	I	No	105/436	25,000	.90	27,778

DEPARTMENT OF THE ARMY
SAVANNAH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 889
SAVANNAH, GEORGIA 31402

REVIEW CERTIFICATE

REDDIES RIVER PROJECT

NORTH WILKESBORO-WILKESBORO-ELKIN-JONESVILLE, NC

LAND ENHANCEMENT STUDY

The attached study estimates the increase in Real Estate values attributable to the Reddies River Project. The increase results from removal and/or reduction in the flooding hazard along the Yadkin River in the above captioned communities.

The format of the study is to estimate the difference in land values both "Before" and "After" construction of the Reddies River Dam by reference to local market transactions involving real estate subject to both flooding and non-flooding. The market was investigated during the first week of June 1973 and the report is dated 14 June 1973. The most recent transaction found was April 1973 and the effective date could be construed to be any date reasonably close to that month.

I have reviewed the report in the office and am generally familiar with the property considered although I have not made a specific inspection. The report reflects an adequate research of the market in the two locations and the value conclusions are supported by the information shown. The report is approved for planning purposes in the total amount of $905,000 as follows:

N. Wilkesboro/Wilkesboro Area	$610,000
Elkins/Jonesville Area	$295,000
TOTAL	$905,000

FOR THE DISTRICT ENGINEER:

18 June 1973

JOHN F. CADNEY, JR.
District Chief Appraiser

EXHIBIT 2-1

Sample Computations of Average Annual Flood Damages

1. Benefits attributable to Haddies River Lake were computed by subtracting the damages remaining regulated by W. Kerr Scott Project from the damages remaining regulated by W. Kerr Scott Project and Haddies River Lake. Average annual damages to commercial development for Reach No. 1 regulated by W. Kerr Scott was chosen as a sample computation. Discharges for selected frequency storms were determined from the discharge - frequency relationship (Figure 1) and converted to stage using the stage - discharge curve (Figure 2). The damage for a selected frequency storm was obtained from the stage - damage curve (Figure 3). Figure 4 was used to summarize the damage for selected floods up to the 200-year frequency flood. Average damages between successive selected frequencies were then multiplied by the incremental probability between these frequencies to obtain that part of the average annual damage contributed by storms falling within them. Average annual incremental damages were totaled to obtain the average annual damage. Similar computations were made for all categories of flood damages. The results are shown in Tables 1-6, 1-7 and 1-8. Discharge - frequency and stage - discharge curves for all five economic reaches are given in Design Memorandum No. 2, Hydrology and Hydraulic Analysis. Stage - damage curves are given in Appendix I, Figures 1-7 through 1-19.

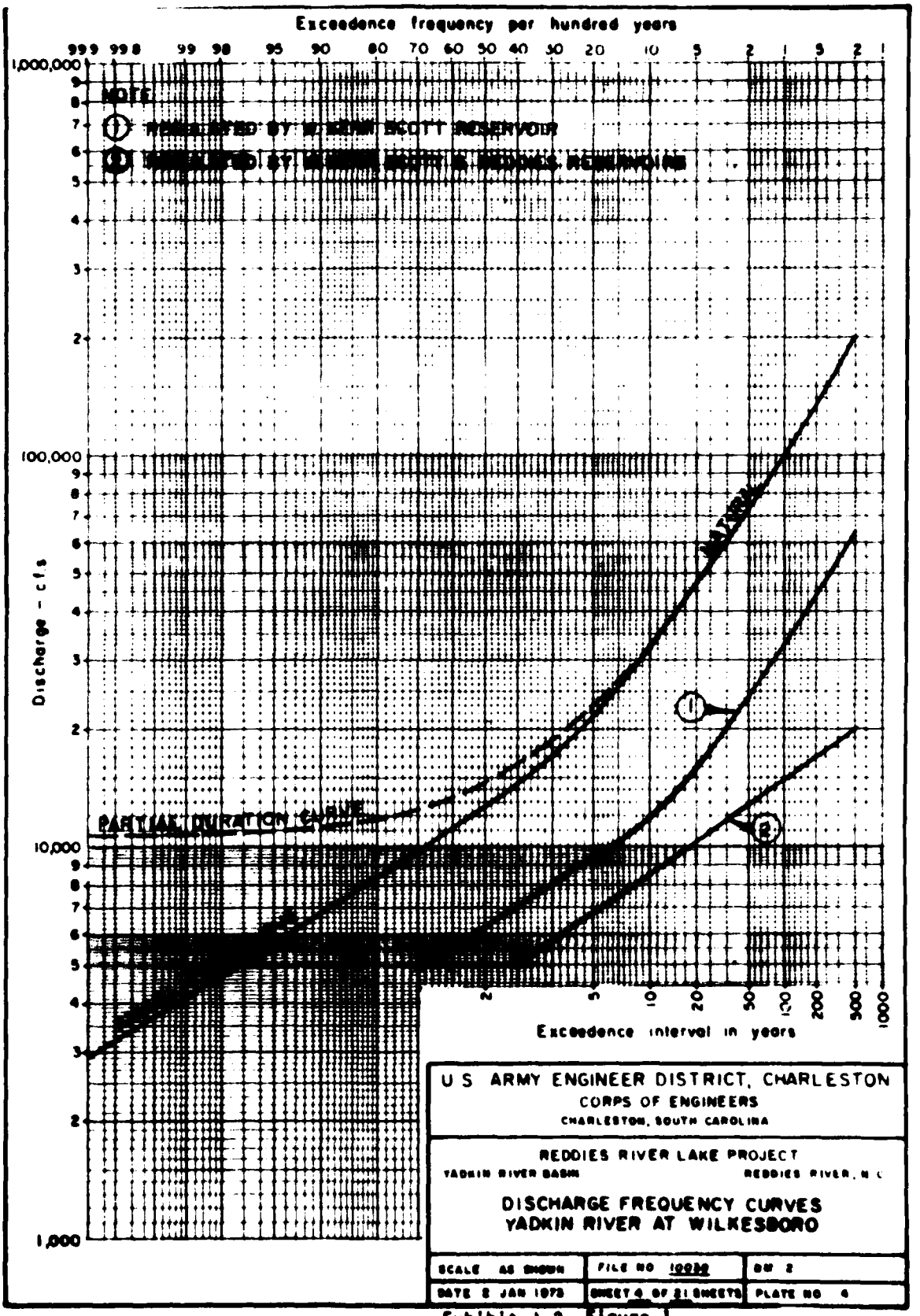
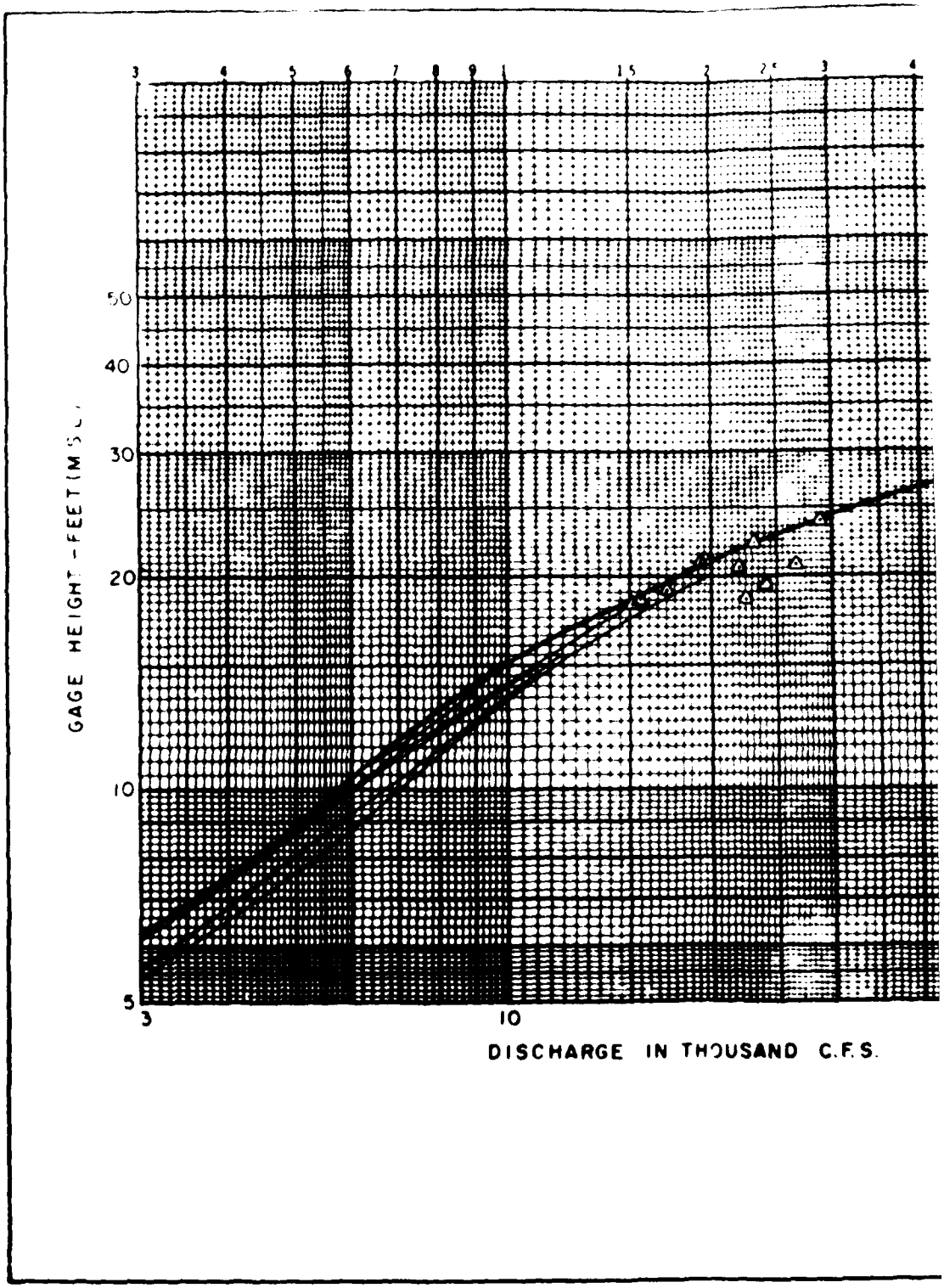


Exhibit 1-2, Figure 1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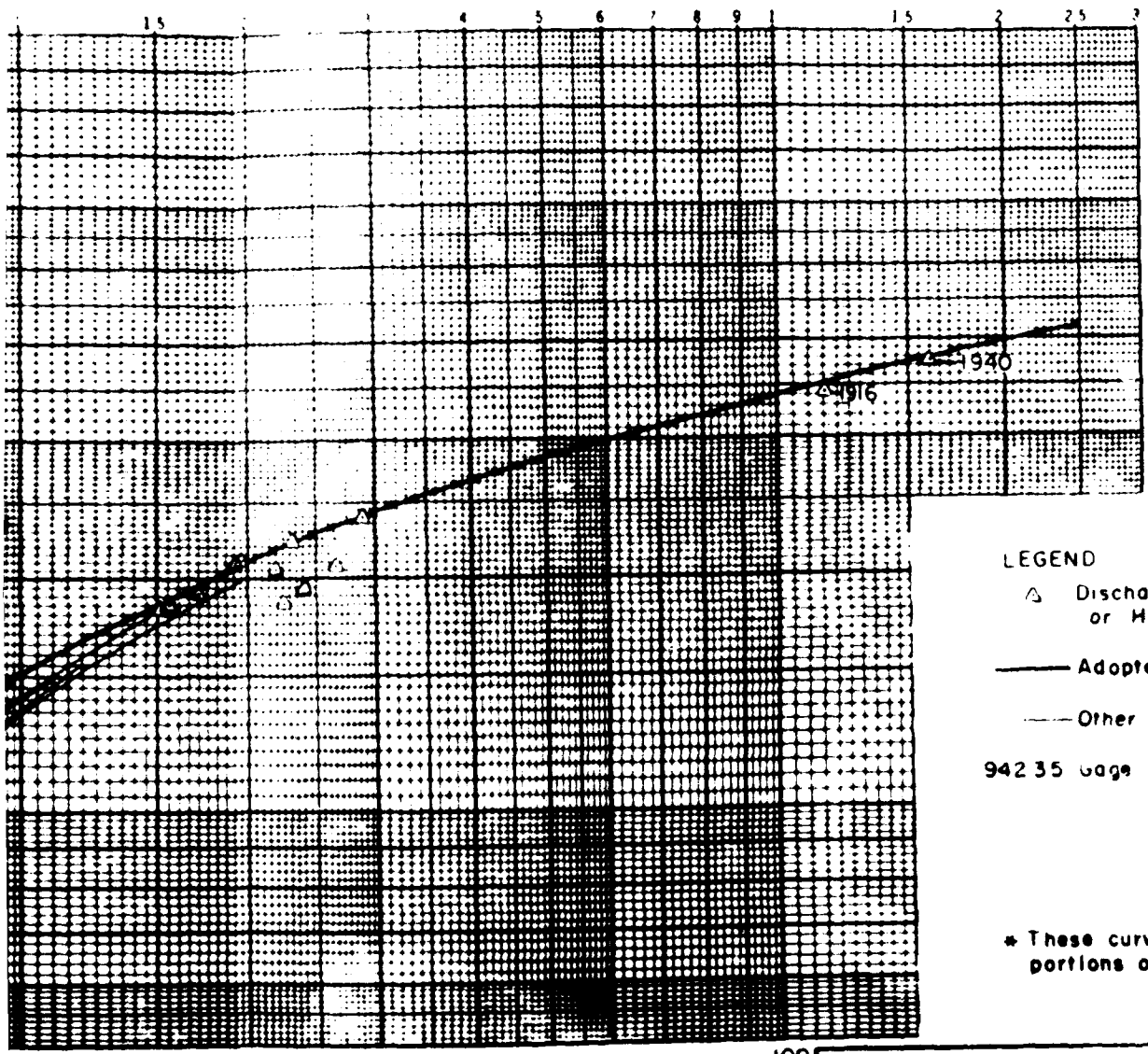
DISCHARGE IN THOUSAND C.F.S.



LEGEND

△ Discharge measurement or HWM

——— Adopted Curve

—— Other Rating Curves*

942.35 Gage Datum

* These curves cover various portions of Period of Record

10

DISCHARGE IN THOUSAND C.F.S.

100

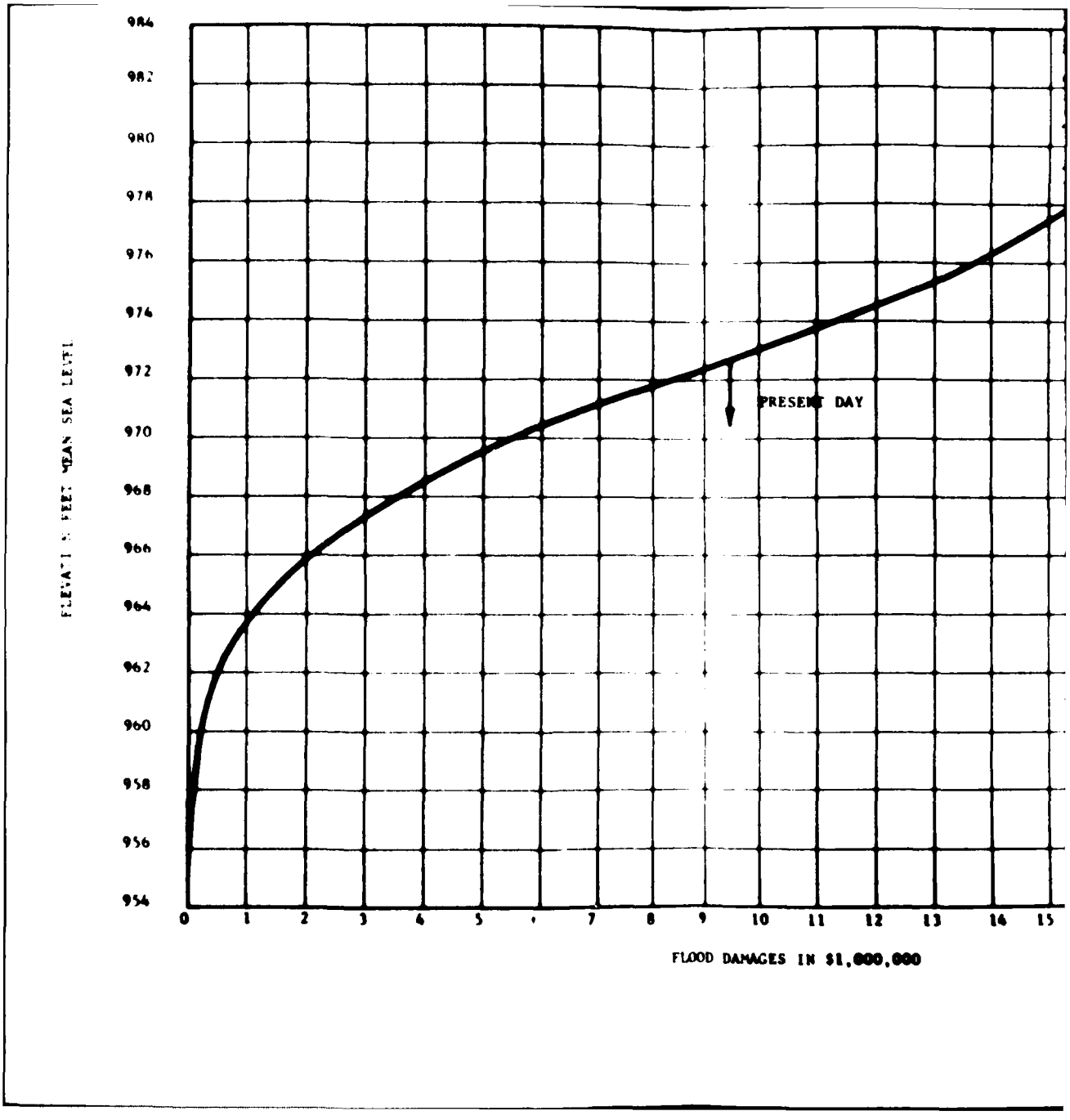
U.S. ARMY ENGINEER DISTRICT, CHARLESTON
CORPS OF ENGINEERS
CHARLESTON, SOUTH CAROLINA

REDDIES RIVER LAKE PROJECT
YADKIN RIVER BASIN — REDDIES RIVER, N.C.

RATING CURVE
YADKIN RIVER AT WILKESBORO

SCALE: As Shown	FILE NO. 10030	CM 2
DATE 31 May 974	SHEET OF SHEETS	PLATE NO. 4-A

Exhibit 1-2, Figure 2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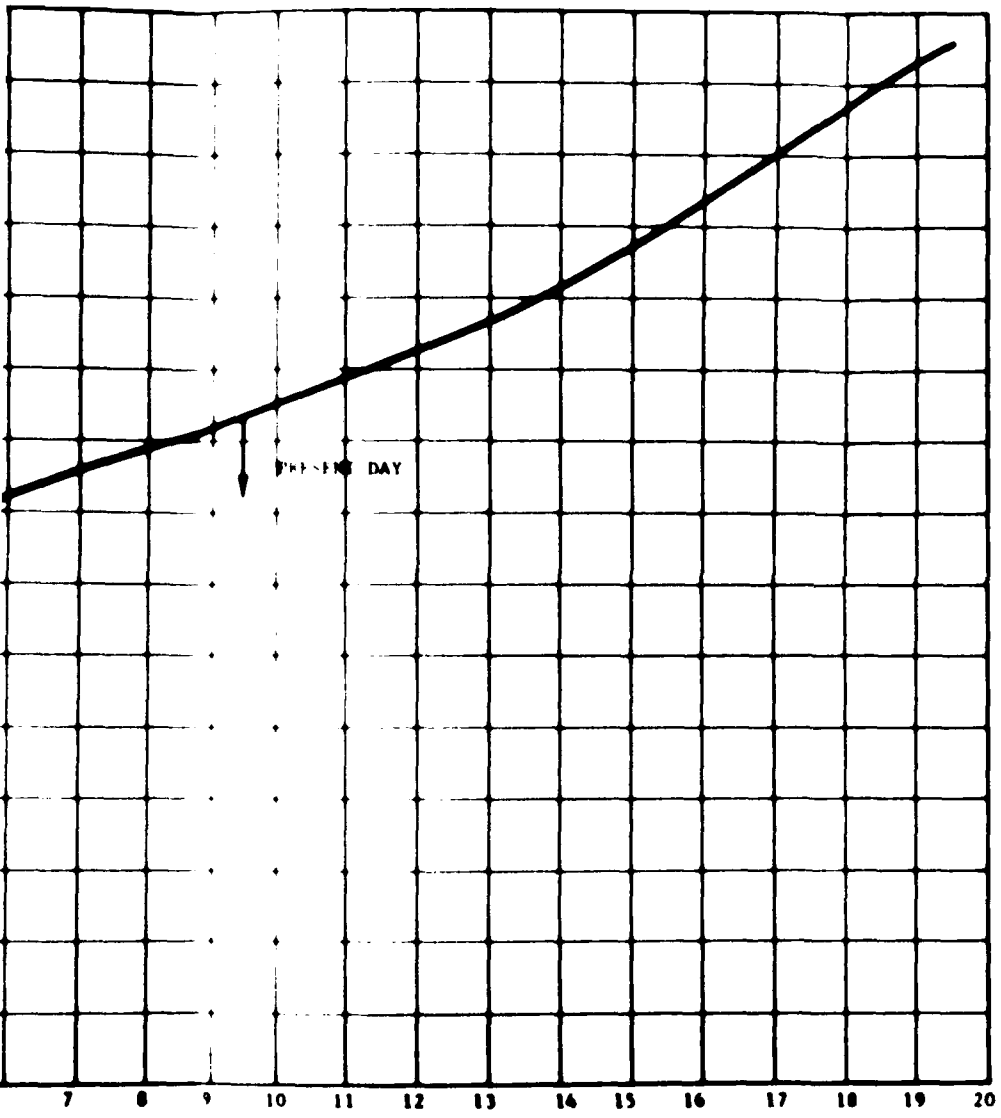
FLOOD DAMAGES IN $1,000,000



FLOOD DAMAGES IN $1,000,000

GDM- PHASE I
REDDIES RIVER LAKE PROJECT
YADKIN RIVER BASIN, N.C.
COMMERCIAL LOSSES
STAGE DAMAGE CURVE
REACH 1 WILKESBORO GAGE
29 APRIL 74

Exhibit 1-2, [illegible]

AVERAGE ANNUAL DAMAGE COMPUTATION

Type of Damage Commercial Damage Stage 955.0

Reach Number 1 Gage Location USGS GAGE @ Wilksboro

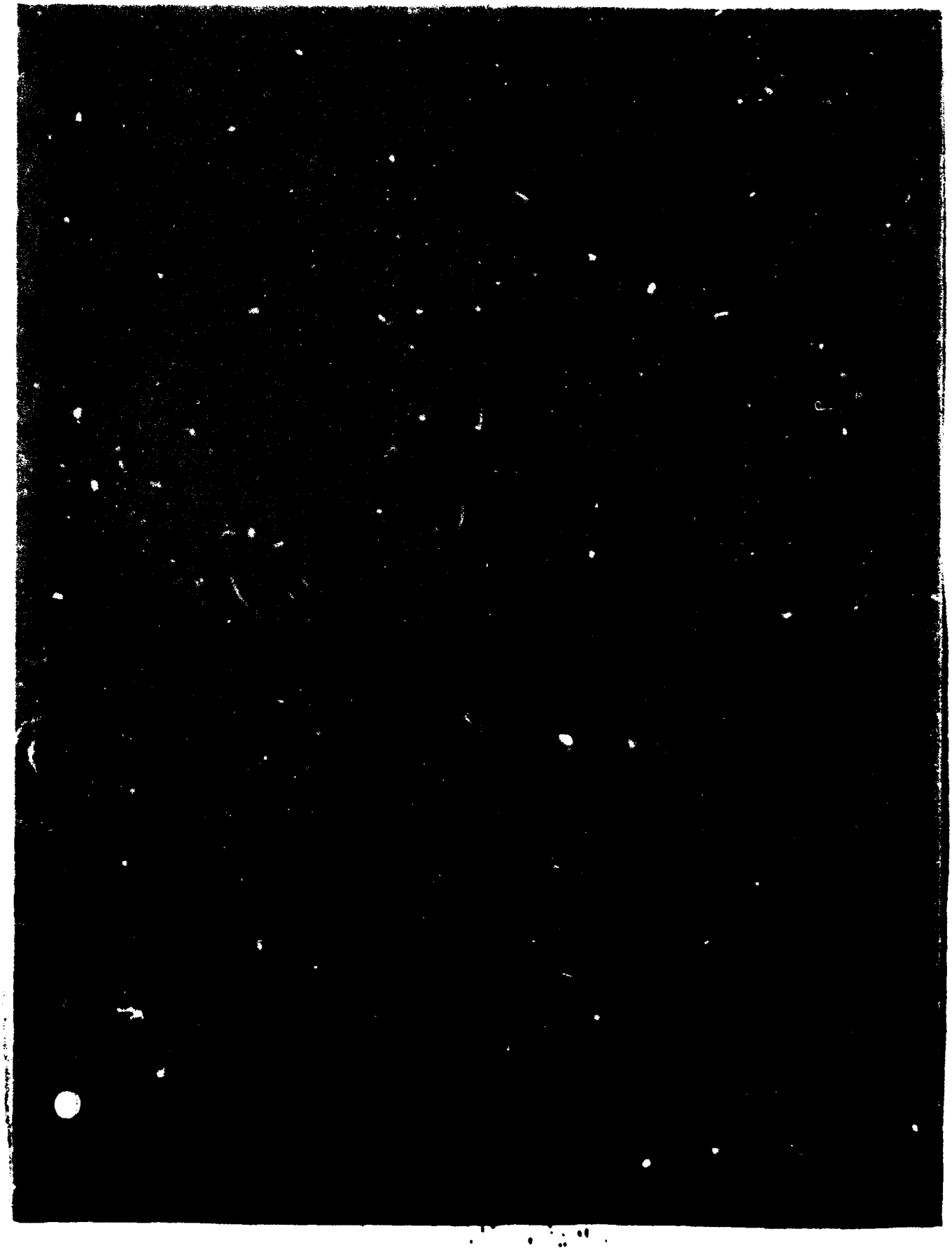
Condition Regulated by W. Kerr Scott

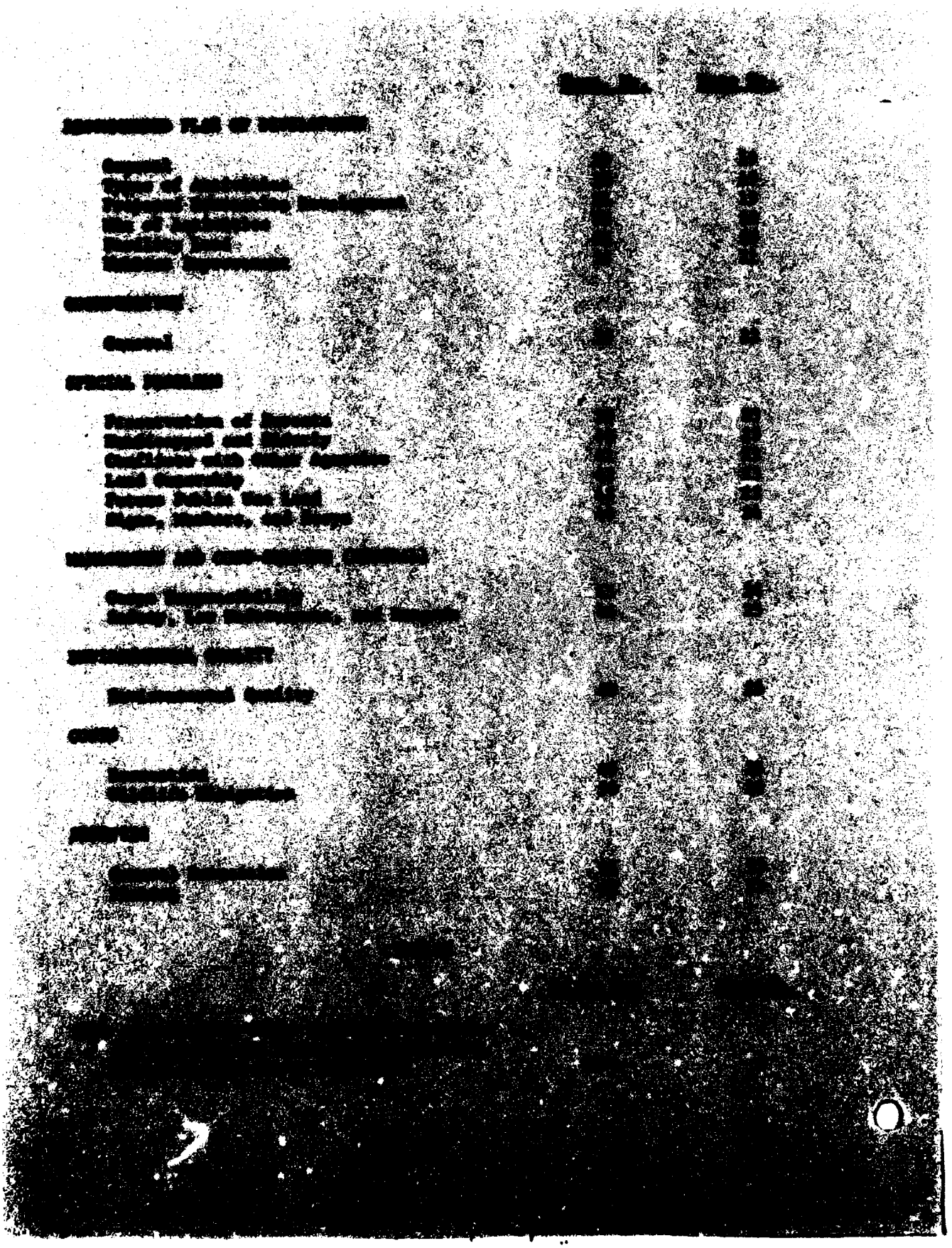
Frequency in years	Probable Occurrence	Incremental Probability	Elevation of WS (msl)	Damages in $1,000	Average	Damage Increment $
		.0010				
1,000	.0010					
		.0010				
500	.0020					
		.0013				
300	.0033					
		.0017			4800.0	8,160
200	.0050		969.3	4800.0		
		.0050			3900.0	19,500
100	.0100		967.2	3000.0		
		.0025			2750.0	6,880
80	.0125		966.6	2500.0		
		.0042			2200.0	9,240
60	.0167		965.6	1900.0		
		.0083			1600.0	13,280
40	.0250		964.4	1300.0		
		.0083			1085.0	9,010
30	.0333		963.3	870.0		
		.0167			685.0	11,440
20	.0500		961.6	500.0		
		.0167			430.0	7,180
15	.0667		960.4	360.0		
		.0333			285.0	9,490
10	.1000		959.0	210.0		
		.1000			130	13,000
5	.2000		956.9	50.0		
		.1333			29.0	3,870
3	.3333		955.3	8.0		
		.1667			4.0	670
2	.5000		953.2	0		
		.5000			0	0
1	1.0000			0		
		1.0000			0	0
.5	2.0000			0		

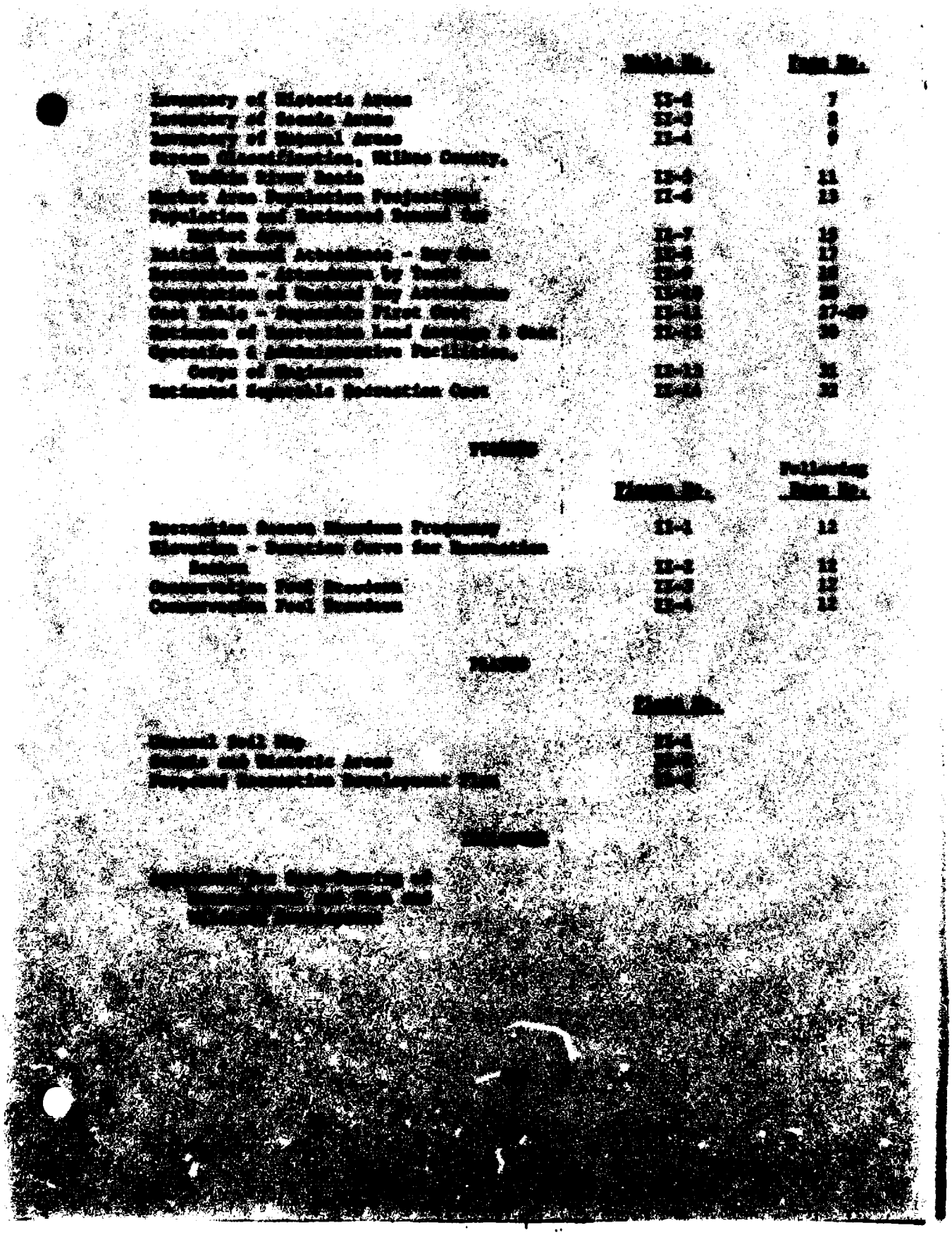
TOTAL $111,700

SAN 120, 4/26/65

Exhibit I-2, Figure 4







[redacted]

[redacted]

[redacted]

1. [redacted] Specific Congressional authorization for the basin [redacted] River Basin Project is contained in the Flood Control Act approved 24 July 1946 (Public Law 526, 79th Congress, second session) which reads, in part, as follows:

> "....The project for the construction of four detention reservoirs on the Willamette, Upper Willamette, [redacted] and Bubbles Numbered 3 above 20 being substantially in accordance with plans contained in the report of the Chief of Engineers dated June 15, 1945 (House Document No. 51, 79th Congress, first session), with such modifications thereof as in the discretion of the Secretary of War and the Chief of Engineers may be advisable, at an estimated cost of $7,104,000....."

This Law authorized four detention reservoirs: Willamette, Upper Willamette, Bubbles No. 1 and Bubbles No. 2 sites. The Definite Project Report on Bubbles Dam and Reservoir, dated 15 March 1950, contained in the recommendation that only one earth-fill dam at Bubbles Site No. 2, and one appurtenant dike be constructed. The project was approved by the Chief of Engineers on 3 March 1950. The project was authorized in July 1950 by an Economic Survey and in 1950 by a Reconnaissance Report. Although [redacted] approved on 2 project purposes, construction was postponed for additional [redacted] Law authorized the [redacted] and [redacted] for complete [redacted] analysis.

2. [redacted] This appendix is designed to describe conditions at the [redacted] River Lake Project, to identify the nature and scope of present and future recreation needs of the area, and to present a plan for the orderly development to meet those requirements. [redacted] principals of applicable public laws and policies [redacted] The material contained herein will assist [redacted] in [redacted] as to the availability of adequate recreation at the [redacted] project.

3. [redacted] In scope, this [redacted] planning approach is essentially [redacted] [redacted] [redacted]

[redacted] cost-sharing contract was prepared and forwarded to [redacted] Colville for review and comment. [redacted] of this Appendix.

3. Background. Previous studies for the [redacted] include the Definite Project Report (DPR); a [redacted] and a Post-Authorization Supplement (PAS). [redacted] studies are given below:

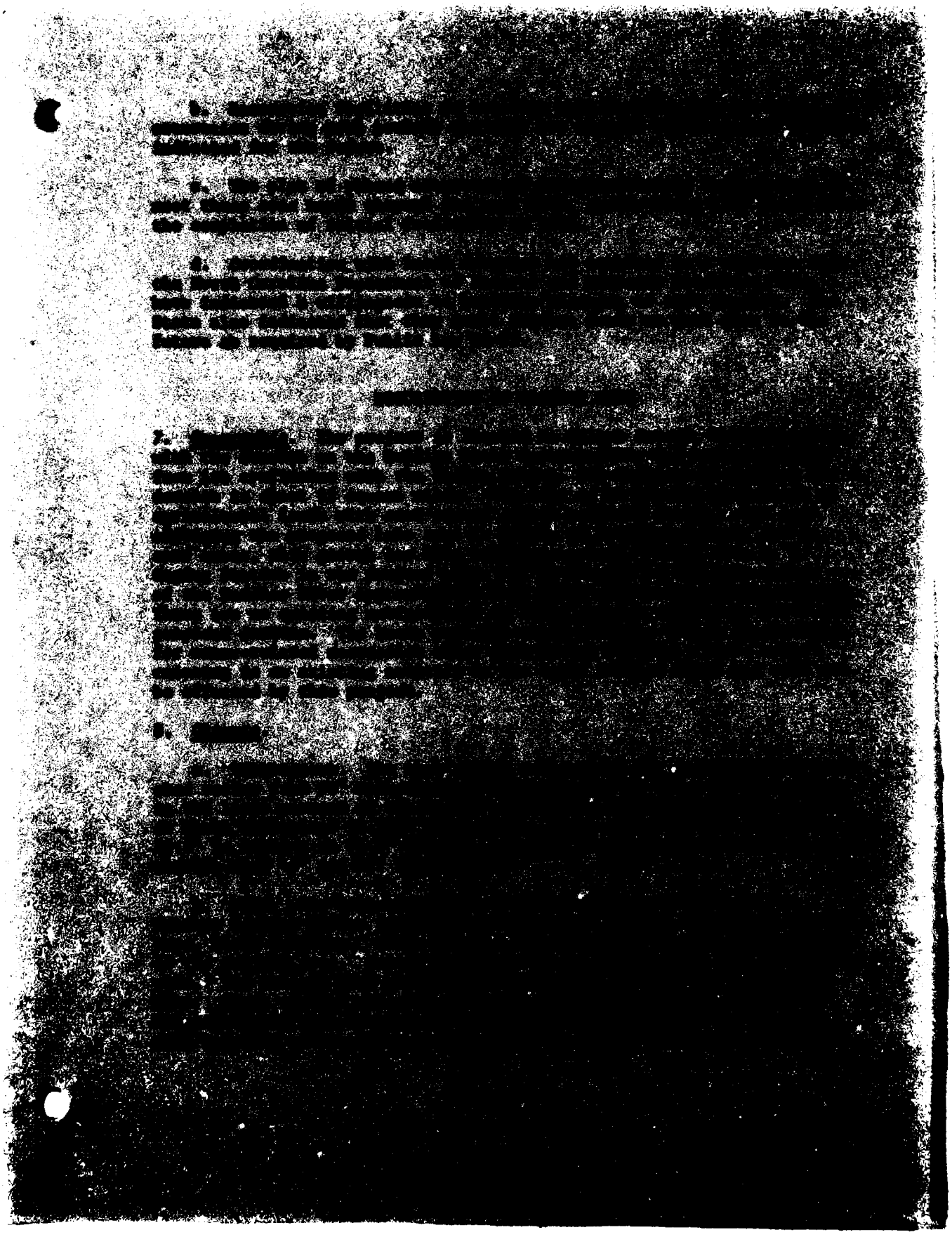
a. The Definite Project Report, dated 13 March 1956, [redacted] possibility of only minimal future [redacted] it was recommended that areas suitable [redacted] be turned over to local municipalities [redacted] ments so desired. Except for this, [redacted] operation was required in connection with the [redacted] reservoir."

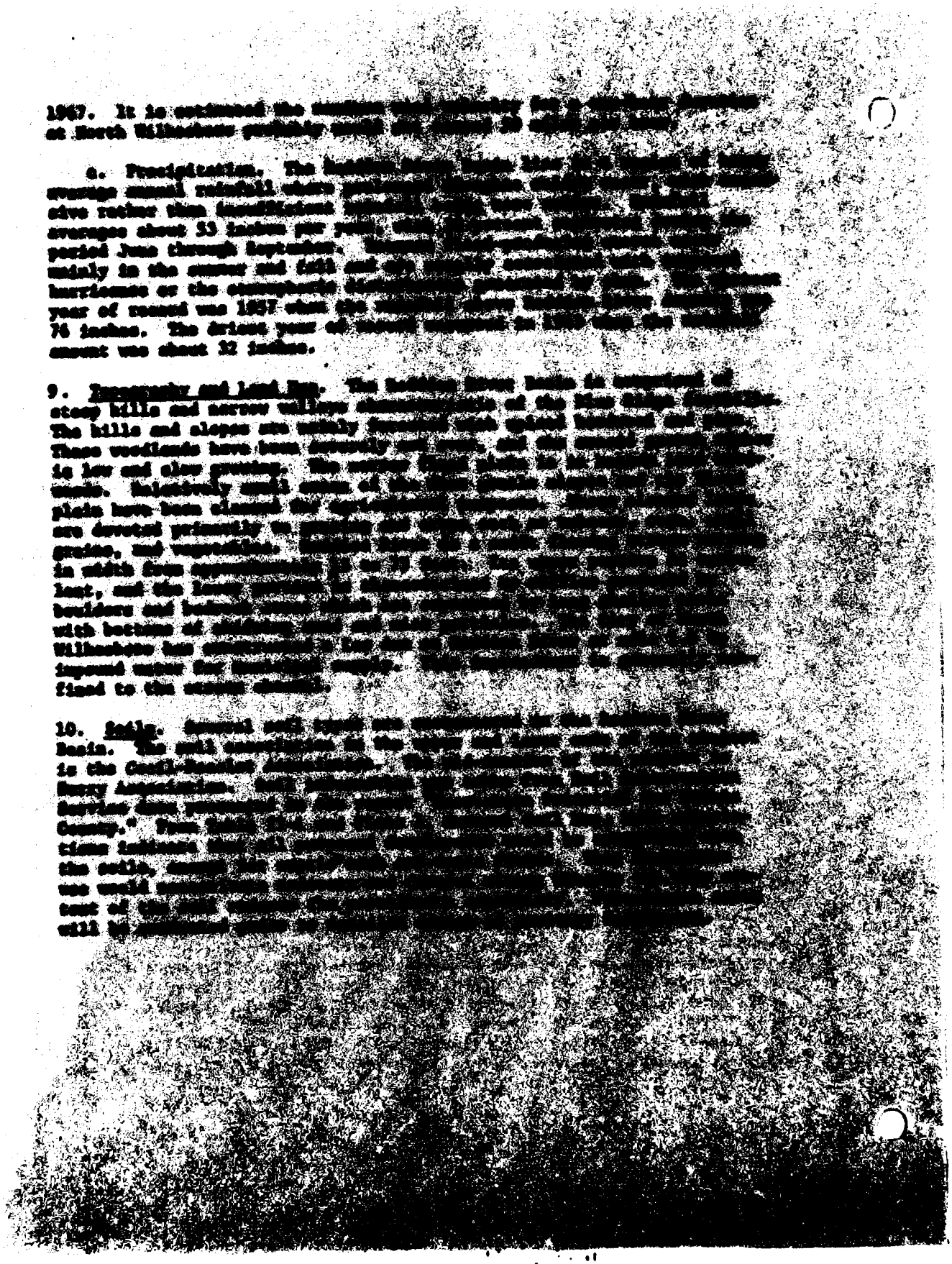
b. In July 1960, at Kennedy's request [redacted] and to reclassify the project as [redacted] project was treated as a [redacted] reconnaissance of the [redacted] and to plan for the [redacted] proposed plan was [redacted] opposed by the Bureau of [redacted] engagement as outlined by the [redacted] Wildlife. [redacted] with the Federal Water Project [redacted] included in this report [redacted] the State Department of [redacted] its intention to participate [redacted] River Lake Project in [redacted] Kennedy Library was [redacted] for adaptation to [redacted]

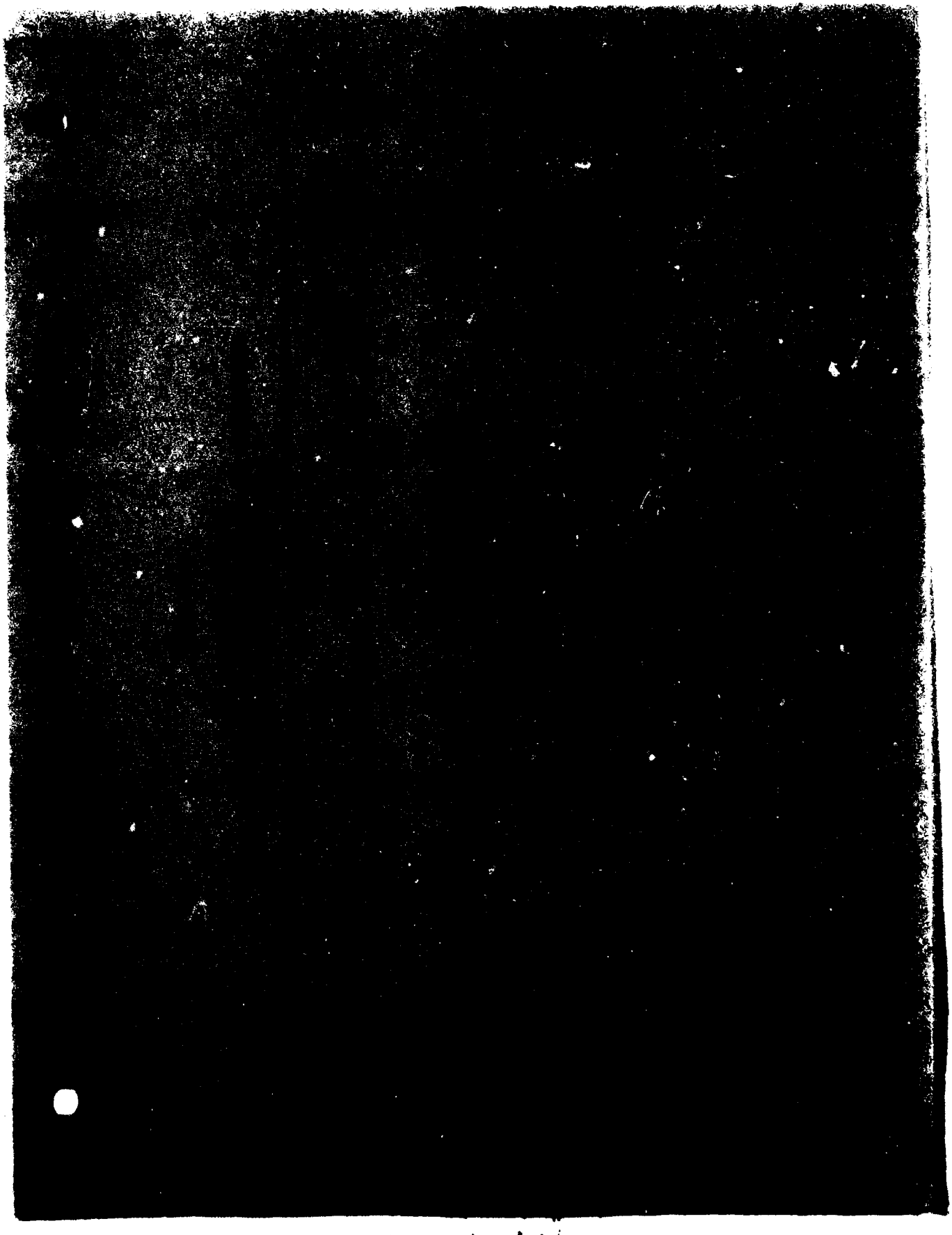
c. [redacted]

d. [redacted]

e. [redacted]







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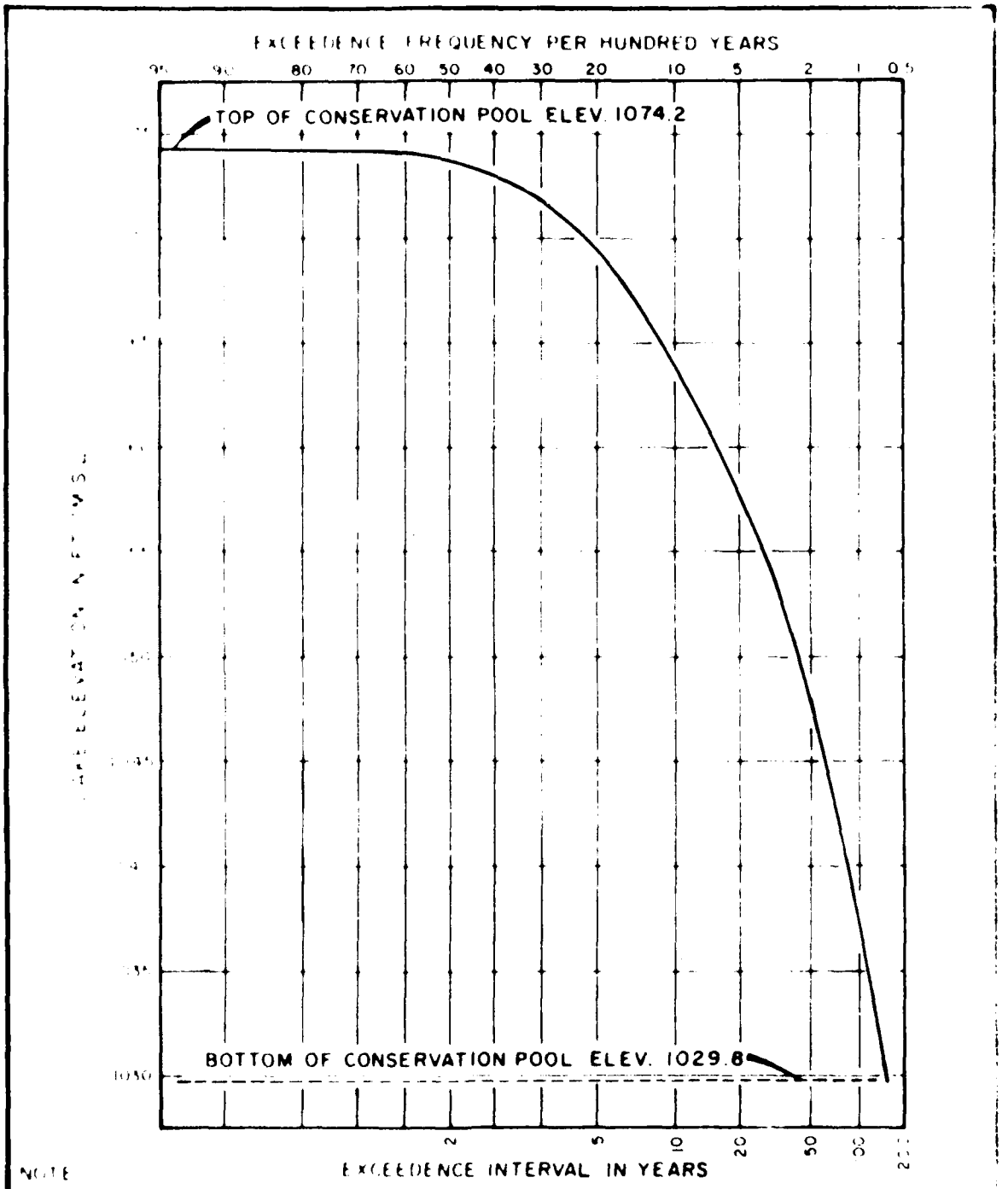


NOTE

(1) Curve based on monthly routing for 1922 to 1972 period

(2) Minimum release - 36 cfs

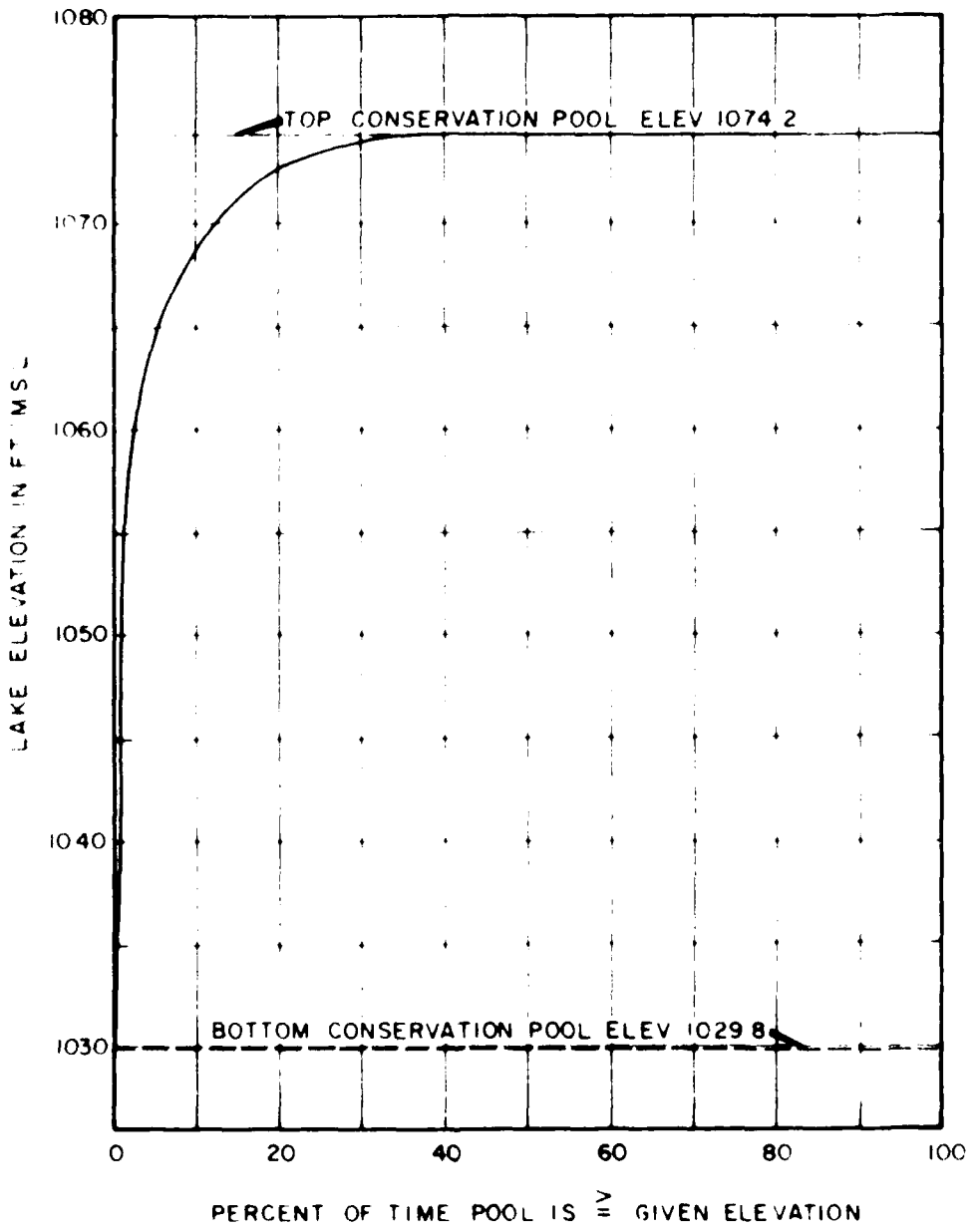
(3) Water supply demand - Constant 50.5 cfs

(4) Recreation Season - 1 May through 30 Sept

GDM - PHASE I
REDDIES RIVER LAKE PROJECT
YADKIN RIVER BASIN, N.C.
15 AUGUST 1973

RECREATION SEASON DRAWDOWN FREQUENCY

FIGURE II



NOTE

(1) Curve based on monthly routing for 1922 to 1972 period

(2) Minimum release - 36 cfs

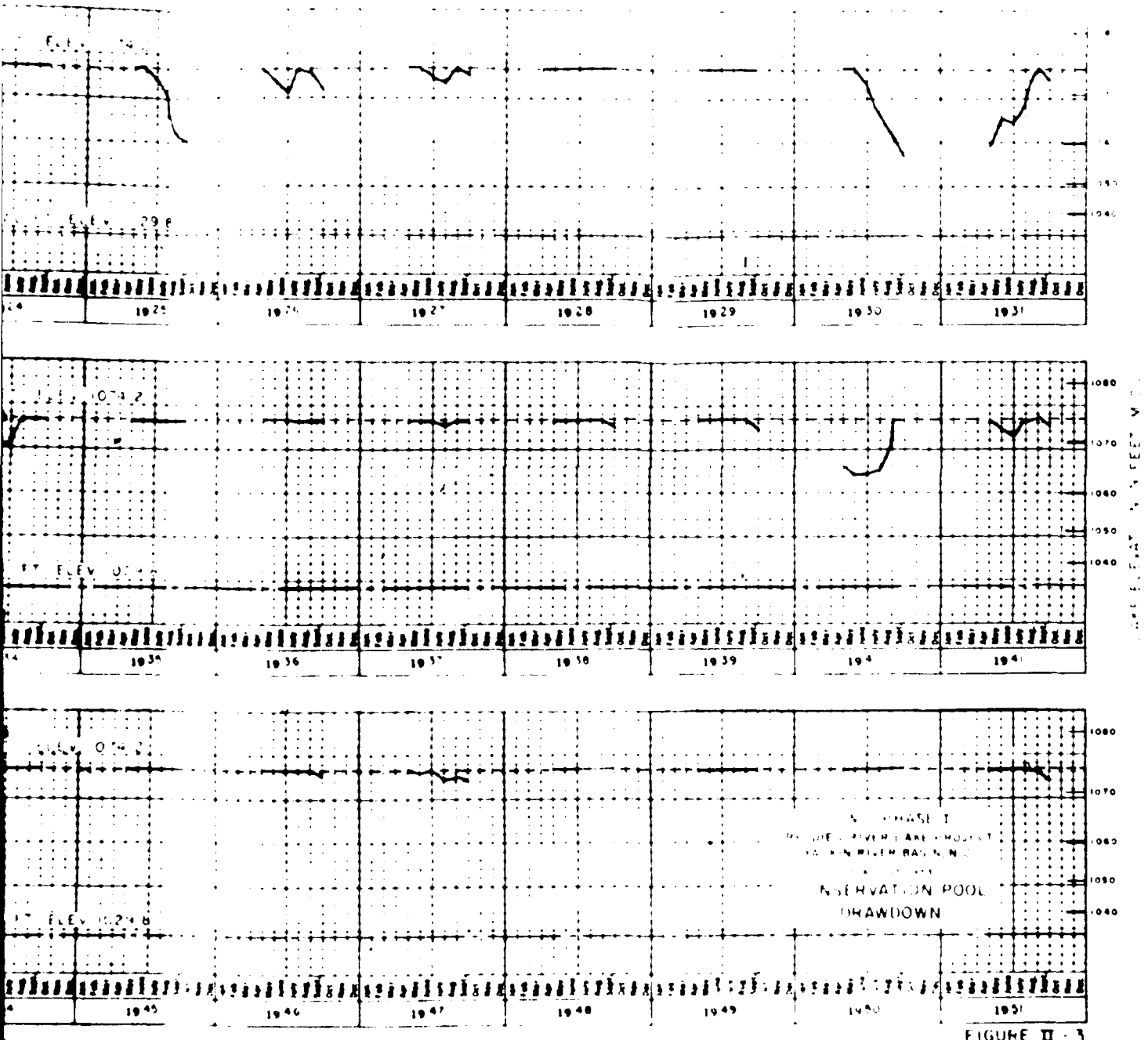
(3) Water supply demand - Constant 50 5 cfs

(4) Recreation Season - 1 May through 30 Sept

Elevation - Duration Curve
For Recreation Season
CONSERVATION POOL ONLY

FIGURE II - 2

FOR NOTES SEE FIGURE II-4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NSERVATION POOL
DRAWDOWN

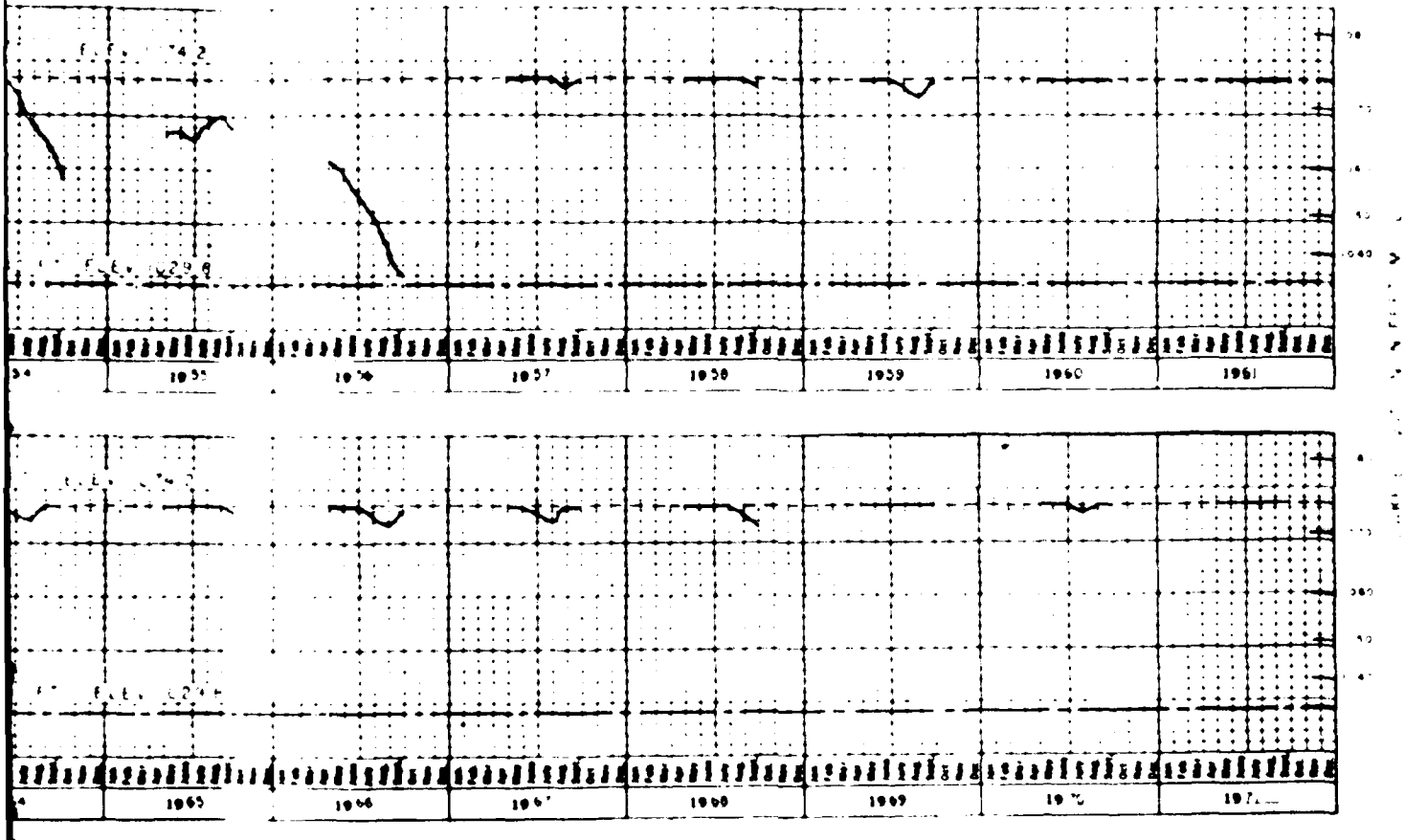
FIGURE II - 3

for 1952 to 1970 period

(2) Minimum release 36 cfs

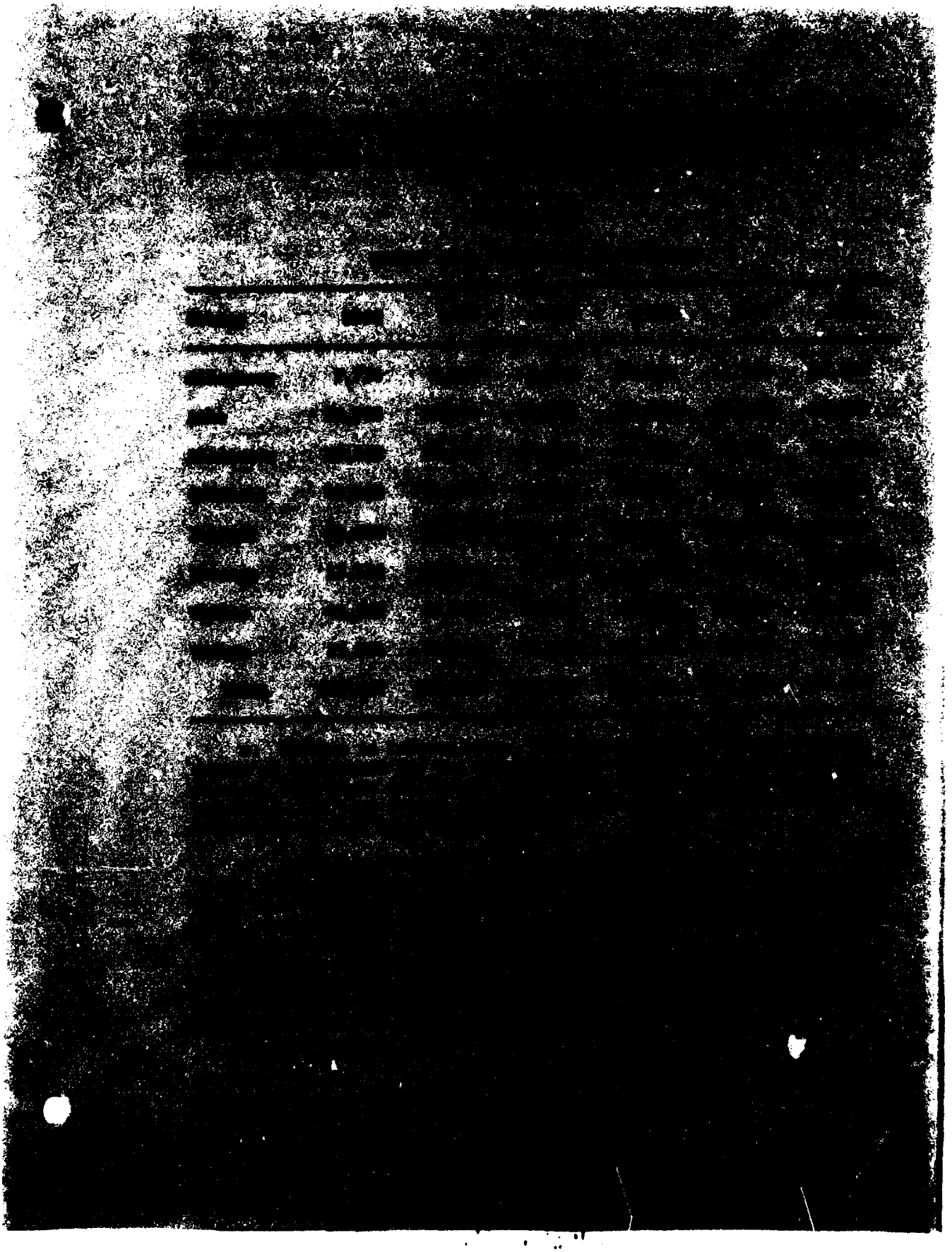
(3) Water supply demand constant

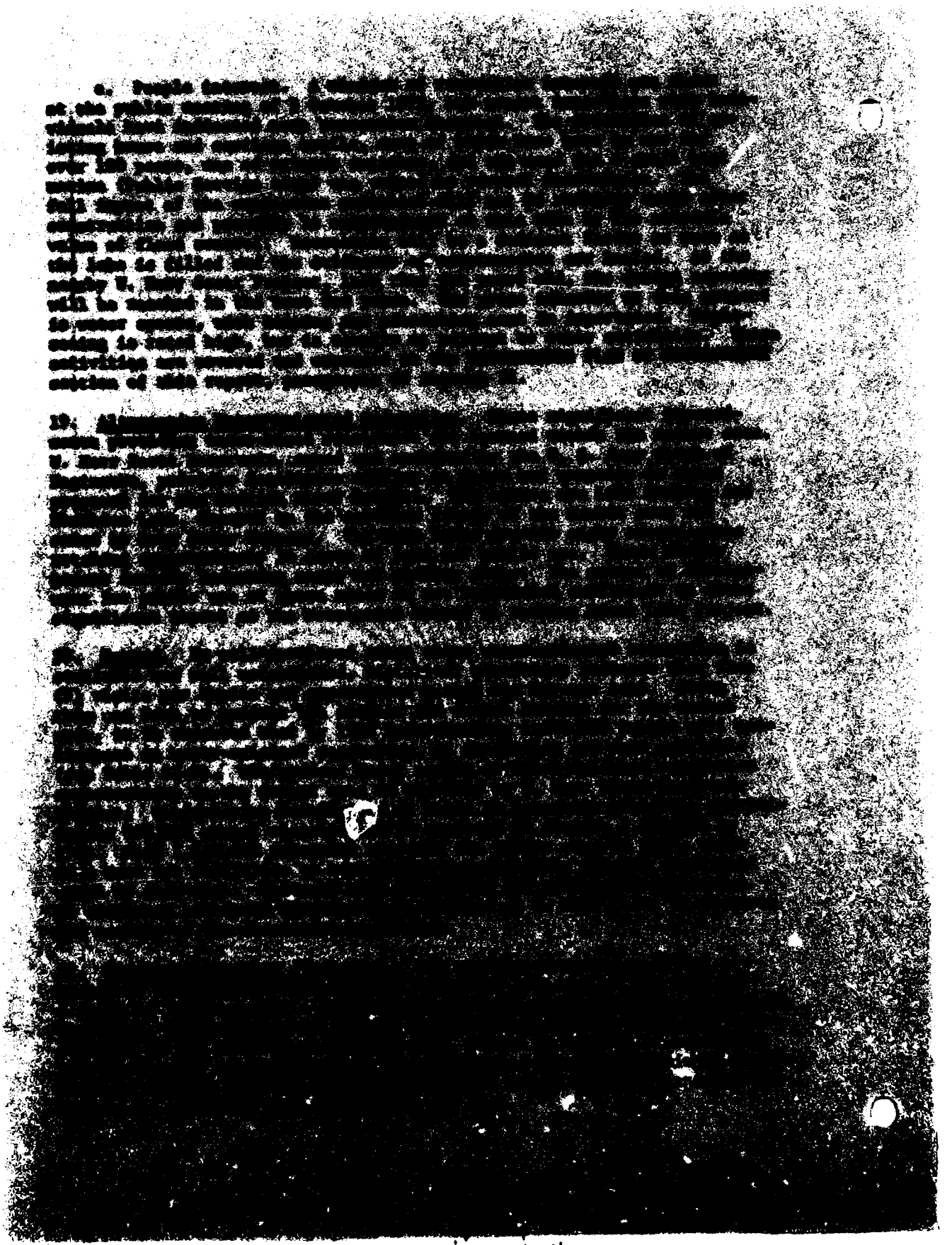
(4) Recreation Season May through

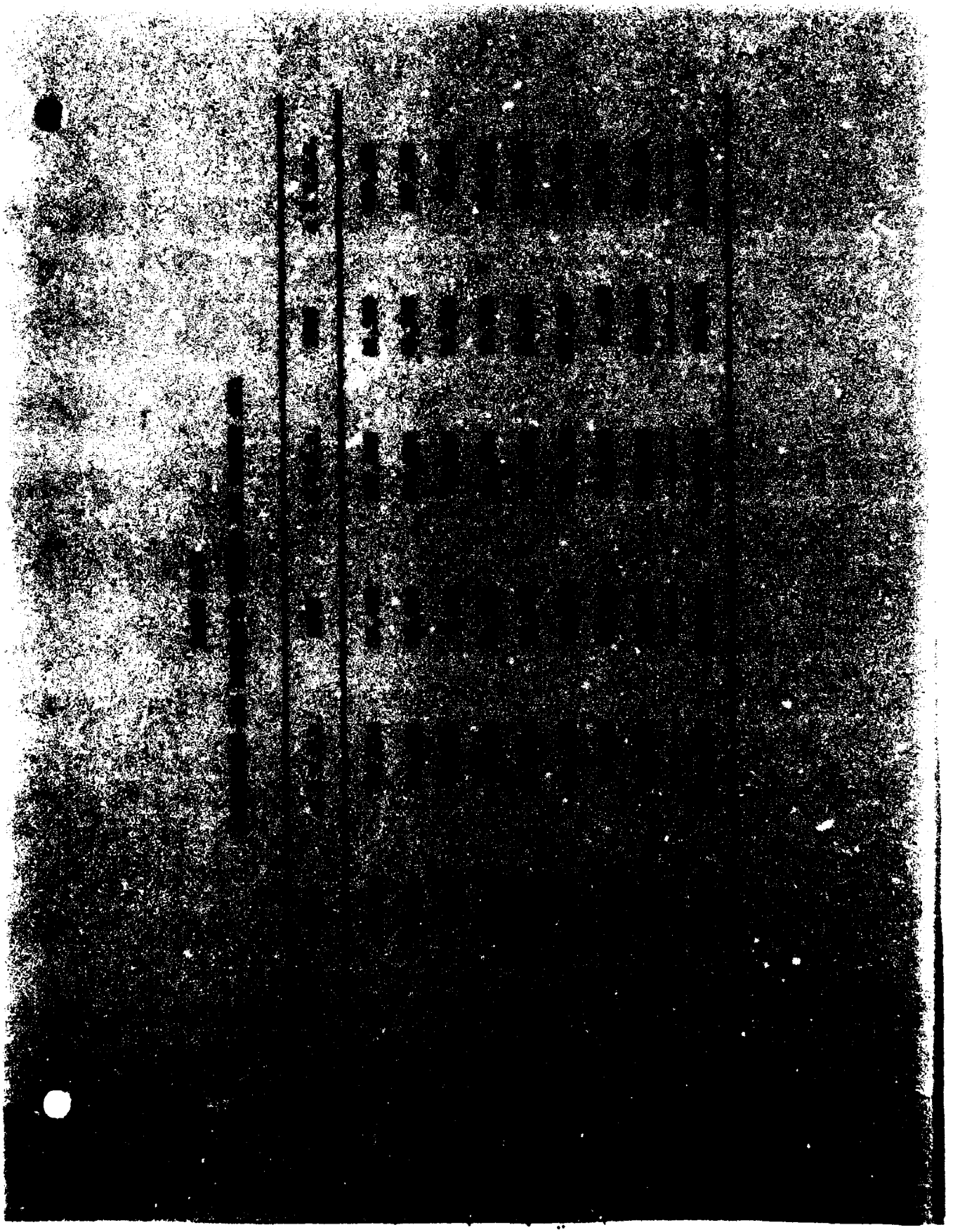


CONSERVATION POOL
DRAWDOWN

FIGURE II - 4







[redacted]

23. [redacted]. Procedures outlined in [redacted], "Procedures for Estimating [redacted]," [redacted], were used to develop [redacted].

24. [redacted]. [redacted] project was selected as a [redacted] on which to base [redacted]. This unit was [redacted] Lytton, an [redacted] east side of the [redacted] Willowbrae; the [redacted] forward to [redacted] physical characteristics, [redacted] recreation activities were [redacted]. The results are [redacted] are shown in the following [redacted]:

[redacted]

25. [redacted]

26. [illegible]. For purposes of this study, the recreation attendance for this project [illegible] in the year 2015. It was assumed that [illegible] would increase in proportion to the increase of the water area. It was assumed that [illegible] would participate in boating at any one time. Existing facilities [illegible] that initial per capita visitation rates be applied without change over the economic life of the project, and the increase in attendance be determined by the compatible growth of the population within the market area. The projected annual attendance is shown in Table II-9.

TABLE II-9

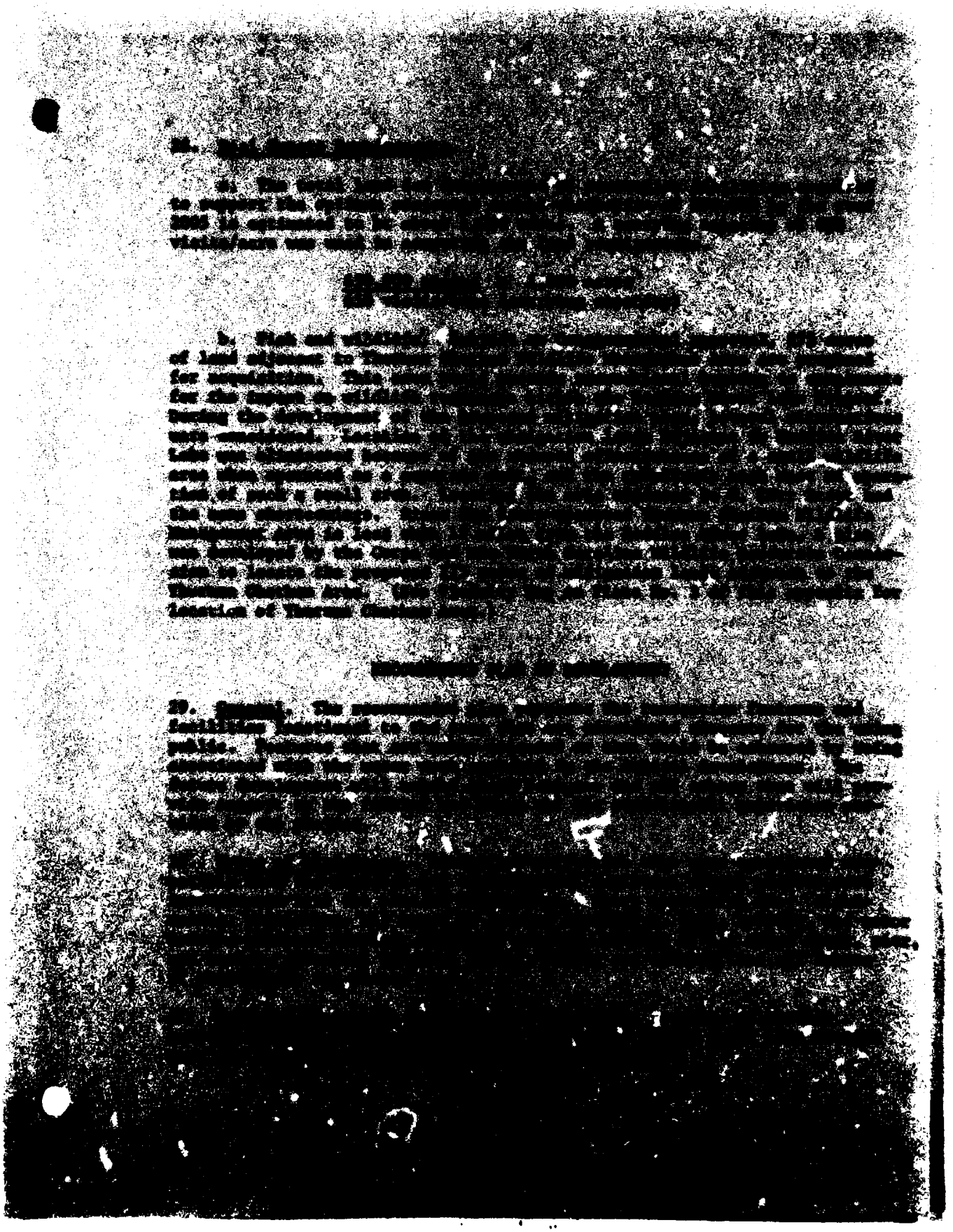
RECREATION - ATTENDANCE BY YEARS

Years	Market Area Population	Weighted Per Capita Attendance	Estimated Annual Attendance (Rounded)
1982	316,000	1.32	400,000
1985	328,100	1.32	400,000
1990	351,100	1.32	395,000
1995	376,700	1.32	371,000
2000	402,300	1.34	411,000
2005	428,000	1.32	450,000
2010	455,300	1.32	450,000*
2015	481,000	1.32	450,000*

*Leveling off of attendance is based on optimum use of the water area.

In order to present [illegible] of the [illegible] development will be [illegible] From the above [illegible] direct employment [illegible] area is expected [illegible] [illegible] [illegible] [illegible] will [illegible] [illegible] a number of [illegible]

[illegible]



a. Initial development. Initial developm[illegible] limited to that required to accommodate the public use [illegible] planned visitation for the three years of the following [illegible] project construction. Facilities required for administration, [illegible], and maintenance functions will also be included. Description and quantity of cost-shared facilities are shown in detail in paragraph 38.

b. Future development. Building work required for ultimate development will be constructed when FEL funds are allocated or required under the Federal Water Project Recreation Act, P.L. 89-72. Future development will consist of expansion of initial public use facilities.

32. Mix of Activities. The following data were developed from a comparison of uses at similar nearby lakes, modified to reflect the projected uses at Robbins Project. The following percentages are applied to the attendance to determine the use of each category: camping - 30 percent; sightseeing - 20 percent; swimming - 15 percent; picnicking - 15 percent; boating - 10 percent; fishing (boat - 5 percent; shore fishing - 5 percent; general recreation, including hiking, bird watching, photography, etc. - 11 percent. (Attendance lasting less than 3 hours, classified as general recreation.)

33. Facility Load. The demand or load expected on the various proposed type of facilities is based on the attendance each is expected to receive on an average weekend day. The facilities will be designed and arranged in the most efficient manner to accommodate this demand. Table II-10 shows the methodology used in formulating the expected weekend day attendance; the percentages used are based on actual use of similar type projects in the Southeast. The anticipated attendance was developed for both Initial (1985) and Ultimate (2035) Phases.

TABLE II-10

COMPUTATION OF WEEKEND DAY ATTENDANCE

Year	Annual Attendance	Weekend Day Attendance
1985 (Initial)	468,200	[illegible]
2035 (Ultimate)	650,000	[illegible]

[illegible]

In addition to the above values, the required elements of the minimum size of development are established. Facilities for [illegible] were developed by criteria contained in HH 2120-0-400 and are as follows:

a. One picnic site for each ten daily picnickers.

b. One campsite for each five daily campers.

c. One Lunchbing ramp for each 10,000 annual visitors.

Using the previously discussed criteria, the number of family campsites, family picnic sites, and lunchbing ramps needed for initial and ultimate development were estimated as follows:

Family campsites:

Initial = [redacted] = [redacted] = (250) 250

Ultimate = [redacted] = [redacted] = (500) 250

Family picnic sites:

Initial = [redacted] = [redacted] = (90) 100

Ultimate = [redacted] = [redacted] = (180) 100

Lunchbing ramps:

Initial = [redacted]

Ultimate = [redacted]

[redacted]

reach. This loss will be replaced by a 600-acre lake providing habitat for approximately the same warm-water species now found in the stream with the addition of such species as large-mouth bass and crappie. The U. S. Fish and Wildlife Service in their April 22, 1969 report indicated that the increase in habitat area would result in a net fishing increase from 700 man-days to approximately 13,600 man-days annually. In their update of fishery values associated with Roddies River Lake Project (Exhibit 3), the Service predicted the total average annual angler days over the 100-year project life to be 9,100. The Corps' estimate of average annual man-days of boat fishing based on average annual attendance and the mix of activities presented herein (paragraph 27 and 32) is 12,600.

b. Wildlife. The lake will also cause a complete loss of existing farm and forest game habitat in the conservation pool and a partial loss of similar habitat in the periodically inundated flood pool. This will reduce the hunting opportunity in the affected areas. To mitigate this loss of wildlife habitat, it is proposed to purchase 275 acres of land adjacent to the State-operated Thurman Chatham Wildlife Management Area, and to turn this land over, by lease, to the North Carolina Wildlife Resources Commission to develop, operate, and maintain. The acquisition of this land was requested by the U.S. Fish and Wildlife Service (Exhibit 2). The purchase of this land will require Congressional approval.

c. Forest management. The woodland areas in this proposed project have been severely cut over, and the second growth timber is very slow growing. A comprehensive Forest Management Plan will be prepared as early as possible after the project becomes operational in order to protect, preserve, and improve the existing stand and to develop new forest cover required by the project. This forest cover will preserve, improve, and maintain wildlife habitat, scenic values, and control soil erosion. The Forest Management Plan will follow the requirements set forth in ER 1130-2-400, and will provide an environment that will enhance the proposed recreation plan of development.

d. Lake surface zoning. As part of the Master Plan, a Lake Surface Zoning Plan will be developed as early as possible after the project becomes operational to prevent overcrowding and to insure the safety of boaters.

[illegible]

34. General. Preliminary coordination with affected Federal, State, and local agencies was accomplished to assure that the recreation plan is compatible with their plans for existing and future development.

35. [illegible] Federal agencies directly involved are Bureau of Outdoor Recreation and the Fish and Wildlife Service. These agencies have prepared preliminary surveys of the needs and benefits of this project. Their recommendations were considered in preparation of the plan of development. [illegible] Federal agencies will be coordinated as planning progresses.

37. State agencies have been contacted through the North Carolina Department of Natural and Economic Resources. The Department has responded favorably. A draft recreation cost-sharing agreement has been prepared which includes provisions for subsequent development of the detailed recreation plan jointly formulated and agreed upon by both State and Federal parties. The draft agreement is Inclosure 1 to this appendix.

38. Local contact was initially made by a public meeting held in Wilkesboro, North Carolina, on 5 October 1972. At this time, the majority of interested citizens voiced their approval of the project. These opinions and views have been considered in the development of the recreation plan for this project.

SPECIAL PROBLEMS

39. Preservation of Forests. One of the major damages to recreation resources of a project is the cutting of forest cover on lands above the normal pool. The Corps, from initial stages through acquisition, will do everything possible to advise the public of the importance of trees to recreation. The public should be advised that the trees have a value and will be appraised the same as the lands and improvements. Actually, for future recreation development, the trees are more important that the improvements.

40. Handicapped and Elderly. Several locations will be designed to accommodate the handicapped and elderly. Provision will be made for handrails and ramps to make mobility easier. Restrooms will be provided with raised stools and grab rails. Stall space will be of ample size to accommodate wheelchairs. Water fountains will be made easily accessible, and other features will be incorporated into the final design of facilities as required to encourage the use by the handicapped and elderly.

41. Conflicts with Other Agencies. No conflict with other agency plans is anticipated. This plan was coordinated with BOR, U.S. Fish and Wildlife, State of North Carolina, and Wilkes County. No opposition to the general concept was noted.

42. Land Ownership. All land within the project boundary (and the separable recreation land) is currently in private ownership. No land will be withdrawn from Bureau of Land Management or U.S. Forest Service ownership. The City of North Wilkesboro owns the lands on both sides of the river below the dam, and they will furnish these lands in fee to accommodate proposed recreation facilities. These facilities would provide fishing access to the area. This dam will adjoin the upper end of the North Wilkesboro water supply impoundment.

43. Future Public Use Land. All land acquired for recreation will be open for public use, although land identified for future development will not be developed until the managing agency has provided its share of the

development cost. The use of undeveloped future sites may be limited at times by the managing agency when overuse is presenting a health or sanitation problem.

44. Signs, Markers, and Buoys. Project, intermediate, approach, highway directional, and inter-area miscellaneous signs will be placed at appropriate locations in the project area. Shoreline mileage markers will be placed at prominent referenced points around the lake. These markers will be so located as to be visible to the boaters and will be oriented from the centerline of dam clockwise around the shoreline of the lake. The location and design of the main project signs and area entrance signs will be coordinated with the managing agency. Aids to navigation will be placed along the main stream and up all major tributaries. The navigation buoys will be coordinated with the U.S. Coast Guard for design and placement, but will be a project cost.

MANAGEMENT AND COST-SHARING (FEDERAL)

45. Corps Responsibility. In accordance with Public Law 89-72 and the attached draft recreation agreement, the Federal Government assumes the following responsibilities:

a. Will operate and maintain those lands, structures, and facilities such as dams, dikes, spillways, and outlet works required for control and regulation of the water stored in the lake. The access road to the dam, and any project visitor facilities constructed in conjunction with these works, or land designated in Table II-12 and shown on Plate 3 will be accomplished by the Corps. Debris removal will be accomplished for a period of two years after initial impoundment of water to elevation 1074.2 msl.

b. In addition to project land, the Government will acquire separable land specifically to enhance the recreation potential of the project.

c. The Government in cooperation with the State of North Carolina will prepare a mutually acceptable Plan of Recreation Development and Management for the project.

d. The Government agrees to provide 50 percent of the separable first cost of all recreation development.

e. The Government will make available by lease, to the State of North Carolina for management and administration, the use and occupancy of the selected areas and facilities. These lands and facilities are tabulated in Tables II-11 and II-12 and shown on Plate 3 of this report.

f. Operation and maintenance of all facilities on project lands, except those leased to the State or third parties, will be provided by the Federal Government.

46. Safety, Law Enforcement, and Security. An adequate system of law enforcement is needed to protect the public from hazards and the natural resources from damage. The North Carolina Department of Natural and Economic Resources, together with the State and local law enforcement agencies, will provide for visitor safety protection, guidance, search and rescue capability, natural resource protection, fire control, and traffic control. The Corps will provide a uniformed ranger force to assist the State and local agencies and to conduct facility inspection to insure compliance with leases.

47. Adequate management programs will be developed for fire protection, forest management, water safety, and fish and wildlife management. These programs will be implemented in accordance with ER 1130-2-400 (Project Operation) and ER 1145-2-400 (Water Resources Policies and Authority).

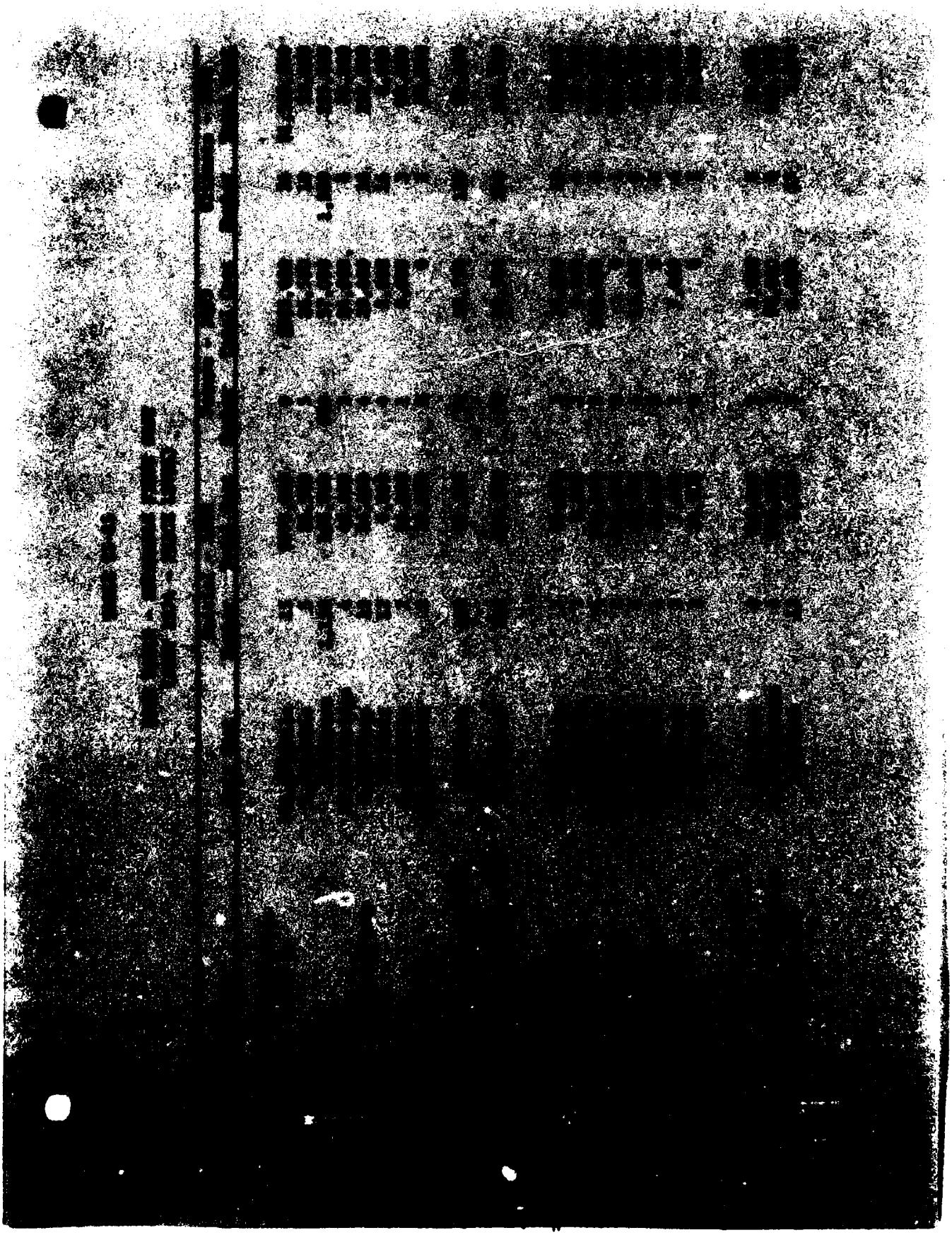
ENVIRONMENTAL QUALITY

48. Environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and recreational purposes. The quality of the environment as it exists will be protected, during and after construction, in every way possible. A program will be developed and publicized prior to acquisition to pay a premium for woods fronting land in recreation areas and above fee recreation pool. All structures will be designed to blend with existing terrain and will require landscape planting to enhance this appearance. Recreation roads will be designed for a minimum disturbance to the land while accomplishing their primary objective of quick access. All borrow areas will be graded to drain and restored with grass and trees. As many as possible will be located in the basin area below the bottom of the lake. Tree planting, as necessary to replace and every extent, will be accomplished in the operation of the project.

COST

49. Apportioning. The following Tables 11-11, 12, 13, and 14 are estimates of cost for recreation facilities, lands and easements, and operational and administrative facilities. These estimates are based on constructing the facilities by contract. The annual and total separable cost for the recreational development will be displayed when a mutually acceptable [illegible] is reached. Development and operation is proposed by the State including provision of access and parking, and the [illegible] of recreation facilities. [illegible] the [illegible] agreement for [illegible] life development. [illegible]

50. Wildlife Mitigation. Until the exact location of the 275 acres which is proposed to be acquired adjacent to the Thurman Chatham Wildlife Management Area is determined, a detailed estimate of the cost cannot be made. However, an overall estimate of $420 per acre (includes timber improvements, acquisition, etc.) was used to establish the estimated total acquisition cost of $115,500, rounded to $115,000.



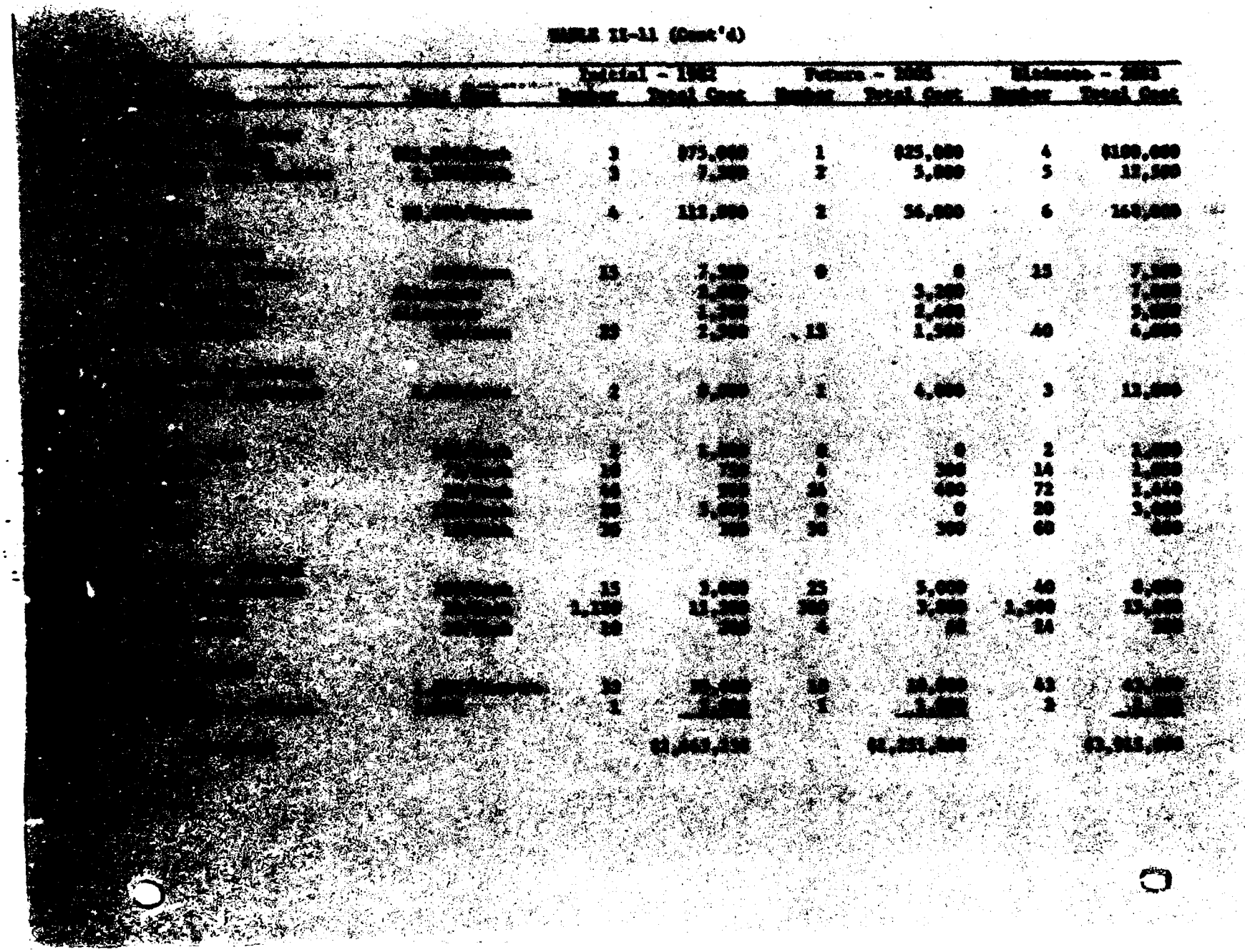
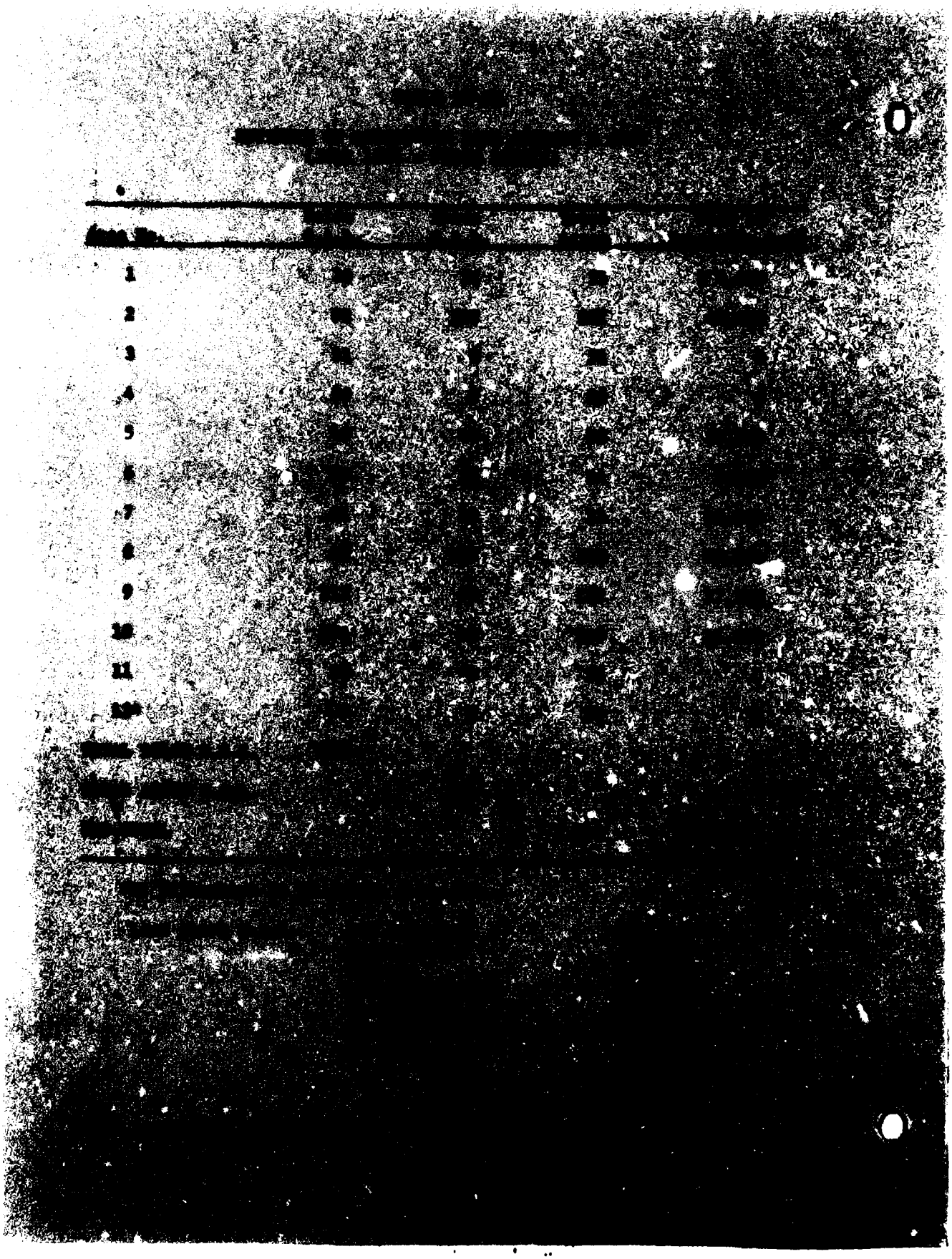
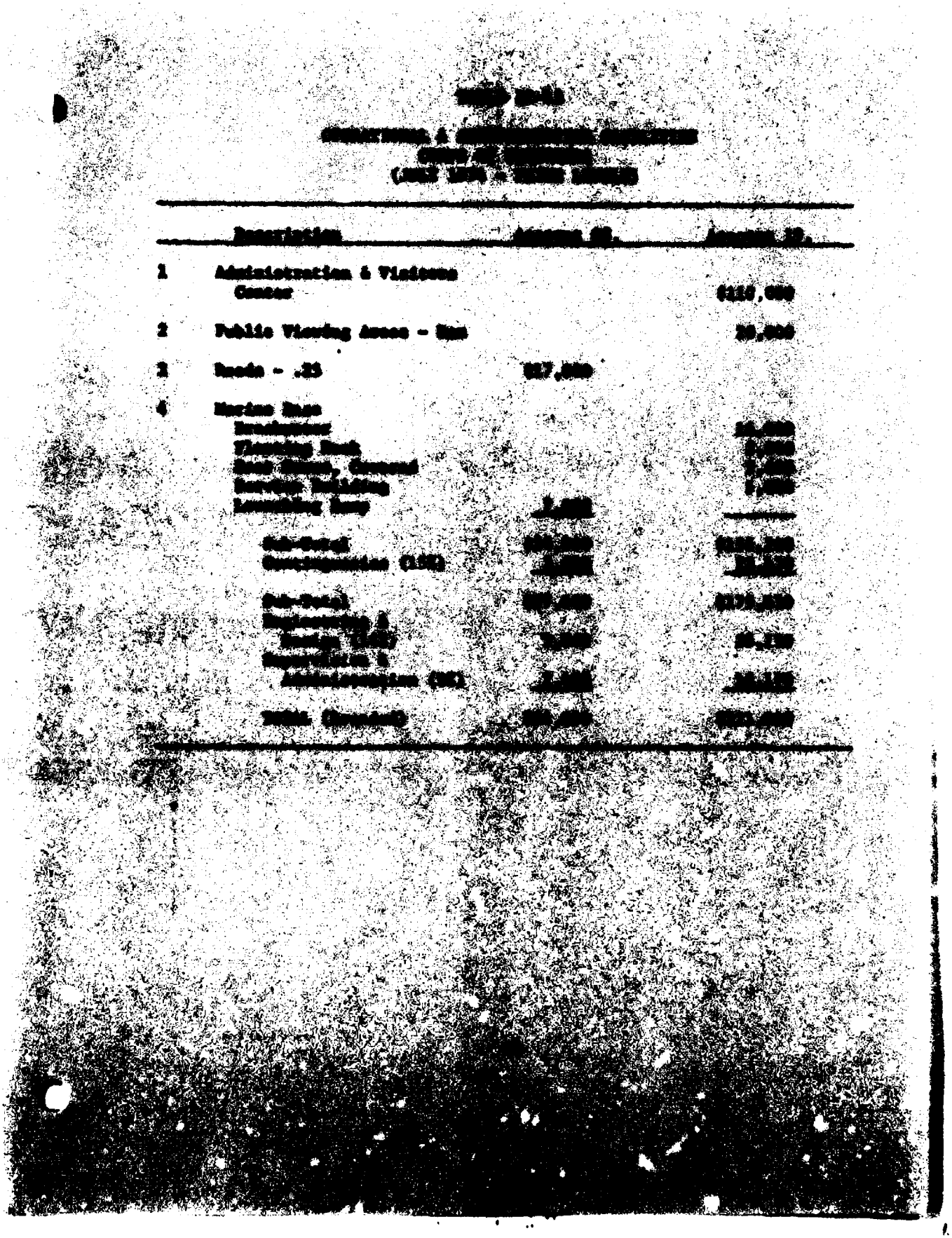
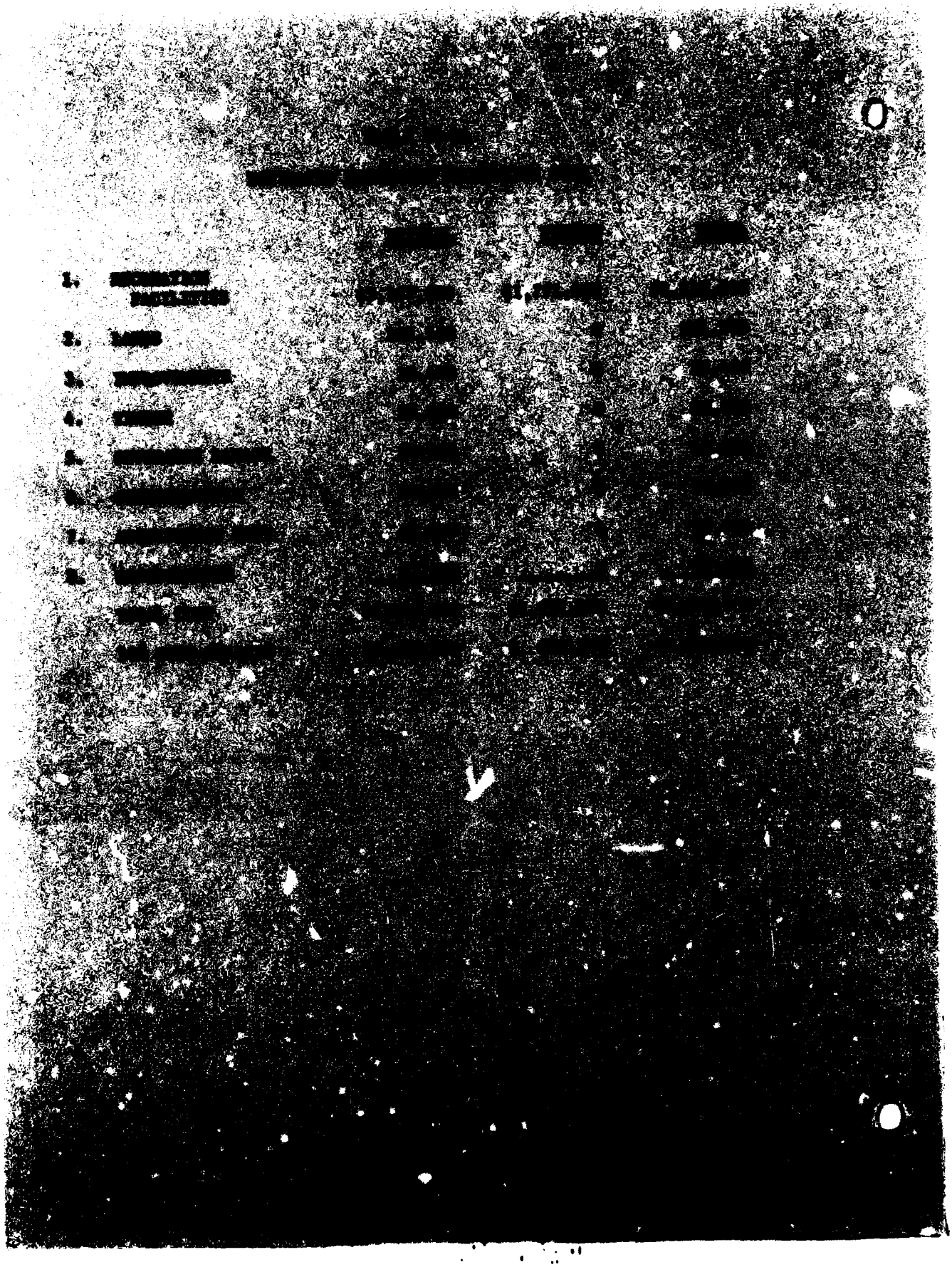


TABLE II-11 (Cont'd)

	Initial - 1985		Future - 2005		Ultimate - [illegible]	
	Number	Total Cost	Number	Total Cost	Number	Total Cost
[illegible]		$2,663,230		$1,251,860		$3,915,090
[illegible]		202,472		167,240		369,712
[illegible]		3,865,790		1,439,000		4,304,790
[illegible]		428,000		208,000		636,000
[illegible]		372,000		160,000		532,000
[illegible]		$9,303,000		$3,771,000		$9,958,000



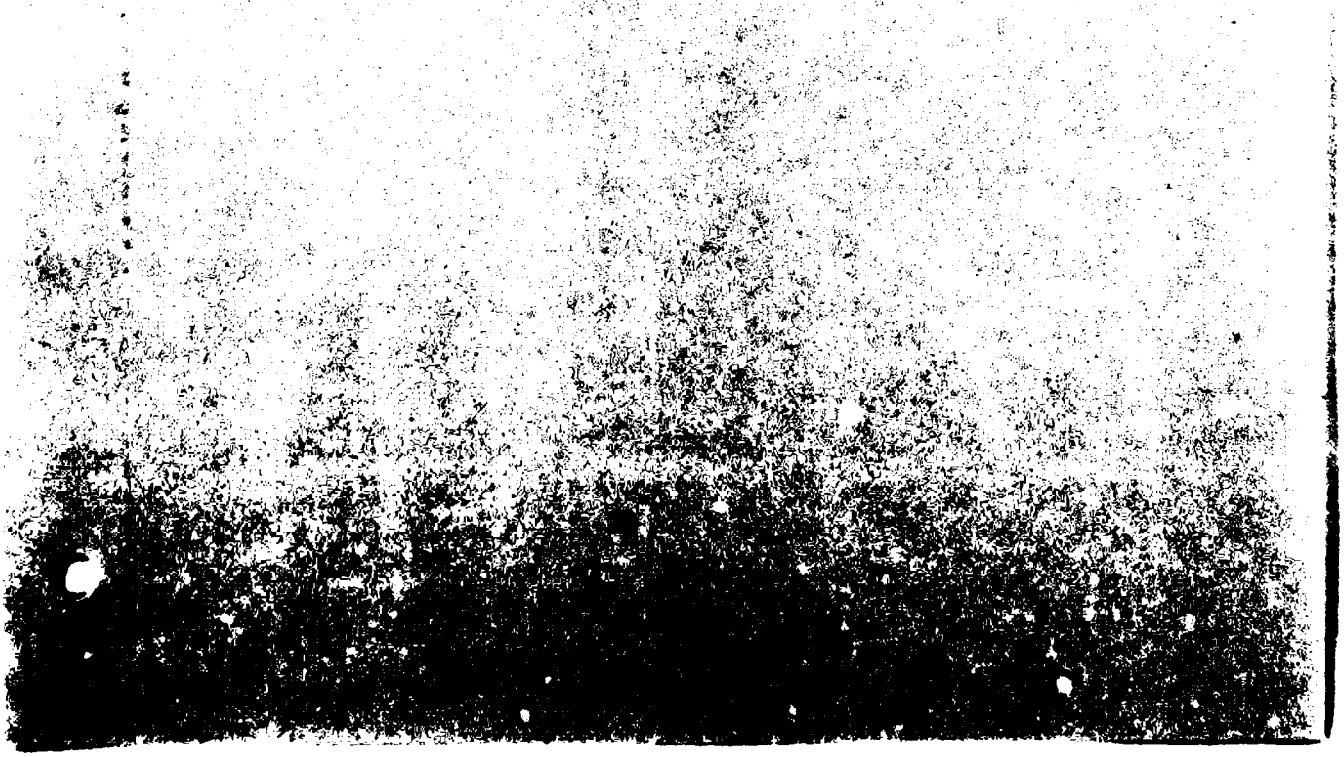




[redacted]

51. General Recreation. Although the project will not include any unique or outstanding archaeological, ecological, geological, or historical features of national significance, it is surrounded by places with regional values. The project will be aesthetically pleasant and is only 15 miles from the Blue Ridge Parkway. Good access to the area is provided through existing local roads and State highways. Maintenance of the planned recreation facilities will assure high quality recreation experiences. Based on the planned development and maintenance of these facilities, the unit value of a general recreation experience is estimated to be $1.15. Applying this unit value to the estimated general recreation annual visitation for each of the 100 years of project life, and discounting at an interest rate of 3-7/8 percent, gives an average annual general recreation benefit of $648,600.

52. Fishing. Based on the warm-water fishing in the lower reaches and the cold-water fish habitat in the upper reaches of the lake, the unit value of a man-day of fishing is estimated to be $1.35. This unit value was applied to estimated annual man-days of fishing for each of the 100 years of project life, discounted at 3-7/8 percent, and reduced by 2% to reflect the future usage the river would receive if the proposed lake were not constructed. This gave an estimated average annual fishing benefit of $16,400.



LEGEND

1 CECIL-PACOLET ASSOCIATION

2 CHESTER-ASHE-HAYESVILLE ASSOCIATION

3 ASHE-CHANDLER ASSOCIATION

4 SURRY ASSOCIATION

CECIL ASSOCIATION

CECIL-APPLING ASSOCIATION

CONGAREE-CHEWACLA ASSOCIATION

BIBKHAM-HIWASSEE ASSOCIATION

LOUISBURG-WEDOWEE ASSOCIATION

STONY STEEP LAND ASSOCIATION

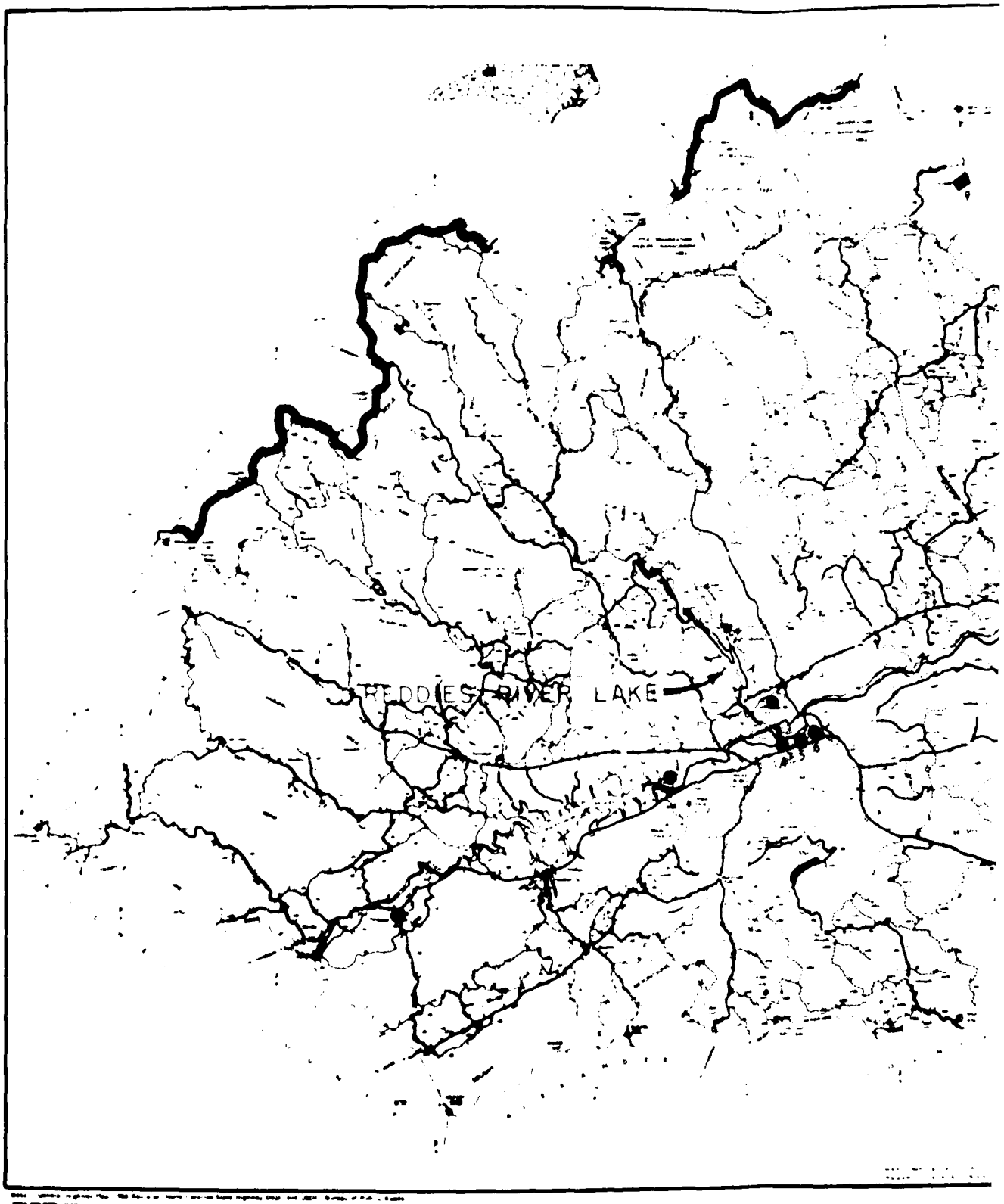
N

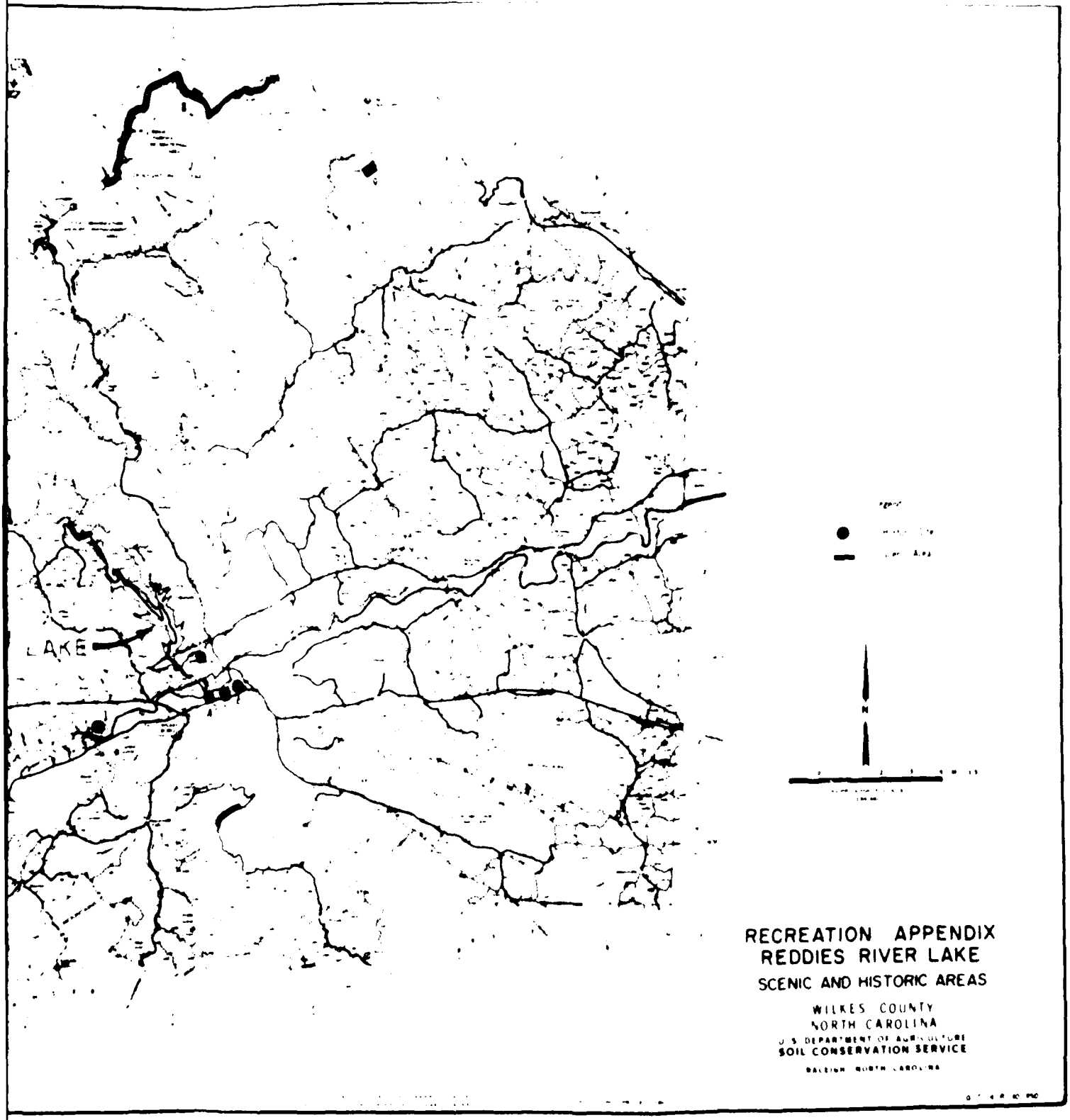
1 0 1 2 3 4 MILES

RECREATION APPENDIX
REDDIES RIVER LAKE
GENERAL SOIL MAP

WILKES COUNTY
NORTH CAROLINA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
RALEIGH, NORTH CAROLINA

APPENDIX II
PLATE I


REDDIES RIVER LAKE



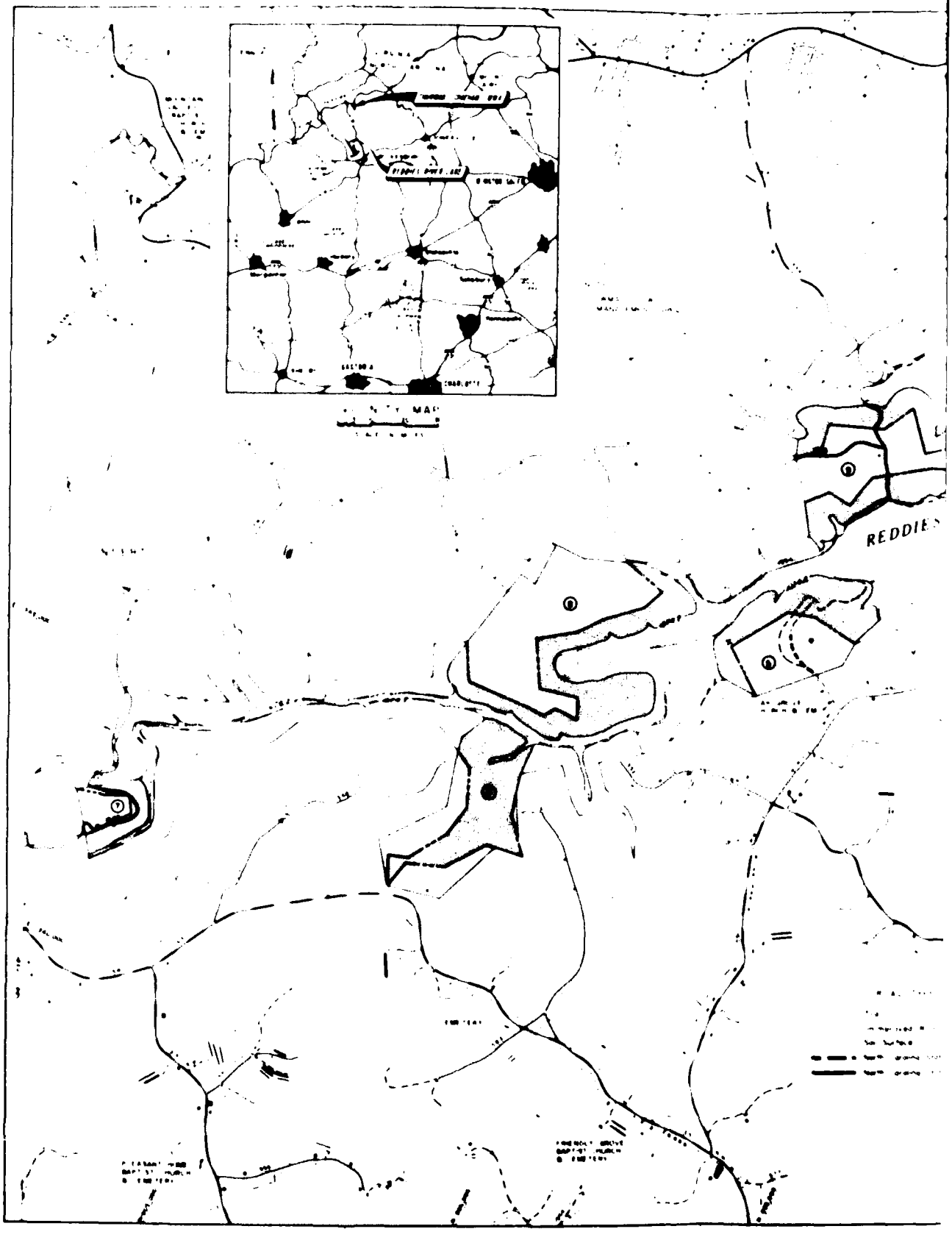
RECREATION APPENDIX
REDDIES RIVER LAKE
SCENIC AND HISTORIC AREAS

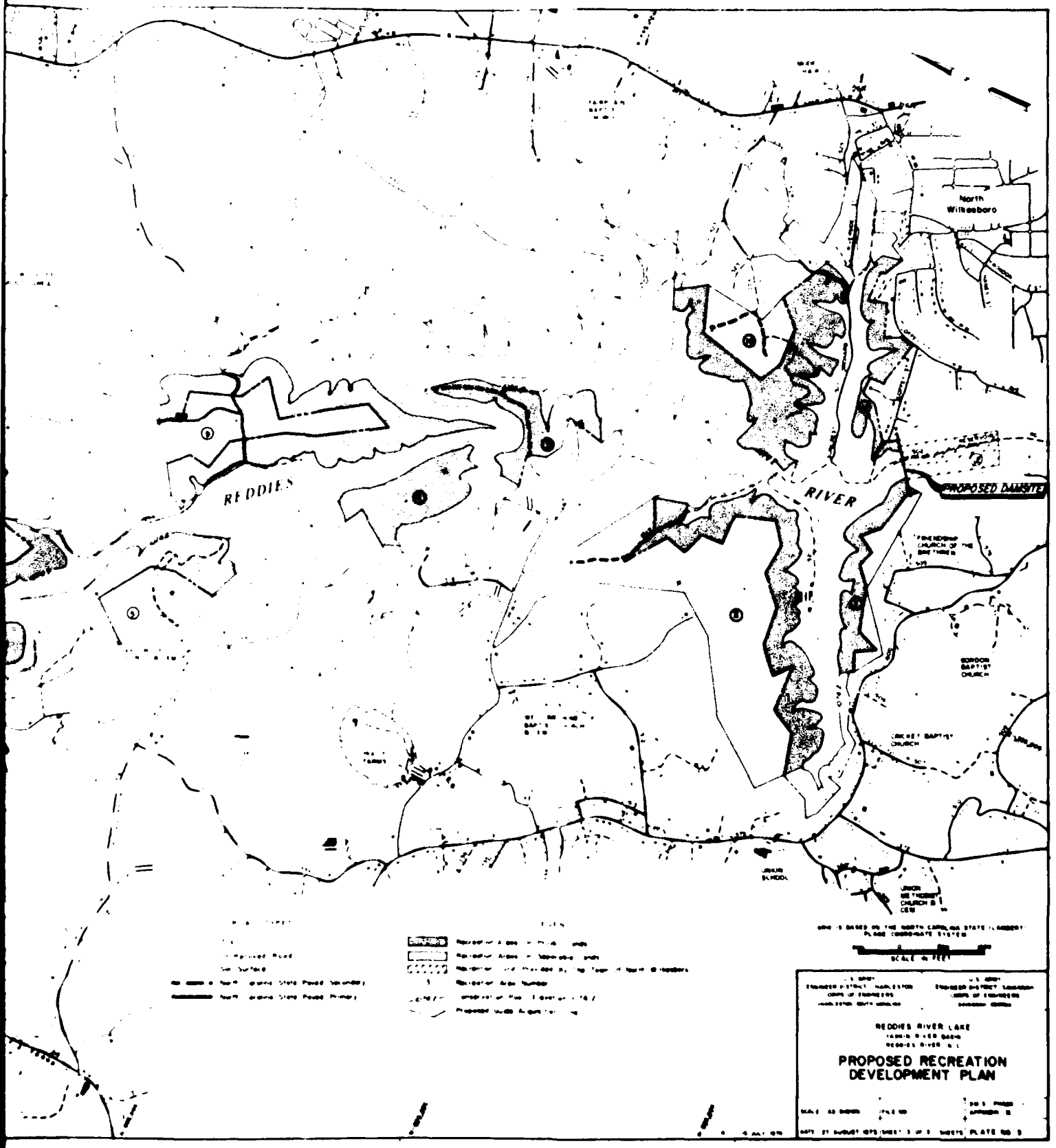
WILKES COUNTY
NORTH CAROLINA

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

RALEIGH, NORTH CAROLINA

APPENDIX II
PLATE 2


REDDIES


North Wilkesboro
REDDIES
RIVER
PROPOSED DAM SITE
REDDIES RIVER LAKE
PROPOSED RECREATION DEVELOPMENT PLAN

DRAFT

UNITED STATES OF AMERICA

and

AGREEMENT FOR COST-SHARING OF RECREATIONAL DEVELOPMENT (P.L. 89-72, 16 U.S.C. 460l-12)

STATE OF NORTH CAROLINA

THIS CONTRACT entered into this _____ day of _____, 19__ by and between the UNITED STATES OF AMERICA (hereinafter called the "Government"), represented by the Contracting Officer executing this contract, and the State of North Carolina acting by and through the NORTH CAROLINA DEPARTMENT OF NATURAL AND ECONOMIC RESOURCES (hereinafter called the "STATE");

WITNESSETH THAT:

WHEREAS, the construction of the Roddies River Lake on Roddies River, North Carolina, (hereinafter called the "Project"), has been authorized in the Flood Control Act of 1946 (Public Law 526, 79th Congress, 2nd Session) in accordance with plans contained in the report of the Chief of Engineers dated 19 June 1946, with such modifications thereof as in the discretion of the Secretary of War and the Chief of Engineers may be advisable; and

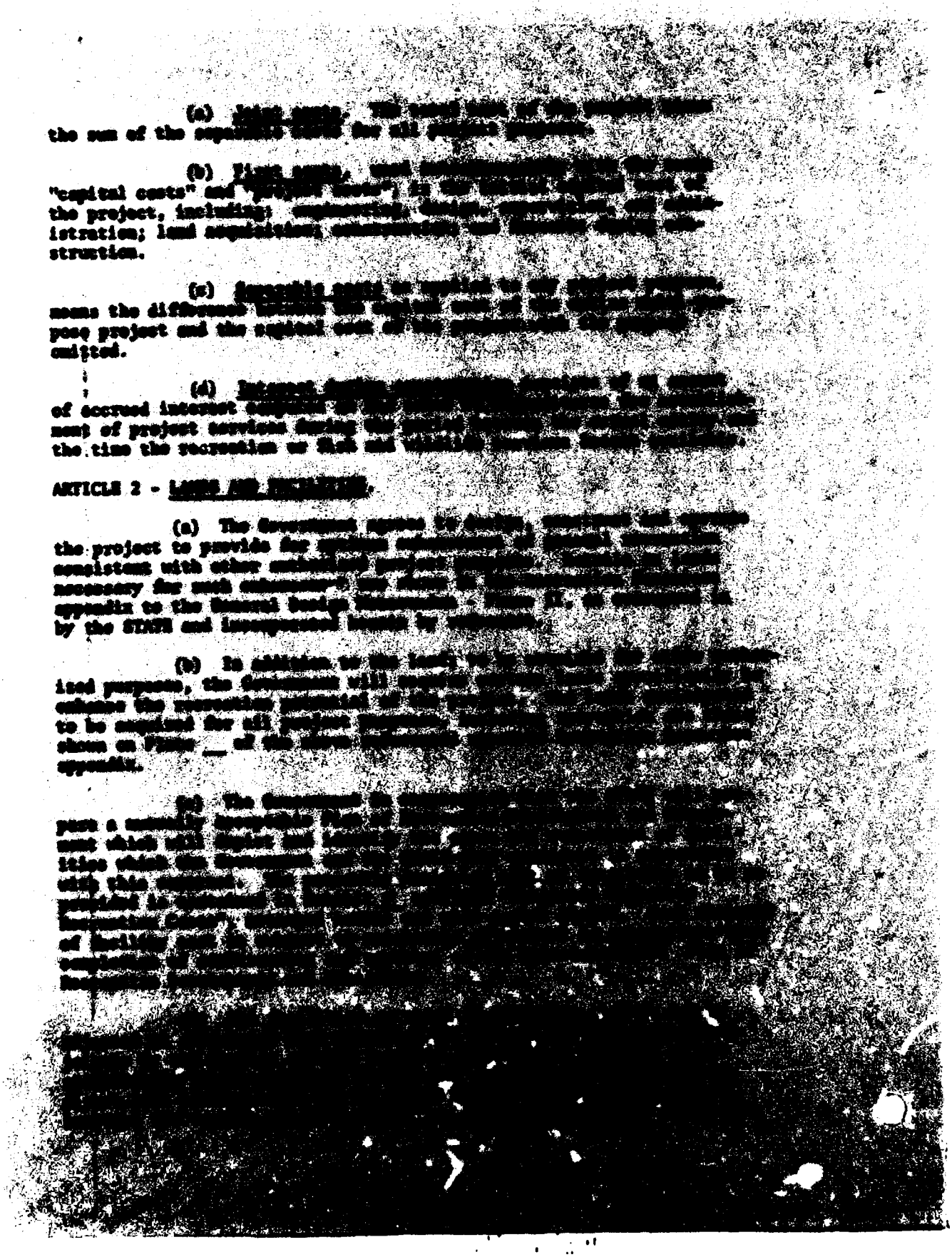
WHEREAS, THE STATE is authorized to administer project land and water areas for recreational purposes, and operate, maintain and replace facilities provided for such purposes and is empowered to contract for such purposes, and empowered to contract in these respects; and

WHEREAS, the Government is authorized by the Federal Water Project Recreation Act, (Public Law 89-72, 16 U.S.C. 460l, et seq) to make contracts with non-Federal public bodies for development, management and administration of the recreation and fish and wildlife resources of Federal water resources projects;

NOW, THEREFORE, the parties agree as follows:

ARTICLE 1 - DEFINITION OF TERMS. For the purpose of this contract certain terms are defined as follows:

[illegible] 71-4



to be constructed by each party shall be formally agreed upon by the two parties prior to construction, consistent with the provisions of Article 5.

(e) The Government will make available by lease to the State of North Carolina, for [illegible] management and administration, the use and occupancy of approximately [illegible] acres of land and water areas more fully described in the Plan of [illegible] Development and Management), together with facilities located thereon and capital or construction pursuant to this contract. No provision of this contract, including this subparagraph (e), shall excuse any such lease, but each and every obligation of each party hereto shall remain in full force and effect unless altered by mutual agreement of Article 20 hereof.

(f) Title to all lands and facilities specifically acquired, developed or constructed by or with Government assistance to enhance the recreation and/or fish and wildlife potentials of the project shall at all times be in the United States.

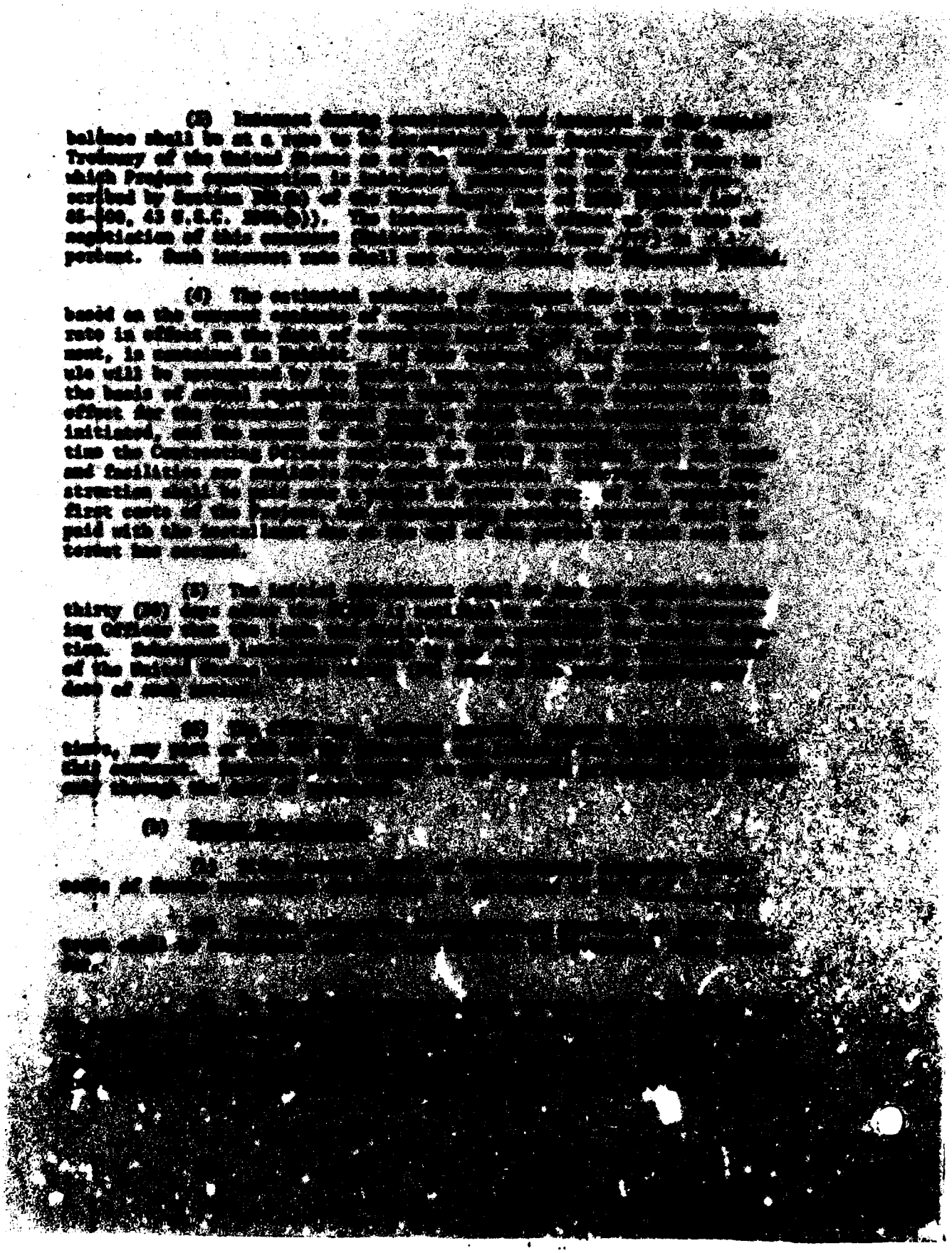
(g) The performance of any obligation or the expenditure of any funds by the Government under this contract is contingent upon Congress making the necessary appropriations and funds being allocated and made available for the work required hereunder.

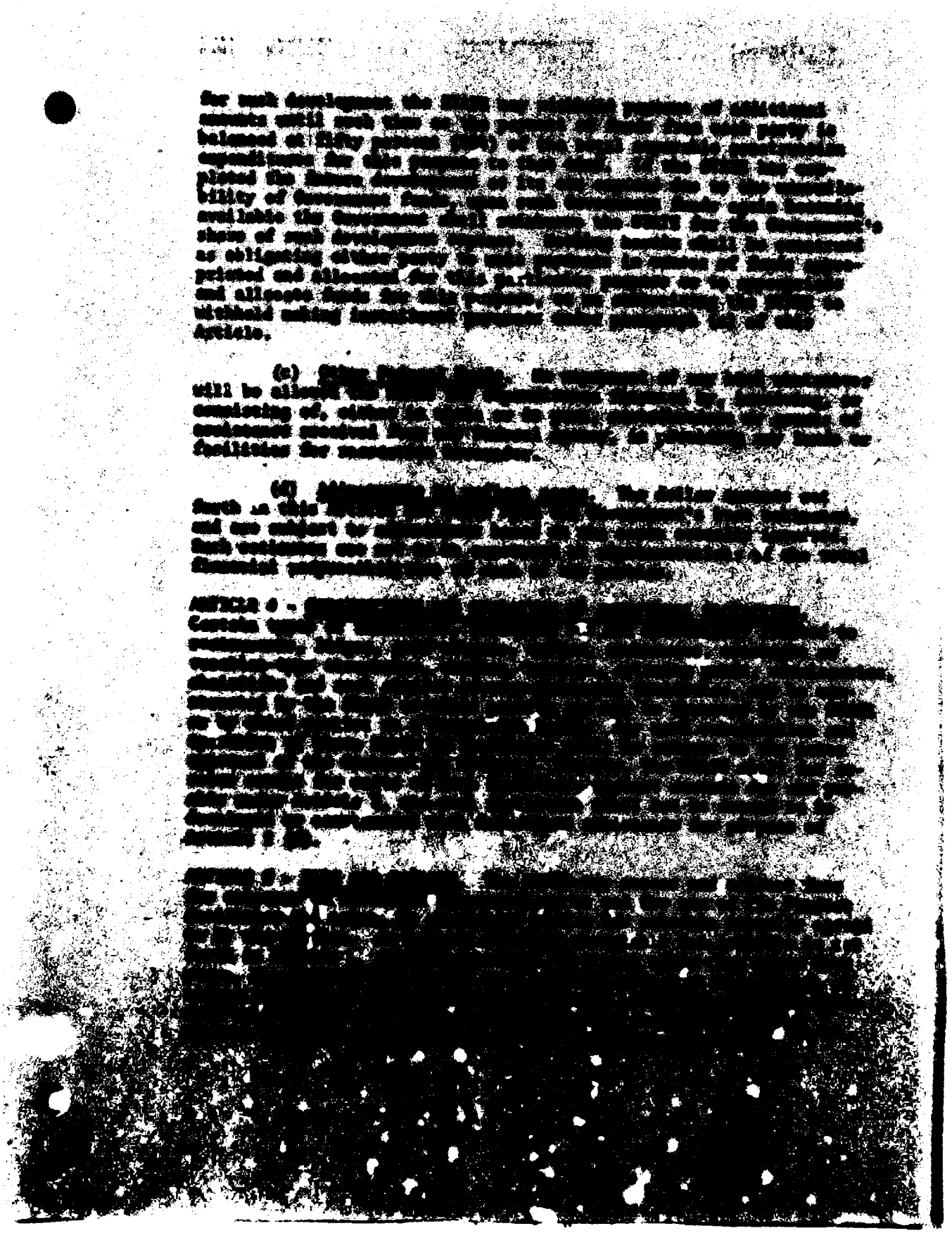
ARTICLE 3 - CONSIDERATION AND PAYMENT. Each party hereto will pay or contribute in [illegible] percent (50%) of the separable first costs of recreation development and fifty percent (50%) of the separable first costs of future recreational development. In addition, as between the parties hereto and except as may be provided in the Article 4 of the separate contract between the parties, the Government will pay one hundred percent (100%) of the first costs of the project allocated to recreation and to fish and wildlife enhancement.

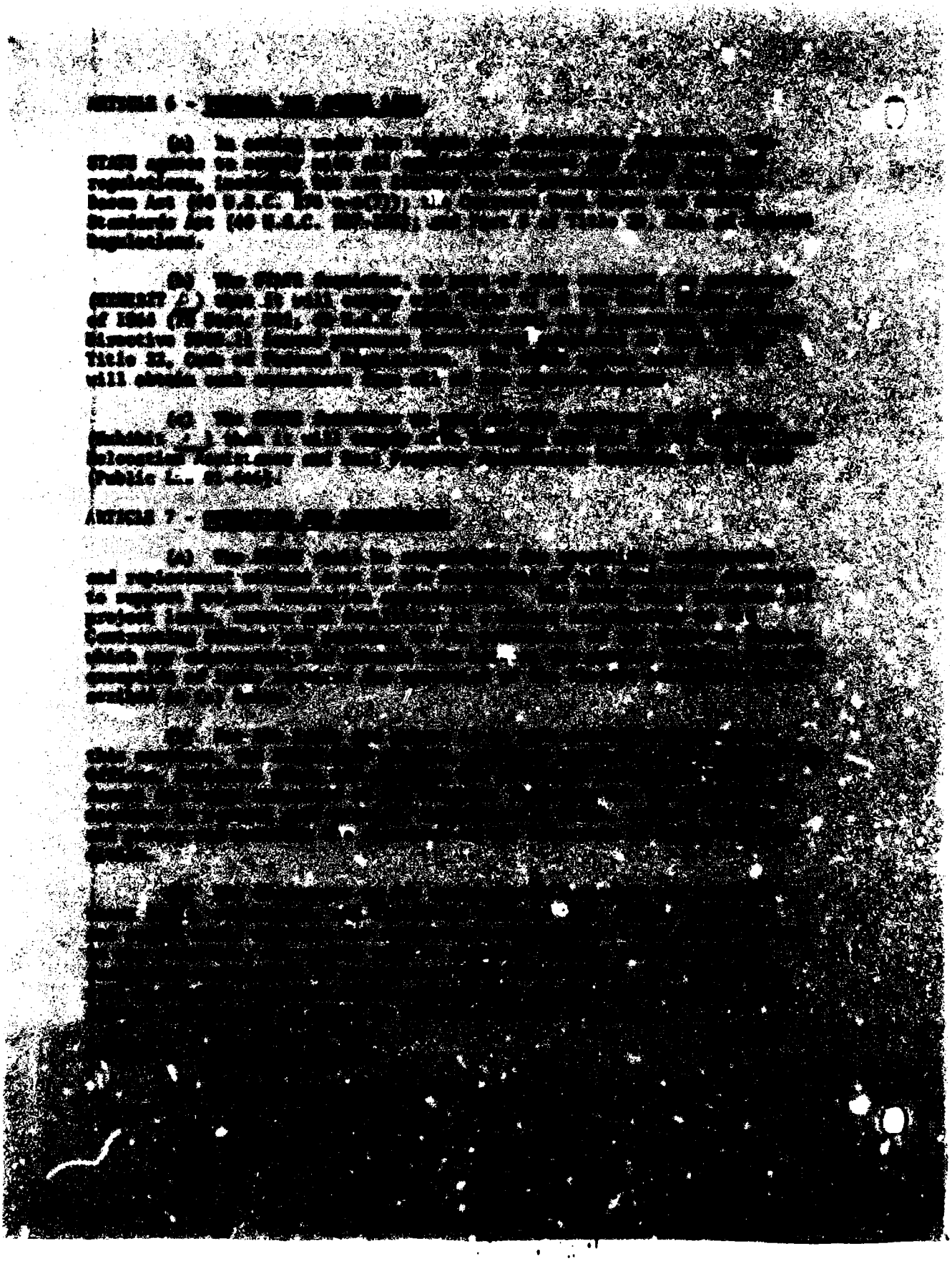
(a) Initial deposit. [illegible] percent (50%) of the estimated separable first costs of [illegible] recreation development is estimated to be [illegible]. The [illegible] share of the separable first costs shall be paid to the Government as follows:

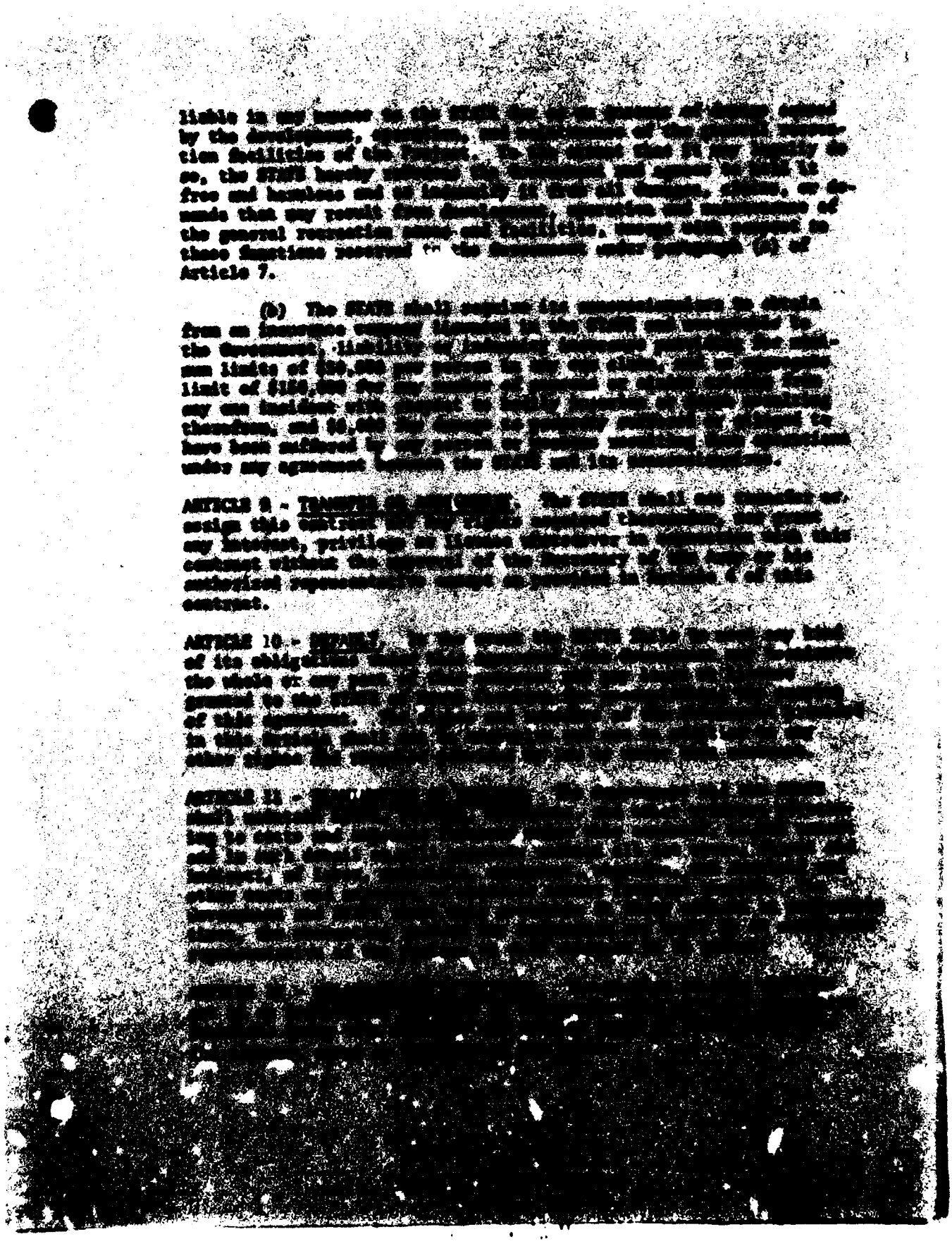
(1) There shall be credited [illegible] share in an amount equal to the sum of the [illegible] costs of the lands or facilities provided by the [illegible], such costs being determined as of the time such lands or facilities were [illegible] (or, in the case of lands [illegible] due to the Project) and of [illegible] and of the [illegible] separable first costs of the [illegible]

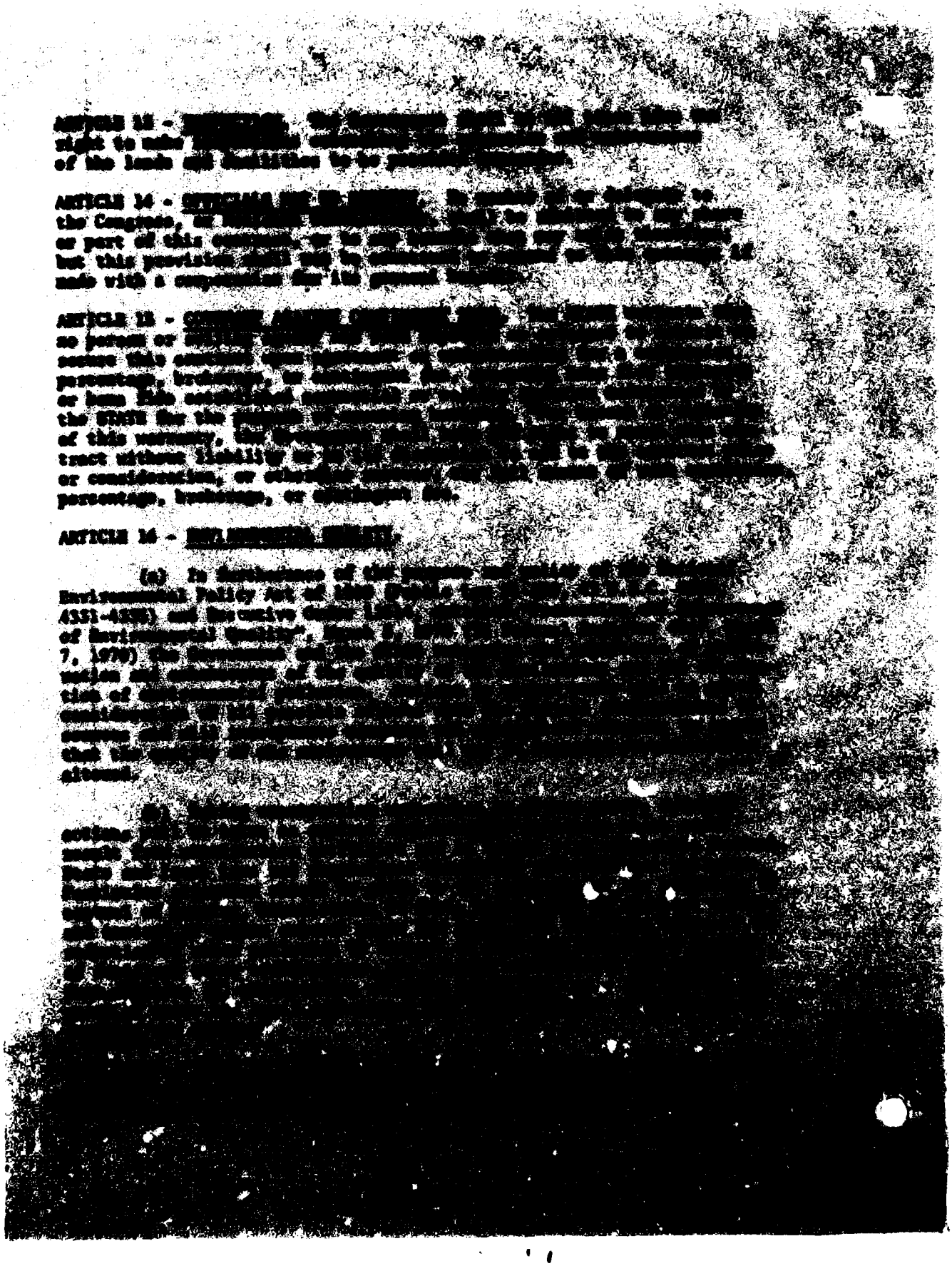
[illegible]











and the two appraisers so named shall name a third appraiser, and the decision of at least two of such three appraisers as to the fair market value shall be final and conclusive upon both parties.

ARTICLE 18 - EFFECTIVE DATE. This contract shall take effect upon approval by the Secretary of the Army or his authorized representative.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

THE UNITED STATES OF AMERICA

By _____

Colonel, Corps of Engineers
District Engineer
Contracting Officer

DATE _____

THE STATE OF NORTH CAROLINA
THROUGH THE NORTH CAROLINA
DEPARTMENT OF NATURAL AND
ECONOMIC RESOURCES

By _____
[redacted], JR.
Governor

By _____
[redacted]
Secretary
Department of Natural and
Economic Resources

This agreement is reviewed and approved for legal sufficiency as a binding legal obligation on the State of North Carolina consistent with Title III of Public Law 89-298, and with Chapter 1071 of 1967 North Carolina Session's Laws (General Statutes 143-354).

APPROVED:

By _____ (Assistant Attorney General)
[redacted]
Attorney General
State of North Carolina

Date _____

[redacted]

By _____

Date _____

EXHIBIT A
ESTIMATED SEPARABLE RECREATION COSTS

This is the same as Table II-14 of Appendix II, Recreation Resources.

EXHIBIT B

Schedule of Annual Principal and Interest Payments for Initial Recreation Development Based on the State of North Carolina's Share of Separable First Cost Presently Estimated at $2,133,000 - Reddies River Lake, North Carolina

Payment Number	Interest 4.371%	Principal	Total Payment	Balance Due
				$2,133,000.00
1	$93,233.43	$12,445.57	$105,679.00	2,120,554.43
2	92,689.43	12,989.57		2,107,564.86
3	92,121.66	13,557.34		2,094,007.52
4	91,529.07	14,149.93		2,079,857.59
5	90,910.58	14,768.42		2,065,089.17
6	90,265.05	15,413.95		2,049,675.22
7	89,591.30	16,078.70		2,033,587.52
8	88,888.11	16,790.89		2,016,796.63
9	88,154.18	17,524.82		1,999,271.81
10	87,388.17	18,290.83		1,980,980.98
11	86,588.68	19,090.32		1,961,890.66
12	85,754.24	19,924.76		1,941,965.90
13	84,883.33	20,795.67		1,921,170.23
14	83,974.35	21,704.65		1,899,465.58
15	83,025.64	22,653.36		1,876,812.22
16	82,035.46	23,643.54		1,853,168.68
17	81,002.00	24,677.00		1,828,491.68
18	79,923.37	25,755.63		1,802,736.05
19	78,797.59	26,881.41		1,775,854.64
20	77,622.61	28,056.39		1,747,798.25
21	76,396.26	29,282.74		1,718,515.51
22	75,116.31	30,562.69		1,687,952.82
23	73,780.42	31,898.58		1,656,054.24
24	72,386.13	33,292.87		1,622,761.37
25	70,930.90	34,748.10		1,588,013.27
26	69,412.06	36,266.94		1,551,746.33
27	67,826.83	37,852.17		1,513,894.16
28	66,172.31	39,506.69		1,474,387.47
29	64,445.48	41,233.52		1,433,153.95
30	62,643.16	43,035.84		1,390,118.11
31	60,762.06	44,916.94		1,345,201.17
32	58,798.74	46,880.26		1,298,320.91
33	56,749.61	48,929.39		1,249,391.52
34	54,610.90	51,068.10		1,198,323.42
35	52,378.72	53,300.28		1,145,023.14
36	50,048.96	55,630.04		1,089,393.10
37	47,617.37	58,061.63		1,031,331.47
38	45,079.50	60,599.50		970,731.97
39	42,430.69	63,248.31		907,483.66
40	39,666.11	66,012.89		841,470.77
41	36,780.69	68,898.31		772,572.46
42	33,769.14	71,909.86		700,662.60
43	30,625.96	75,053.04	$105,679.00	625,609.56

EXHIBIT B (cont.)

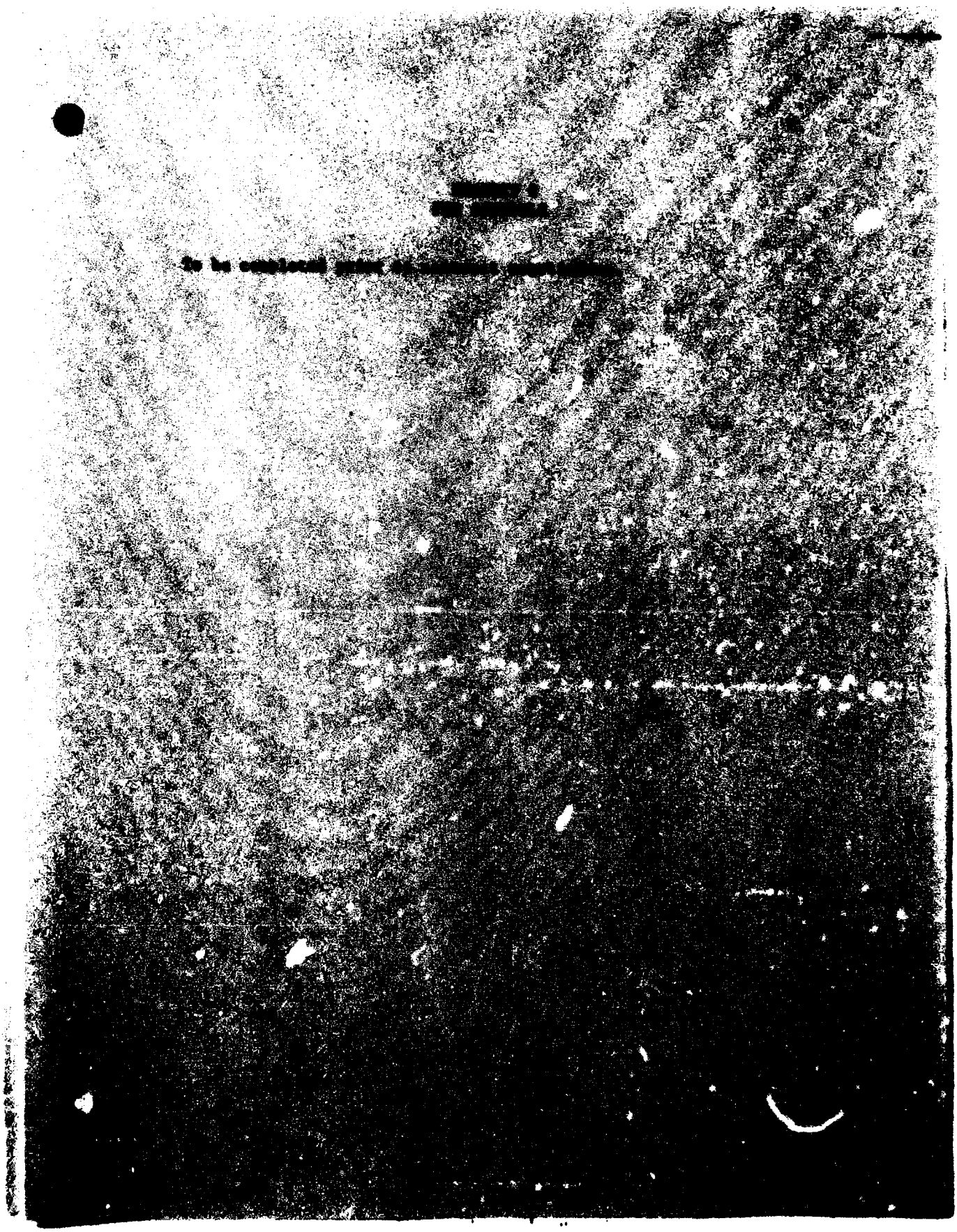
Schedule of Annual Principal and Interest Payments for Initial Recreation Development Based on the State of North Carolina's Share of Separable First Cost Presently Estimated at $2,133,000 - Reddies River Lake, North Carolina

Payment Number	Interest 4.371%	Principal	Total Payment	Balance Due
44	$27,345.39	$78,333.61	$105,679.00	$ 547,275.95
45	23,921.43	81,757.57		465,518.38
46	20,347.81	85,331.19		380,187.19
47	16,617.98	89,061.02		291,126.17
48	12,725.12	92,953.88		198,172.29
49	8,662.11	97,016.89		101,155.40
50	4,421.50	101,155.40	$105,576.90	00.00

EXHIBIT B (cont.)

Schedule of Annual Payments
For Initial Recreation Development
Roddies River Lake, North Carolina

Payment Number	Principal and Interest on $2,133,000	Annual Operation & Maintenance	Annual Major Replacement	Total Annual Payment
1	$105,679.00	$60,000	0	$165,679.00
49	$105,679.00	$60,000	0	$165,679.00
50	$105,576.90	$60,000	0	$165,576.90



ASSURANCE OF COMPLIANCE
WITH THE DEPARTMENT OF DEFENSE DIRECTIVE
UNDER TITLE VI OF THE CIVIL RIGHTS ACT OF 1964

The State of North Carolina (hereinafter called the State) HEREBY AGREES THAT it will comply with Title VI of the Civil Rights Act of 1964 (PL 88-352) and all requirements imposed by or pursuant to the Directive of the Department of Defense (32 CFR, Part 300, issued as Department of Defense Directive 5500.11, Change 1, dated 11 April 1968) issued pursuant to that title, to the end that, in accordance with Title VI of that Act and the Directive, no person in the United States shall, on the grounds of race, color, or national origin be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the State receives Federal financial assistance from the Department of the Army and HEREBY GIVES ASSURANCE THAT it will immediately take any measures necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the State by the Department of the Army, assurance shall obligate the State, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the State for the period during which the Federal financial assistance is extended to it by the Department of the Army.

THIS ASSURANCE is given for the consideration of and for the purpose of obtaining any and all Federal grants, loans, contracts, agreements or other Federal financial assistance [illegible] to the State by the Department, including installment payments after such date on account of arrangements for Federal financial assistance which were approved before such date. The State recognizes and agrees that such Federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the State, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign this assurance on behalf of the State.

[redacted]

APPENDIX III

UPPER YADKIN RIVER BASIN
NORTH CAROLINA WATER
QUALITY STUDY

ENV ONMENTAL PROTECTION AC NCY
REGION IV
1421 Peachtree St., N.E., Atlanta, Georgia 30309

March 12, 1973

Mr. Jack J. Lesemann
Chief, Engineering Division
Charleston District
U. S. Army Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Mr. Lesemann:

This off e has completed a water quality study of the Upper Yadkin River Basin. The report was prepared upon request of your district office dated August 4, 1972, to provide an update of the water quality needs in this basin.

The report concentrates in two areas of potential water quality degradation: (1) the influence of the City of Winston-Salem wastes to the water quality of the Yadkin River and, (2) the nutrient enrichment of the High Rock Lake due to the phosphorus and nitrogen discharges from the waste sources in the basin.

It is our conclusion that due to the availability of waste treatment techniques at the source, there is no need for reservoir storage for downstream water quality control in the Upper Yadkin River Basin.

Sincerely yours,

Otto Pride
Chief
Water Quality Planning Section

UPPER YADKIN RIVER BASIN
NORTH CAROLINA
WATER QUALITY STUDY

February 22, 1973
Environmental Protection Agency
Region IV
Atlanta, Georgia

ABSTRACT

A water quality study of the Upper Yadkin River Basin to determine the need for flow augmentation was performed. The wastes from the City of Winston-Salem were found to have the largest effect on the Yadkin River. It was also found that the nutrient loads entering the High Rock Lake in the Yadkin River will tend to accelerate the rate of eutrophication in the lake. It is concluded that due to the availability of waste treatment techniques at the source, there is no need for reservoir storage for downstream water quality control in the Upper Yadkin River Basin.

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WATER QUALITY STUDY
REDDIES RESERVOIR PROJECT
YADKIN - PEE DEE RIVER BASIN
FEBRUARY 1973

I. INTRODUCTION

A. Purpose

This report has been prepared upon request by the U. S. Army Corps of Engineers, Charleston District, dated August 4, 1972, to provide an update of the water quality needs in the Upper Yadkin River Basin. It is based upon information readily available; no field studies were performed.

B. Scope

The Upper Yadkin River Basin is situated in the Northwest section of North Carolina. There are over 50 individual point waste sources in this basin, both industrial and domestic. The major waste sources are located in and around the City of Winston-Salem. The scope of this study is confined to: (1) The effects of biodegradable wastes discharged to the Yadkin River and its tributaries in the vicinity of Winston-Salem, and (2) The contribution by all known waste sources in the basin to the nutrient enrichment of the High Rock Reservoir. These constitute the most critical water quality management problems in the basin, and those which would be most directly affected as a result of flow regulation from the proposed Reddies Reservoir.

C. Objective

This study is concerned with whether flow augementation at the proposed reservoir in the Reddies River or any other tributary in the basin should be provided as an element of the overall water quality management in the basin.

D. Acknowledgements

The cooperation and assistance of the following city, state and federal agencies added significantly to this study.

U. S. Army Corps of Engineers
Charleston District
Charleston, South Carolina

U. S. Department of Interior
Geological Survey
Raleigh, North Carolina

Department of Natural and Economic Resources
State of North Carolina
Raleigh, North Carolina

City of Winston-Salem
Water and Sewage Division
Winston-Salem, North Carolina

II. DESCRIPTION OF STUDY AREA

A. Location and Boundaries

The study area includes the part of the drainage basin of the Upper Yadkin River from W. Kerr Scott Reservoir to High Rock Lake. The total drainage area is approximately 2,400 square miles which includes the regions drained by the Yadkin River and its principal tributaries; Reddies, Roaring, Ararat, and South Yadkin Rivers. There are two major impoundments within this basin; namely, the W. Kerr Scott Reservoir, and High Rock Reservoir.

The basin primarily encompasses the following North Carolina counties: Wilkes, Surry, Yadkin, Forsyth, Iredell, Davie, Davidson, and Rowan. The principal community in the study area is the City of Winston-Salem with an estimated 1970 population of 112,000.

B. Physiography and Hydrology

The Upper Yadkin River Basin headwaters rise in the Blue Ridge mountains and flow through the Piedmont Plateau. Headwater sources are 3,500 to 4,000 feet above sea level, but quickly drop to 1,500 feet. The stream bed elevations in the region between Kerr Scott and High Rock Reservoir drops from 950 to 580 feet in a river length of 200 miles and the average slope within this reach is 1.8 feet/mile.

The minimum 10-year, 7-day low flow in the Yadkin River varies from 200 cfs at Wilkesboro, near Kerr Scott Reservoir, to 880 cfs at Salisbury, near High Rock Reservoir. Kerr Scott Reservoir was completed in 1962 and is located in the Yadkin River near North Wilkesboro, North Carolina, approximately 90 miles upstream from Winston-Salem. Its project purposes

are flood control and water supply, having a 33,000 AC-FT[3] conservation pool allocated to Winston-Salem and Wilkes County, North Carolina for water supply. Kerr Scott Reservoir is designed to release water equal to the inflow coming into the reservoir. This reportedly does not significantly affect the natural low flow conditions in the Yadkin River. The average retention time in the reservoir is 30 days.

The other major impoundment in the study area is High Rock Reservoir. This impoundment was constructed in 1927 and is located in the Yadkin River near Salisbury, North Carolina, approximately 30 miles downstream from Winston-Salem. This reservoir has a volume of 235,000[4] AC-FT, with an average rentention time of 23 days. Maximum retention time under 7-day, 10-year flow conditions would be 125 days.

There is also the proposed Reddies River Reservoir in the Upper Yadkin Basin which is under consideration by the Corps of Engineers. The reservoir is proposed to have a volume of 60,500 AC-FT of which 35,000 would be for flood control, 9,150 for water supply, 12,000 for water quality control and an inactive pool of 4,350. The reservoir is proposed to provide a flow of 20 cfs for water quality control during a recurrence of the most severe drought of record which would have an average frequency of once every 40 to 50 years.[5] The water quality control storage was included in the proposed project based upon the advise of the FWPCA and was consistent with agency policy at that time.

III. WASTE SOURCES

Tables 1 and 2 summarize major point waste sources in the study area, both domestic and industrial. These data were obtained from the State of North Carolina sub-basin interim plans[6] and the EPA STORET[7] system. The parameters used in this report to evaluate the effluent quality of each waste source in the study area are ultimate carbonaceous biochemical and nitrogenous oxygen demands (CBOD and NBOD), total nitrogen (N) and total Phosphorus (P).

Detailed analysis regarding dissolved oxygen resources was limited to the effects of the City of Winston-Salem's waste on the water quality of the Yadkin River. It can readily be seen from Tables 1 and 2 that Winston-Salem's

AD-A150 812 REDDIES RIVER LAKE YADKIN RIVER BASIN REDDIES RIVER NORTH CAROLINA GENERA..(U) CORPS OF ENGINEERS CHARLESTON SC CHARLESTON DISTRICT MAR 75 4/4

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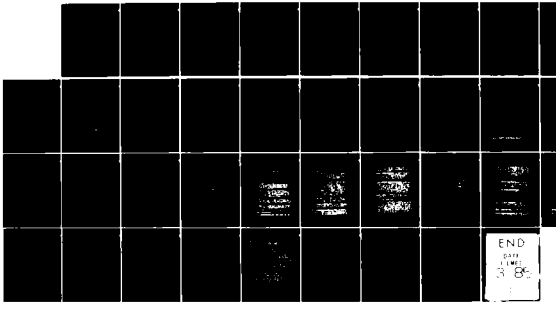

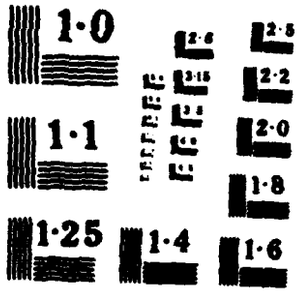
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1·1
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2·0
1·8
1·6

waste contribution amounts to more than 50% of the total waste load of the entire basin with the other loads being dispersed through out the basin. The nutrients basically total nitrogen (N) and phosphorus (P), are all considered in the study as contributing to the enrichment of the High Rock Reservoir.

A. Domestic Wastes

(1) Waste Quality

The assumption used to evaluate the domestic wastes presented in Table 1 are: (a) actual population, (b) population based upon 100 gallons.capita/day whenever actual population is not available, (c) 0.25 pounds ultimate carbonaceous BOD/capita/day, (d) 0.20 pounds ultimate nitrogenous BOD/capita/day, (e) 0.025 PO_4/capita/day (asP), (f) 0.042 pounds nitrogen/capita/day (asN)[8].

(2) Estimated Efficiency of Treatment Levels

For purposes of this report, treatment levels have been categorized into three groups which may be qualitatively described as follows[8]:

Marginal Secondary (Treatment Level 1)

Conventional secondary treatment systems which are overloaded.

High Rate Biological (Treatment Level 2)

Conventional secondary treatment systems with proper operation.

Secondary with Nitrification (Treatment Level 3)

Biological treatment for removal of carbons and for nitrification. Table 3 presents the estimated removal efficiencies of these treatment levels.

B. Industrial Wastes

The data for the industrial waste effluents presented in Table 2 are from actual industrial reports in the study area. Although BOD_5 instead of ultimate oxygen demand (UBOD) appears in these reports; a 1.1 factor times BOD_5 was assumed to obtain UBOD. The nutrients, total N and total P, are the actual pounds per day discharged into the basin as they are reported in EPA permit applications by these industries[7].

TABLE 1

1970 DOMESTIC WASTE SOURCES

SOURCE NAME	COUNTY	FLOW MGD	P.E.**	PRESENT TREATMENT LEVEL	ESTIMATED EFFLUENT DISCHARGE #/D			
					CBOD	NBOD	N	P
Wilkesboro	Wilkes	0.270	2000	1	150	270	75	40
N. Wilkesboro	Wilkes	0.663	5000	0	1000	750	220	110
Jonesville	Yadkin	0.115	1150	3	28	26	38	23
Boonville	Yadkin	0.050	500	1	21	39	19	10
Yadkinville	Yadkin	0.118	1400	2	25	80	40	24
Elkin	Surry	0.435	2000	2	25	140	120	45
Sunbeam Corp.	Surry	0.025	250	2	6	19	8	5
Dobson	Surry	0.070	450	3	5	5	15	5
Mount Airy	Surry	0.715	7190	1	490	870	220	130
Pilot Mountain	Surry	0.170	1400	1	97	175	43	26
Bethania Plant	Forsyth	0.010	100	3	2	2	3	2
Rural Hall Sanitary Dist.	Forsyth	0.170	2100	2	71	250	70	42
Kernersville	Forsyth	0.125	1900	2	71	230	68	40

* Domestic Only
** Assumed 100 gpd/c wherever actual population is not given

TABLE 1 (Continued)

SOURCE NAME	COUNTY	FLOW MGD	P.E.**	PRESENT TREATMENT LEVEL	ESTIMATED EFFLUENT DISCHARGE #/D CBOD	NBOD	N	P
Winston-Salem	Forsyth	25.0	150,000	***	11,000	20,000	5600	3000
Landis	Rowan	0.250	1,800	2	70	230	68	40
China Grove	Rowan	0.300	1,600	2	60	180	50	30
Odell Mobile Home	Rowan	0.004	40	3	1	1	1	0
Salisbury	Rowan	2.405	24,050	2	900	2,900	800	480
Spencer	Rowan	0.479	3,000	2	110	360	100	60
Granite Quarry	Rowan	0.100	1,000	2	30	120	34	20
Pine Valley	Rowan	0.025	200	3	5	3	7	4
Cooleemee	Davie	0.180	1,800	0	450	270	75	45
Mocksville (East & West Plant)	Davie	0.168	2,000	3	56	162	65	40
Mocksville (NW Plant)	Davie	0.010	100	2	3	12	3	2
Troutman	Iredell	0.050	600	2	18	72	20	12
Statesville	Iredell	2.8	25,000	2	840	3,360	930	560
High Point	Guilford	2.6	25,000	3	650	550	830	500
Thomasville	Davidson	1.9	15,200	3	360	180	490	300
Lexington	Davidson	3.6	4,200	2	150	50	135	80
							10,252	5712

Total #/D of Nutrients Entering High Rock Lake (H.R.L.) . . . . .

Total #/D of Nutrients Discharged in H.R.L. by the Yadkin River alone . 8,763 4812

*** Assumes removals of 80% CBOD AND 20% NBOD

TABLE 2

PRINCIPAL INDUSTRIAL WASTES

INDUSTRY	CITY	COUNTY	FLOW MGD	EFFLUENT CHARACTERISTICS UOD #/D	N #/D	P #/D
Abitibi Corp.	Roaring River	Wilkes	0.395	735.0	19	1.0
Canal Mirror Co.	N. Wilkesboro	Wilkes	0.152	29.0	5	0
Coca Cola	N. Wilkesboro	Wilkes	0.025	11.0	0	1
Gardner Mirror	N. Wilkesboro	Wilkes	0.168	11.0	4	11
Holly Farms Poultry	Hiddenite	Alexander	0.471	185.0	-	25
Chatham Mfg.	Elkin	Surry	2.750	1070.0	302	154
Wilson Leonel Farms	Roaring	Surry	0.001	185.0	79	0
Vulcan M'l	Elkin	Surry	0.209	12.0	2	0
Procter Silex	Mount Airy	Surry	0.220	4.0	12	0
Sunbeam	Elkin	Surry	0.029	3.0	1	0
Wilson Leonel Farms	Elkin	Surry	0.360	0.8	0	0
R. J. Reynolds	Winston-Salem	Forsyth		0.1	0	-
Schlitz Brewing	Winston-Salem	Forsyth	0.300	32.0	-	4
RJR Arcester Ind.	Winston-Salem	Forsyth	0.072	7.8	0	1
Mixed Dairies	Winston-Salem	Forsyth	0.0004	0.1	0	0
Burlington	Kernersville	Forsyth	2.004	0.1	0	0
Burlington	Kernersville(Sock)	Forsyth	0.0003	0.1	0	0

TABLE 2 (Continued)

[redacted]	CITY	COUNTY	FLOW MGD	EFFLUENT CHARACTERISTICS UOD #/D	N #/D	P #/D
[redacted]	Harmony	Iredell	0.500	4100.0	-	29
[redacted]	Barber	Davie	1.200	550.0	14	200
[redacted]	Patterson	Caldwell	0.940	52.0	13	42
[redacted]	High Point	Guilford	0.025	3.7	0	0
[redacted]	High Point	Guilford	0.002	0.1	0	0
[redacted]	Lexington	Davidson	0.220	320	122	27
[redacted]	Thomasville	Davidson	0.087	(No report)	0	35
[redacted]	Lexington	Davidson	0.065	2.5	0	0
[redacted]	Lexington	Davidson	0.006	0.1	0	0
[redacted]	Salisbury	Rowan	3.0	1420	1183	931
[redacted]	Landis	Rowan	0.005	113	7	1
[redacted]	Cooleemee	Rowan	0.899	82	2	35
[redacted]	Spencer	Rowan	522.0	53	0	0
[redacted]	Granite Quarry	Rowan	0.315	18	1	1
[redacted]	Salisbury	Rowan	0.020	1	0	0
[redacted]	Salisbury	Rowan	0.005	0.5	0	0
				Total #/D of Nutrients Entering H.R.L.	1763	1497
				Total #/D of Nutrients Discharged in H.R.L. by the Yadkin River alone	1640	1434

TABLE 3
ESTIMATED EFFICIENCY OF TREATMENT LEVELS

DOMESTIC SEWAGE TREATMENT LEVEL	PERCENT REMOVAL			
	CBOD	NBOD*	PHOSPHORUS (P)	TOTAL NITROGEN (N)
1	70	10	20	10
2	85	20	20	20
3	90	85	20	20

*Oxidizable Nitrogen

IV. WATER QUALITY STANDARDS

The North Carolina State Department of Water and Air Resources has promulgated water quality standards for all waters in the Yadkin River Basin[6]. The following table indicates the classification and minimum dissolved oxygen criteria which applies. There are no quantitative standards, as yet, for discharge of nutrients.

TABLE 4

River	Reach	Classification	Minimum D.O. mg/l
1. Yadkin	Main stem from Kerr Scott Reservoir to the Upper portion of the High Rock Lake.	A-II and B	4.0
2. High Rock Reservoir	--	A-II	4.0
3. Muddy Creek	From source to Yadkin	D	3.0
4. Salem Creek	From source to Winston-Salem Dam	A-II	4.0
5. Salem Creek	From Winston-Salem Supply Dam to Muddy Creek	D	3.0

V. WATER QUALITY

Water quality information collected by the State of North Carolina and the U. S. Geological Survey indicates that within the study area, the Yadkin River is generally of good mineral quality. However, dissolved oxygen concentrations do vary along the river particularly during the low flow summer months.

Table 5 presents a dissolved oxygen profile of the Yadkin River from Kerr Scott Reservoir to High Rock Lake.[9] This is the result of a field survey conducted during June 30 through August 5, 1970, by the North Carolina Department of Air and Water Resources. Dissolved oxygen concentrations in the river decreased from levels ranging from 5.6 to 6.9 mg/l upstream of the Muddy Creek confluence (RM 304) to an average of 2.4 mg/l seven miles downstream from this tributary. Muddy Creek carries the wasteload for the City of

TABLE

DISSOLVED OXYGEN DATA
YADKIN RIVER

Survey Date (USGS)	Test Site: River Mile:	1 390	2 388	3 372	4 313	5 304	6 297	7 293	8 292	9 284	10 285	11 279
		D. O. mg/l										
June 30/70		-	-	-	6.6	5.6	5.0	6.2	-	6.2	8.3	5.6
July 16/70		-	-	-	7.4	-	3.8	4.1	3.6	3.7	4.1	4.3
July 23/70		6.4	6.7	6.9	6.0	-	-	2.4	3.4	3.2	2.8	3.3
July 28/70		-	-	-	6.8	-	-	5.1	5.4	5.6	5.4	4.6
July 31/70		-	-	-	-	-	-	3.0	-	-	-	-
Aug. 5/70		-	-	-	6.6	-	-	4.6	3.6	3.7	3.2	3.7
Max.		-	-	-	7.4	-	5.0	6.2	5.4	6.2	8.3	5.6
Avg.		6.4	6.7	6.9	6.7	5.6	4.4	4.3	4.0	4.5	4.8	4.5
Min.		-	-	-	6.0	-	3.8	2.4	3.4	3.2	3.2	3.3

Winston-Salem to the Yadkin River. Table 5 also indicates that water quality is presently seriously degraded in this stream.

VI. CITY OF WINSTON-SALEM: EFFECTS ON THE YADKIN RIVER BASIN

The steps taken to evaluate the effects of this discharge are:

(a) Obtain a verified water quality model in the Yadkin River to simulate actual flow conditions in the stream during the 1970 survey.

(b) Apply the mathematical model to critical flow conditions, i.e., minimum 7-day, 10-year (7Q10) low flow frequency.

(c) Investigate present plans by the City of Winston-Salem for adequate treatment to control waste at the source.

(d) Apply the mathematical model under critical flow taking into account the city plans.

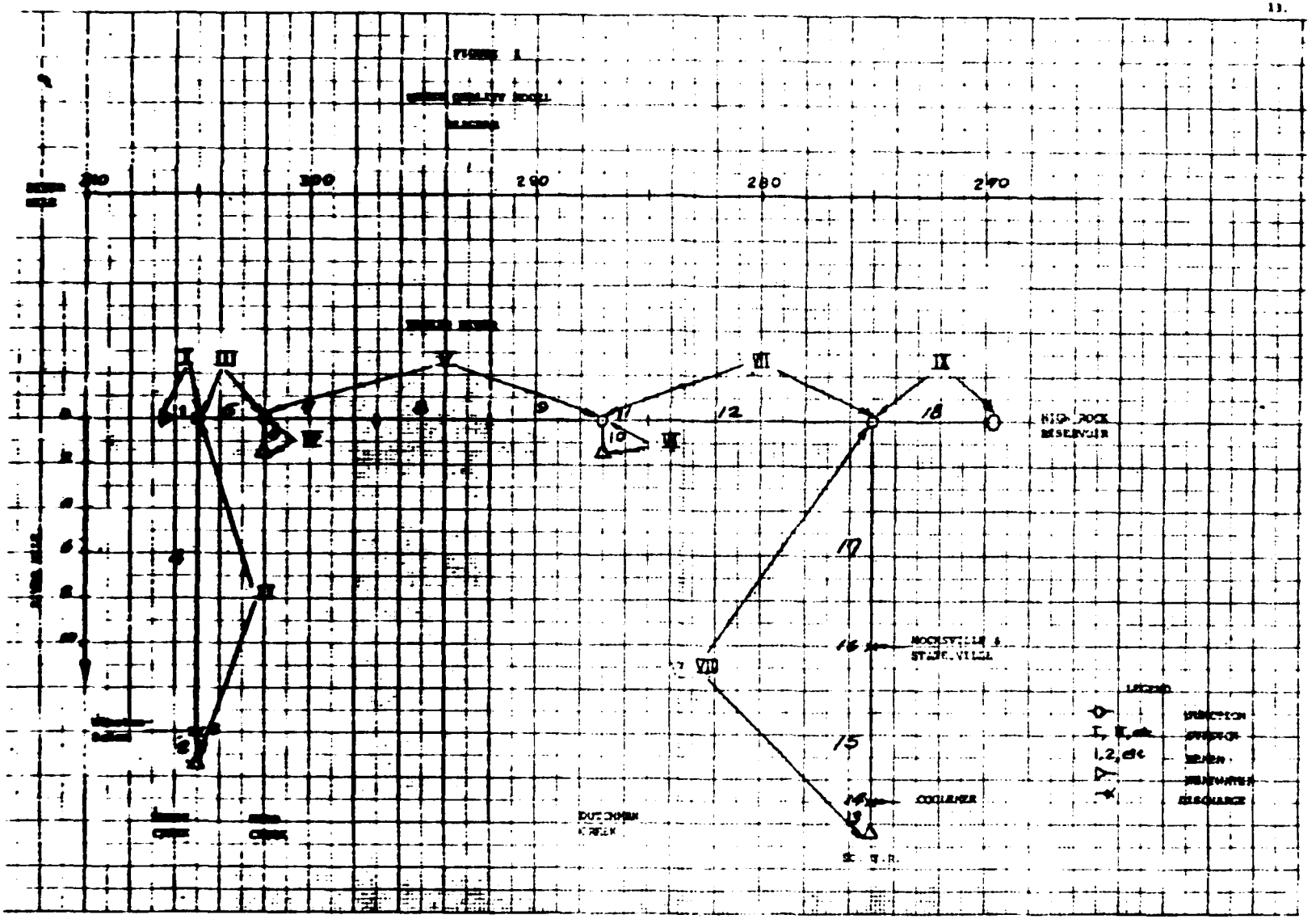
(e) Investigate possible needs for flow augmentation.

A. Verification of the Water Quality Model

The mathematical model used for this study is the DOSAG-1[10] developed by the Federal Water Pollution Control Agency, now EPA, and modified by the Texas Water Development Board. Figure 1 and Table 6 represent a graphical interpretation of the area under investigation for use as the DOSAG model.

The purpose of this model is to mathematically analyze the oxygen budget in a stream. From this analysis, the assimilative capacity of the stream can be determined. The model uses the modified Streeter-Phelps equation which includes the nitrogenous biochemical oxygen demand in addition to the carbonaceous demand, as a major dissolved oxygen sink within the stream system. Photo synthetic activity and benthal oxygen demand are not considered in the model.

The verification of the model consisted of using the data available to simulate the actual D. O. concentrations in the Yadkin River during the period of June 30 through August 5, 1970, survey. The input data for the verification consisted of: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HIGH ROCK RESERVOIR
ROCKSVILLE & STATE VILLE
COCHRANE
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII

TABLE 6

DESCRIPTION OF MODEL COORDINATES

Reach	Description
I - 1	Yadkin River - 1 mile upstream from Muddy Creek
II - 2	Muddy Creek - 1 mile upstream from Salem Creek
II - 3	Winston Salem waste load to Muddy Creek
II - 4	Muddy Creek to confluence with the Yadkin River
III-5	Yadkin River - Reach between Muddy Creek and Reed Creek
IV - 6	Reed Creek - Junction with Yadkin River
V - 7	Yadkin River - Quality reach
V - 8	Yadkin River - Quality reach
V - 9	Yadkin River - Quality reach
XI - 10	Dutchman Creek - Junction with the Yadkin River
VII - 11	Yadkin River - Quality Reach
VII - 12	Yadkin River - Quality Reach
VIII - 13	So. Yadkin River - 1 mile upstream from Coleeme waste load
VIII - 14	Coleeme waste load to So Yadkin River
VIII - 15	So. Yadkin River - Reach between waste load sources.
VIII - 16	Mocksville and Statesville waste loads to the So. Yadkin River
VII - 17	So. Yadkin River to confluence with Yadkin
IX - 18	Yadkin River - Reach between So. Yadkin River confluence and High Rock Reservoir.

(1) Hydrology: The stream flows used in this study were obtained at the following reference stations[11]. Flows obtained at these stations consisted of the actual stream flows during the 1970 survey.

TABLE 7

USGS Gaging Station No.	Location	USGS River Mile (Yadkin)
2-1159.76	Yadkin River at Arcadia	303
2-1165.00	Yadkin River at Yadkin College	295
2-1210.00	Yadkin River near Salisbury	270
2-1158.0	Silascreek near Clemmons	-
2-1158.1	Muddy Creek near Clemmons	-
2-1158.5	Salem Creek at Winston-Salem	-
2-1158.6	Muddy Creek near Muddy Creek	-
2-1159	So. Fork Muddy near Clemmons, N. C.	-
2-1190	So. Yadkin River at Coleemee	-

(2) Hydraulics: Stream velocities and surface level heights are based primarily on the observation of two USGS stations[12]:

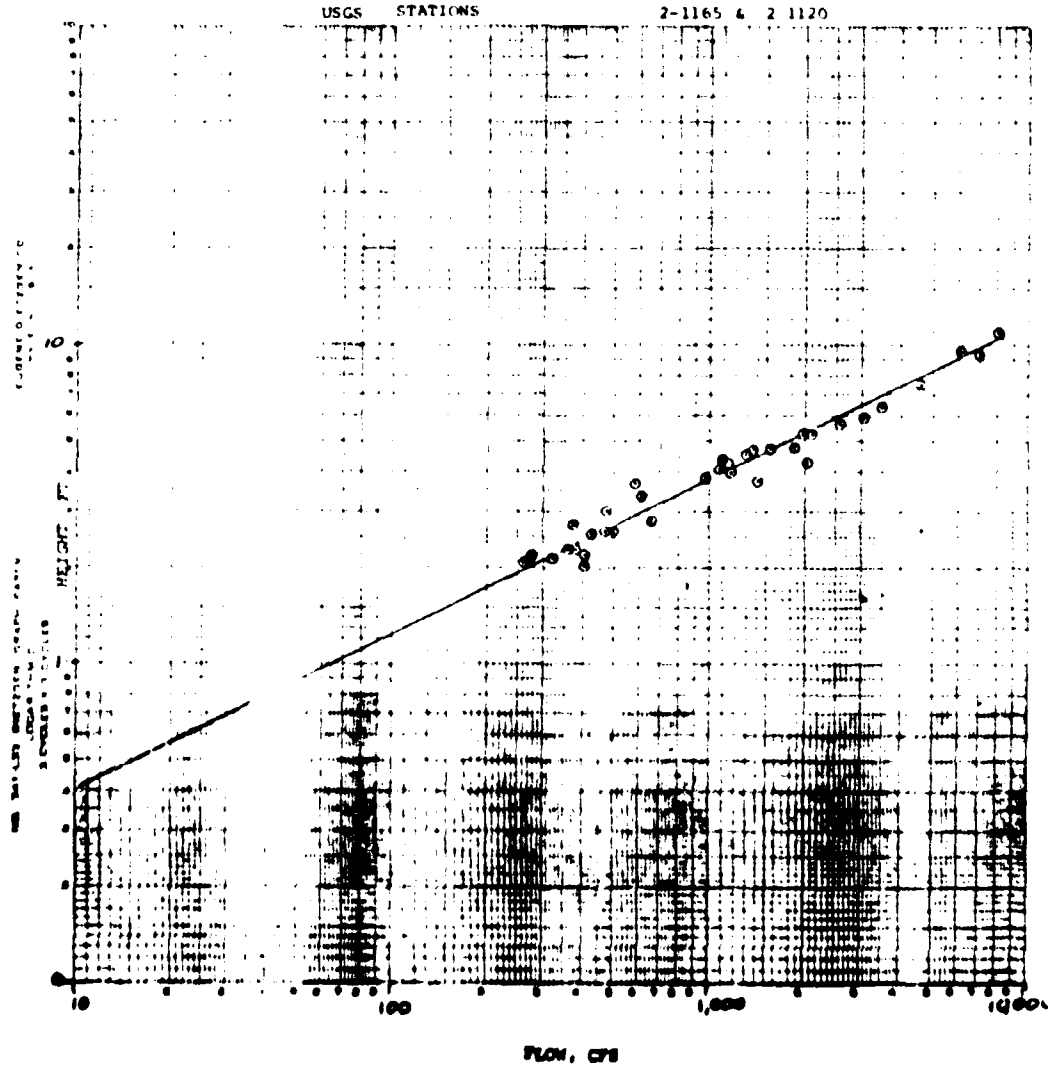
(a) 2-1165 "Yadkin River at Yadkin College"

(b) 2-1120 "Yadkin River at Wilkesboro"

The latter station is closer to the mouth of the Yadkin River and it was used to simulate the hydraulic characteristics of the Yadkin River tributaries. Figures 2 and 3 show the relation-

FIGURE 2

STREAM FLOW VS. HEIGHT



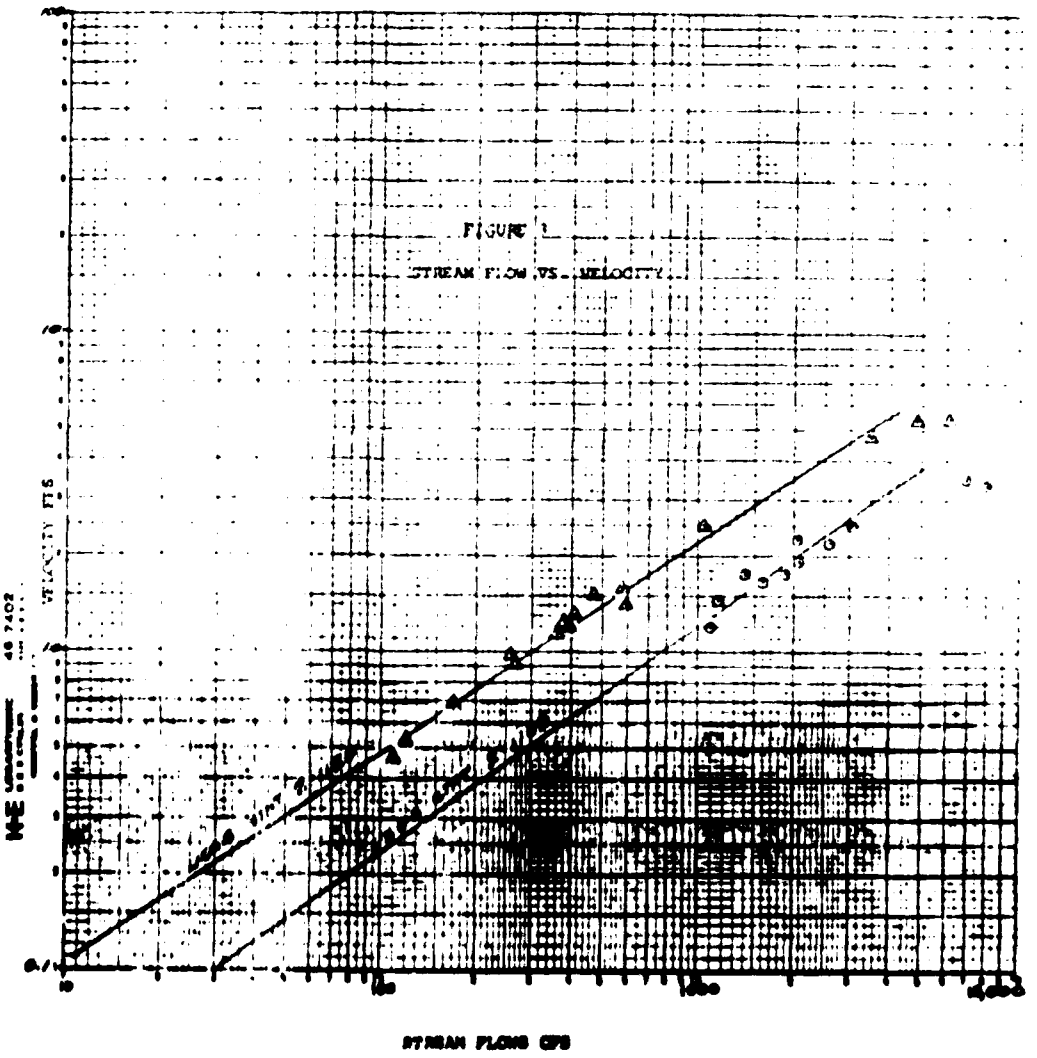


FIGURE 1
STREAM FLOW VS. VELOCITY
VELOCITY FPS
STREAM FLOW CFS

ship between stream flow and velocity and stream flow and height used for the model. Streambed slopes are obtained from the Yadkin River cross section provided by the U. S. Army Corps of Engineers in Charleston, South Carolina[1].

(3) BOD Decay Rates

BOD data is limited in this stretch of the river. BOD_5's available from field data[9] indicate a carbonaceous oxidation rate in the Yadkin River of 2.2/day (base e, at 20°C) from 7 to 16 miles downstream from the Muddy Creek confluence and 0.865/day (base e, at 20°C) from 16 to 34 miles downstream from the same confluence. The 2.2/day rate is typical of waste discharges which are relatively high in suspended and settleable material. This high rate reflects the settling as well as oxidation of the waste material. The 0.865/day rate is closer to the "normal" biochemical oxidation decay in a river. Both of these coefficients are higher than normal decay rates for well treated effluents (0.1 to 0.6/day)[13] and probably is due to the poor treatment taking place at the City of Winston-Salem plant during the time these data were collected. A more normal decay rate should be exhibited after waste treatment improvements are made by the City of Winston-Salem. These improvements are scheduled for completion during 1973.

The nitrogenous BOD decay coefficient is assumed due to the lack of field data, however, a value of 0.7/day fits the actual dissolved oxygen sink occuring in the Yadkin River. Again a lower value of between 0.1 to 0.6/day[13] should develop after improved waste treatment facilities are completed during 1973.

(4) Waste Loads

Estimates of an average waste load for NBOD and CBOD were made for the City of Winston-Salem. Although the city is served by a 18 MGD secondary treatment trickling filter plant, this system is over loaded. Flows from the plant were reported as 32 cfs (20.8 MGD) during July 1970[6]. Biochemical oxygen demands measured 0.3 miles downstream from Salem Creek varied from 300 to 400 mg/l during the time of the June-August 1970 survey[14]. This load is equivalent to 127,000 #/day of ultimate oxygen demand from the plant

TABLE 8

PARAMETERS USED FOR WATER QUALITY MODEL

Reach	July-Aug. 1970 Flow cfs	Slope Ft/Mile	Velocity FPS	Reaeration Rate K_2	CBOD & NBOD Decay Rates K_1 K_1^N		Waste Flow CFS	Waste CBOD MG/1	Waste NBOD MG/L
I - 1	1189.0	1.4	1.35	1.35	0.0	0.0			
II - 2	68.0	1.4	0.37	0.37	0.0	0.0			
II - 3	100.0	1.4	0.48	0.48	0.158	0.0	1.0	367.0	367.0
II - 4	100.0	1.4	0.48	0.48	0.158	0.0			
III - 5	1293.0	1.4	1.45	1.45	2.200	0.0			
IV -6	11.0	1.4	0.11	0.110	0.0	0.0			
V-7	1300.0	1.4	1.45	1.45	2.200	0.0			
V- 8	1300.0	1.4	1.45	1.45	2.200	0.0			
V - 9	1300.0	1.4	1.45	1.45	2.200	0.0			
V-10	50.0	1.4	0.30	0.30	0.0	0.0			
VII-11	1350.0	1.4	1.50	1.5	0.865	0.7			
VII-12	1350.0	1.4	1.50	1.50	0.865	0.7			
VIII-13	124.3	1.4	0.55	0.55	0.00	0.0			
VIII-14	124.5	1.4	0.55	0.55	0.0	0.0	0.2	270	162
VIII-15	124.5	1.4	0.55	0.55	0.0	0.0			
VIII-16	128.0	1.4	0.56	0.56	0.0	0.0	3.5	37.2	121
VIII-17	128.0	1.4	0.56	0.56	0.0	0.0			
IX-18	1478.0	1.4	1.60	1.60	0.865	0.7			

effluent. The above waste load is a realistic figure considering that during the July-August 1970 period, the average discharge from the plant was 32 cfs and the Salem Creek flow averaged only 15 cfs upstream from the plant.

Three other waste sources are also included in the math model. However, the influence of these sources in the water quality of the Yadkin River are negligible in comparison with Winston-Salem's.

All three of these sources discharge into the So. Yadkin River. These are the waste treatment plants at Coleemee, Mocksville, and Statesville.

A summary of the main parameters used for the water quality model are summarized in Table 8 and the analytical results of the mathematical model are compared in Figure 4 to the actual field data.

The math model output simulates the actual field data within ± 0.25 mg/l. This accuracy is considered appropriate considering the limited amount of data available in this stretch of the river.

B. Application of Water Quality Model Under Critical Flow Conditions

Upon verification of the water quality model, 7-day, 10-year low flow conditions were then evaluated. The 7-day, 10-year low flow condition is included in the North Carolina standards and is the base flow against which water quality is evaluated. This particular evaluation indicates existing dissolved oxygen conditions during critical flow conditions subjected to present waste loads. The following is a summary of the 7Q10 flows used in the model and the dissolved oxygen (D.O.) concentrations obtained:

TABLE 9

Model Reach	Description	7Q10 Flow, cfs(2)	Range of D.O. in Reach mg/l
I - 1	Y.R.* upstream of Muddy Creek confluence	620	7.02
II - 2		23	
II - 3		60	
II - 4		90	

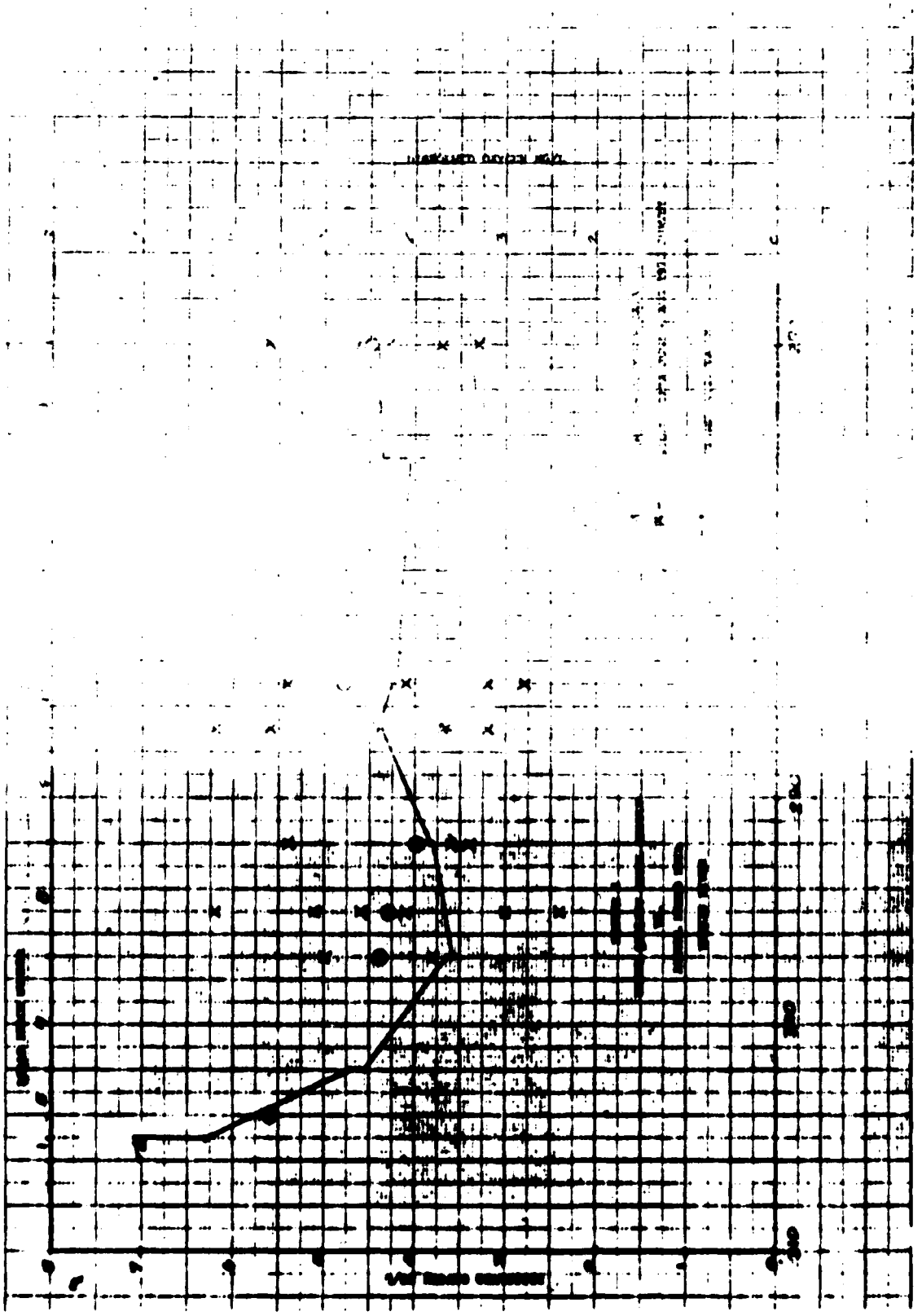
Model Reach	Description	7Q10 Flow, cfs[2]	Range of D. O. in Reach mg/l
III - 5	Y.R.-0 to 3 miles downstream from Muddy Creek confluence	710	5.79-2.84
IV - 6		10	
V - 7	Y.R.-3 to 8 miles downstream from Muddy Creek	720	2.84-3.16
V - 8	Y.R.-8 to 13 miles downstream from Muddy Creek	720	3.24-3.1
V - 9	Y.R.-13 to 18 miles downstream from Muddy Creek	40	
VII - 11	Y.R.-18 to 20 miles downstream from Muddy Creek	760	3.81-3.82
VII-12	Y.R.-20 to 25 miles downstream from Muddy Creek	760	3.21-3.11
VIII - 13		111.3	
VIII - 14		111.3	
VIII - 15		111.3	
VIII - 16		113.1	
VIII - 17		113.0	
IX - 18	Y.R.-30 to 35 miles downstream from Muddy Creek	880.0	0.94-0.73

* Y.R. (Yadkin River)

The above results indicate that due to the present discharges from the City of Winston-Salem, not including the improvements scheduled for completion during 1973, the water quality of the Yadkin River would be extremely degraded under critical 7-day, 10-year flow conditions. The water quality standards for this stretch of the river calls for a minimum D. O. concentration of 4.0 mg/l with minimum daily average of 5.0 mg/l.

C. <u>City Plans for Wastewater Treatment Improvements and Water Quality Effects on the Yadkin River</u>

The City of Winston-Salem is currently upgrading its waste treatment facilities. Information obtained



from the city indicates that these improvements are scheduled to be completed during the summer of 1973. The proposed project includes increasing the existing secondary treatment facilities to a capacity of 36 MGD. In addition, the city wastes are planned to be treated by a conventional activated sludge process in place of the present trickling filter system[15]. Present average flow entering the plant is about 25 MGD with a BOD_5 of 400 mg/l[16]. Over 75% of the BOD entering the plant is actually contributed by industry such as the tobacco, textile, dairy, and brewary firms which reside in the area. The proposed facility will reach its design capacity between 1985 and 1990. At that time, it is projected an average flow of 36 MGD entering the plant with a BOD_5 of 600 mg/l[15].

The assumptions made to evaluate the effects of the proposed facility on the quality of the Yadkin River are:

(a) Ultimate BOD = 1.1 times the BOD_5

(b) The raw waste consist of 50% carbonaceous BOD and 50% nitrogenous BOD.

(c) Estimated BOD removals are 90% for carbonaceous BOD and 20% for nitrogenous BOD.

The effects of these improvements are evaluated using the previously developed mathematical model. The following is a summary of the dissolved oxygen concentrations expected to occur in the Yadkin River after completion of the city's waste treatment plant:

TABLE 10

Reach*	D. O. Change in Reach, mg/l**	
	Prior to Winston-Salem Improvements	1973 After Improvements
I-1	7.02	7.02
III-5	5.79-2.84	6.71-6.08
V-7	2.50-0.36	5.99-5.45
V-8	0.24-0.00	5.41-5.27
V-9	0.02-0.51	5.26-5.34
VII-11	0.81-0.32	5.41-5.49
VII-12	0.21-0.00	5.51-5.74

Reach*	D. O. Change in Reach, mg/l**	
	Prior to Winston-Salem Improvements	1973 After Improvements
IX-18	0.94-0.73	5.89-6.09

* See pages 13 and 14 for identification of each reach.

** Under 7-day, 10-year flow condition.

The results of the model show that the proposed Winston-Salem plant will meet water quality standards, and no flow augmentation is needed at the present time.

It is evident, however, that with the increase in the average waste flow and BOD concentrations, water quality violations will occur in the Yadkin River before the plant reaches its design capacity in 1985. This will be due primarily to the effects of NBOD in the Yadkin River. This can be avoided by providing the plant with a nitrification capability prior to 1985.

Figure 5 shows four calculated D. O. profiles of the Yadkin River below the Muddy Creek confluence during 7-day, 10-year critical flows.

Profile A shows present conditions of the Yadkin River at the 7-day, 10-year low flow conditions.

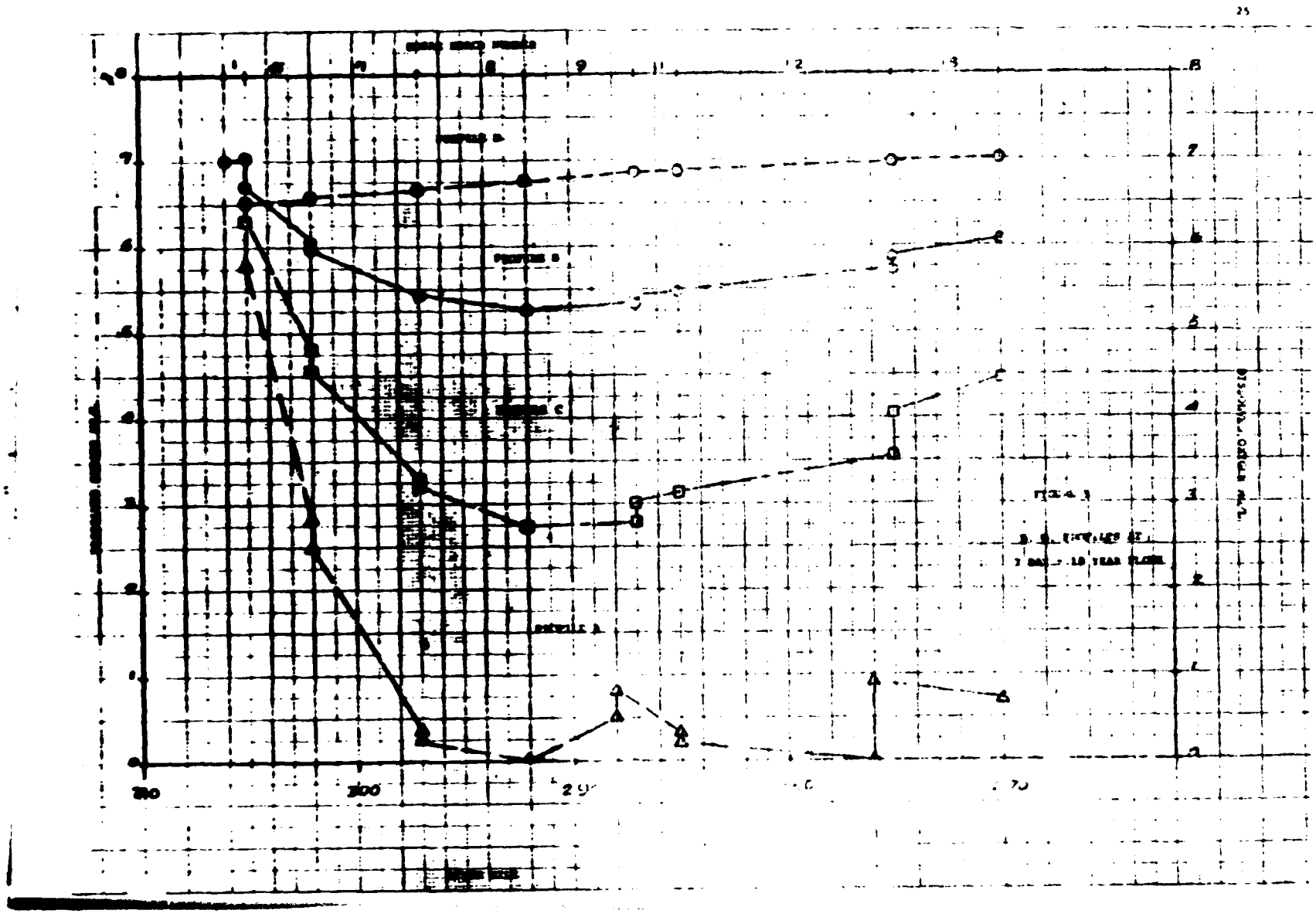
Profile B simulates the D. O. profile after upgrading of the waste treatment facilities at Winston-Salem. (This assumes removal of 90% of the CBOD and 20% of the NBOD.

Profile C forcasts the decrease in D. O. in the river due to the increases in waste flow from 25 MGD to 36 MGD and the higher influent BOD_5 concentrations from 400 to 600 mg/l using the treatment system now nearing completion.

Profile D assumes the upgrading of the city's treatment plant to include nitrification of wastes at the source sometime prior to 1985. The BOD removals are assumed as 95% carbonaceous and 85% nitrogenous.

D. EPA Policy on Storage and Releases for Water Quality Control in Reservoir Planned by Federal Agencies

Section 102(b) of the Federal Water Pollution Control Act Amendments of 1972 requires, in part, that in the planning of any reservoir by a Federal agency, inclusion of storage for regulation of stream flow



shall be considered, except that such storage shall not be provided as a substitute for adequate treatment or other methods of controlling waste at the source.

Based on the results of this study, the City of Winston-Salem will meet water quality standards in the Yadkin River assuming that adequate treatment of wastes is always implemented. Therefore, flow augmentation at the proposed reservoir in the Reddies River will not be needed for maintaining the minimum dissolved oxygen standards in the Yadkin River.

VII. NUTRIENT ENRICHMENT OF HIGH ROCK LAKE

Nutrient enrichment of High Rock Lake is another area where a critical water quality management problem may exist in the basin. Carbon, nitrogen and phosphorus are primary constituents in the cell structure of all green plants. The sustained growth of these plants is dependant upon the availability of these nutrients and the extent to which they flourish in the aquatic environment is, to a great extent, a function of the concentrations of these compounds in lakes and streams. The overabundance of nutrients in water bodies may result in "nutrient enrichment," often leading to accelerated growths of algae and aquatic vegetation. The condition resulting from this phenomena is referred to as "eutrophication," typified by severe diurnal dissolved oxygen fluctuations, and imparting of an unesthetic color, odor and taste to the water, and a general unbalance in the natural ecological processes of the water body.

Lakes provide an environment especially conducive to nutrient enrichment and therefore, become the focal point for eutrophication problems.

A. Current Nutrient Concentration Levels in the Yadkin River

A total of 12,015 # of total nitrogen and 7,209 # of total phosphorus are discharged daily from industrial and domestic sources into the Upper Yadkin River Basin. The location and magnitude of these sources are summarized on Tables 1 and 2 of this report. These nutrients are carried by the Yadkin River and other minor streams into the High Rock Lake. The actual nutrient load entering the High Rock Lake daily in Yadkin River waters alone is 10,403 # total N and 6,246 # of total P. Therefore, the present annual average nutrient concentration at the confluence of the Yadkin River and High Rock Lake are 0.48 mg/l of total N and 0.266 mg/l of total P These values are obtained by using the point

source nutrient loads and the 42-year average flow 4,350 cfs in the Yadkin River at the upper portion of the lake. During extended low flow periods, which often occur in the summer and fall, computed concentrations could be substantially above these levels.

No actual field data was found to relate the contribution of these nutrients to the trophic state of the High Rock Lake. The Federal Water Pollution Control Administration (now EPA) has suggested, however, that "to prevent biological nuisances, total phosphorus should not exceed 0.1 mg/l P at any point within the flowing stream, nor should 0.05 mg/l be exceeded where waters enter a lake, reservoir, or other standing water body."[17] The same report also cites that Muller (1953) concluded that excessive growth of plant and algae in polluted water can be avoided if the concentration of total nitrogen is not allowed to rise much above 0.6 mg/l.

It can be concluded from the above findings that the present nutrients discharges in the basin will tend eventually to accelerate eutrophication of the lake, and increase algae growth in the receiving stream waters if other factors do not limit. The following table is a comparison of the average nutrient levels in the Yadkin River water entering the lake and the suggested maximum concentration levels for prevention of algae growth in a lake:

TABLE 11

NUTRIENT CONCENTRATION, mg/l

	Total N	Total P	Reference
Recommended maximum	0.6	0.05-0.10	FWPCA[5]
1972 Actual concentration at 42 year avg. flow	0.44	0.266	

B. **Theoretical Nutrient Effects at High Rock Lake**

No simple relationship can be expected among nutrient loading, nutrient concentration, and the rate of eutrophication in a lake because of a variety of other

influencing factors such as depth, extent of shoreline, flow-through and detention time. Nevertheless, analyses performed by Vollenweider and NERP*[10] indicates that nutrient loading rates are more significant in evaluating the trophic state of a lake than the maximum concentration. The following table provides a tentative practical guideline developed by NERP which suggests permissible loading rates to prevent eutrophication of a lake.

TABLE 12

PERMISSIBLE LOADING LEVELS FOR TOTAL NITROGEN AND TOTAL PHOSPHORUS (g/m^2 - YEAR)[6]

Mean Depth up to	Permissible Loading up to		Dangerous Loading in Excess of	
	N	P	N	P
4.7 m	0.98*	0.066*	1.8*	0.12*
5 m	1.0	0.07	2.0	0.13
10 m	1.5	0.10	3.0	0.20
50 m	4.0	0.25	8.0	0.50
100 m	6.0	0.40	12.0	0.80
150 m	7.5	0.50	15.0	1.00
200 m	9.0	0.60	18.0	1.20

* extrapolated, log-log relationship

High Rock Lake has a active volume of 235,000 ac-ft and a surface area of 15,000 acres.[4] The mean depth of the lake is 15.5 feet or 4.7 meters. The lake receives a daily load of 12,015 # of total nitrogen and 7,209 # of total phosphorus, which is equivalent to a loading of 1.85 g/m^2-yr and 1.11 $g/m/m^2$-yr, respectively. The following conclusions can be arrived at by comparing these nutrient loadings with the previous suggested dangerous loading criteria.

(1) Total nitrogen loading rates have reached the dangerous levels.

(2) Total phosphorus loading rates have exceeded the dangerous levels by tenfold.

National Eutrophication Research Program, EPA

C. Alternatives to the Reduction of Nutrients in the Upper Yadkin River Basin

It is evident that nutrient discharges in the basin are sufficient to cause concern about possible eutrophication of High Rock Lake. In order to decrease the rate of eutrophication two possible alternatives could be used: (a) flow augmentation and/or (b) treatment for removal of nutrients at the source.

To reduce total phosphorus concentrations from 0.266 to 0.05 mg/l by flow augmentation would require a five-fold increase in the average flow of the Yadkin River at the conflence with High Rock Lake. The 42 year average flow at this location is 4,350 cfs. This alternative amounts to a physical impossibility. The reduction of the nutrient levels by adequate treatment at the source would be the more feasible answer to prevent the increase in rate of eutrophication of High Rock Lake. Improvements to this effect can be achieved by providing each treatment plant with both phosphorus and nitrogen removal capability. An estimated 84% of the total N and 77% of the total phosphorus discharged into High Rock Lake by the Yadkin River came from domestic sources.

It should be further noted that techniques which are presently available for phosphorus and nitrogen removal require that a high degree (95% or greater) of biodegradeable organics also be removed from raw wastewaters to insure efficient nutrient separation. At these treatment levels residual BOD discharges to the Yadkin River would not violate dissolved oxygen standards. Therefore, if phosphorus and/or nitrogen removal becomes a water quality management objective for the upper Yadkin Basin, it is apparent that flow augmentation designed to improve dissolved oxygen levels would not be required. This further substantiates the previous conclusion that flow augmentation from the proposed Reddies River Reservoir would provide no justifiable benefit to water quality in the Yadkin River Basin.

III. CONCLUSIONS AND RECOMMENDATIONS

As a result of this study, it can be concluded and recommended that:

(1) A potential water quality management problem exists in the Yadkin River below the confluence with Muddy Creek.

(a) The City of Winston-Salem's wastes do and will

continue to degrade the Yadkin River, under critical flow conditions until the improvements scheduled for completion during 1973 are implemented.

(b) In the future, minimum dissolved oxygen standards should be met in this stretch of the Yadkin River as long as adequate treatment of the city's wastes is always implemented. Nitrification should be added to the plant capabilities prior to 1985.

(2) The nutrient loads entering the High Rock Lake in the Yadkin River waters will tend to accelerate the rate of eutrophication in the lake. Also, the total nitrogen loading rates have reached the dangerous levels in High Rock Lake, and the total phosphorus loading rates have exceeded the dangerous levels by tenfold.

(a) A five-fold increase in the average flow of the Yadkin River at High Rock Lake would be required in order to reduce the present total phosphorus concentrations to the recommended levels. The 42 year average flow of the Yadkin River at High Rock Lake is 4,350 cfs.

(b) The reduction of nutrient levels by adequate treatment would be a more feasible answer to prevent the increase in the eutrophication rate of the lake.

(c) Phorphorus and nitrogen removal capability should be provided primarily to domestic waste sources as they account for 84% of the total N and 77% of the total P discharged into the lake.

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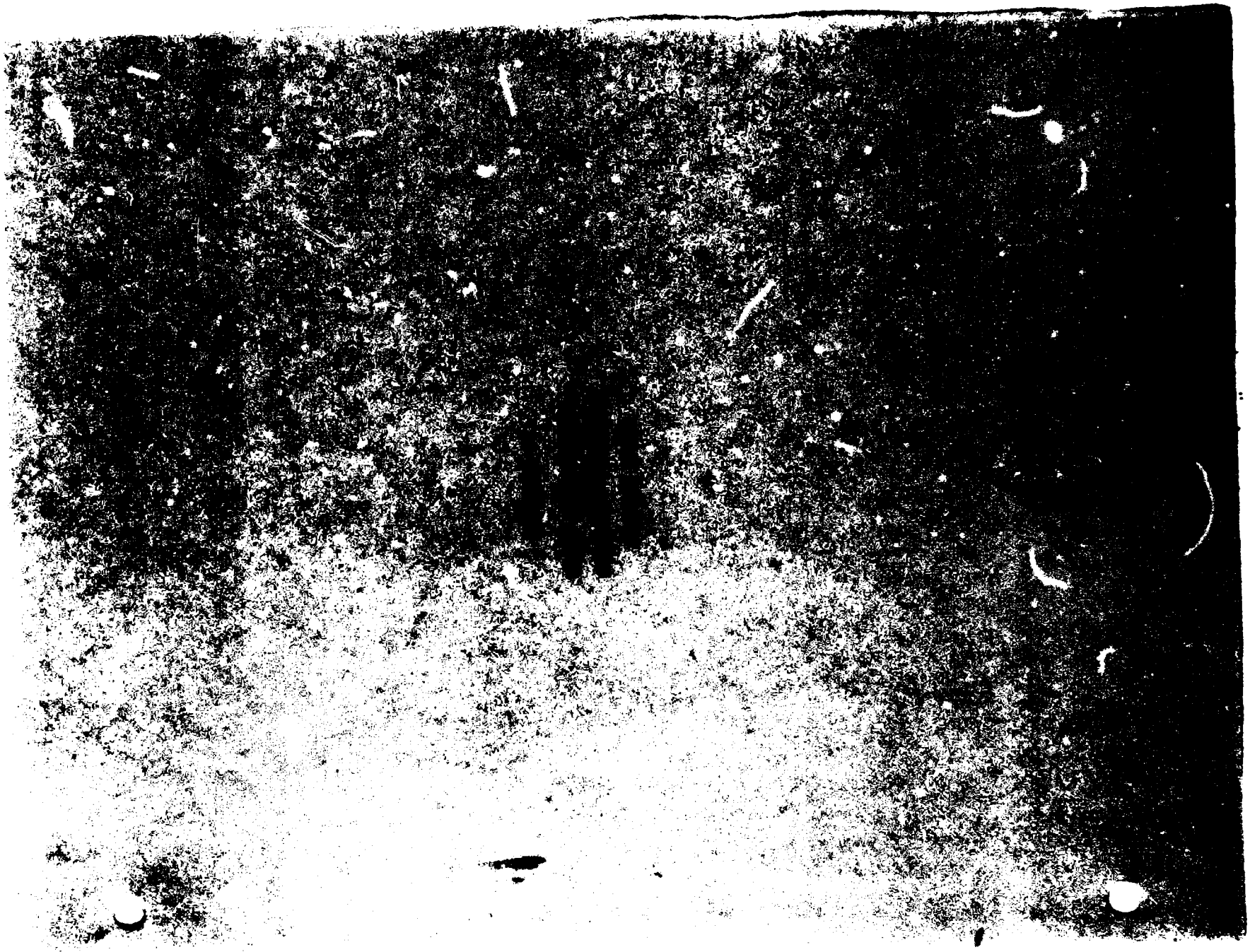
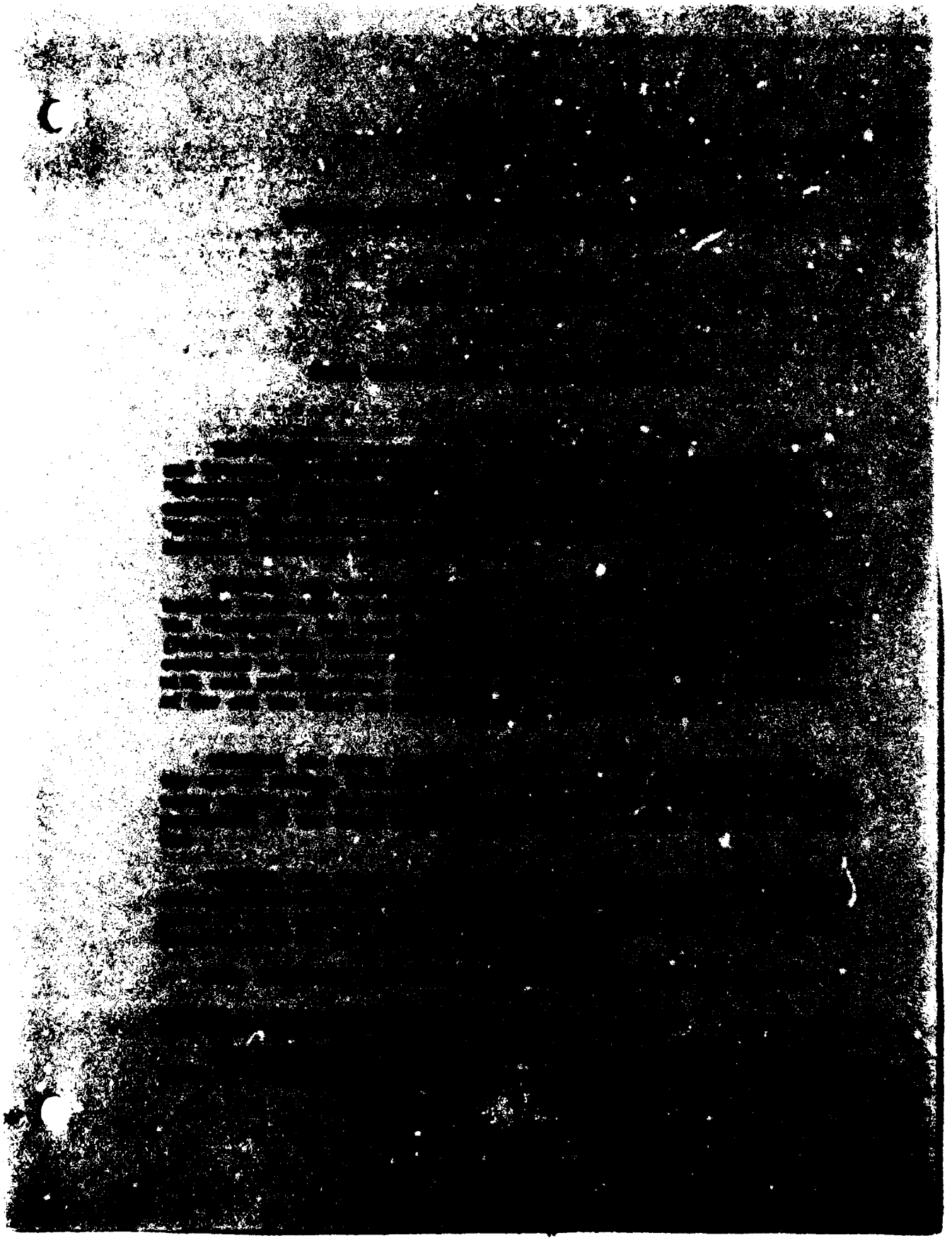
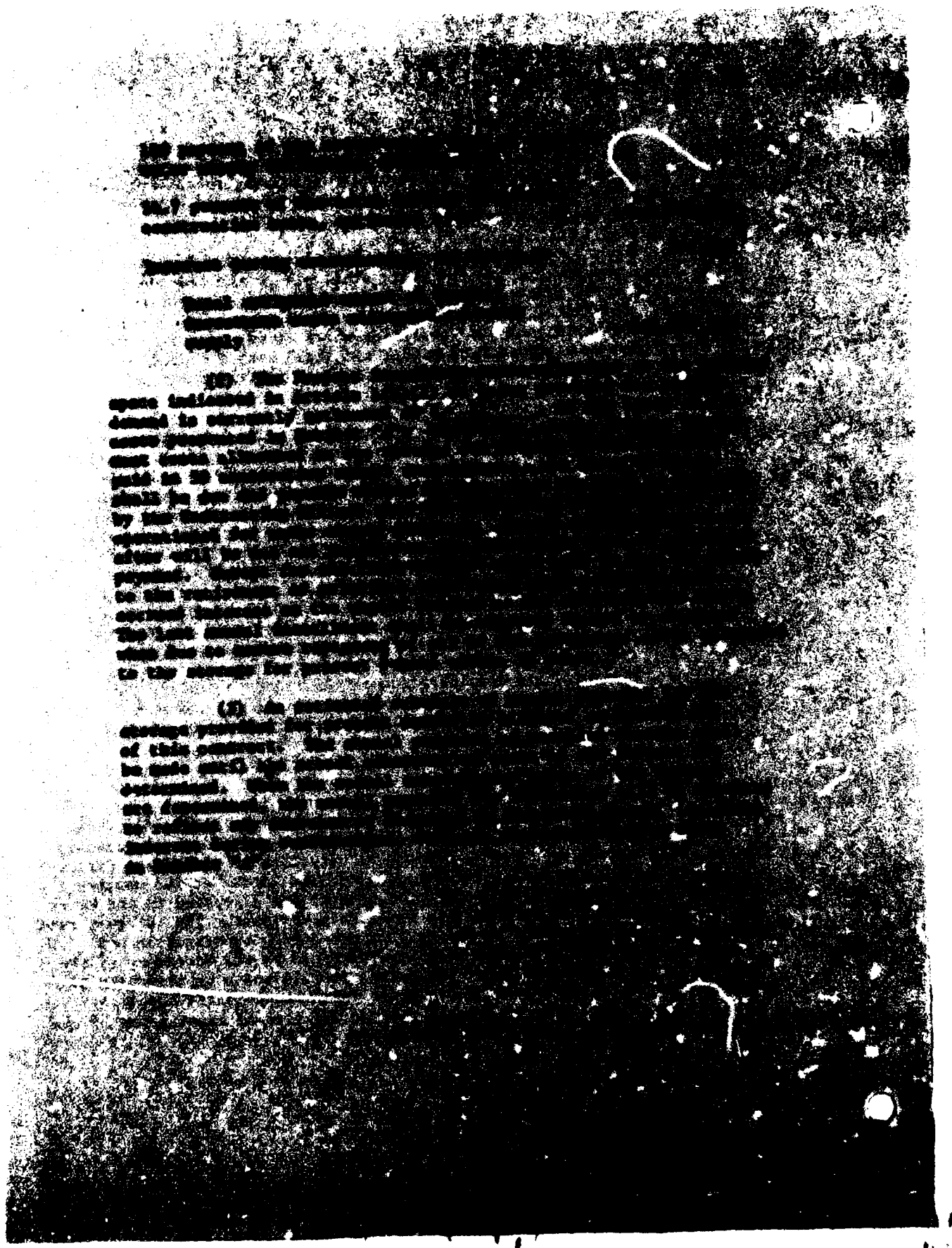
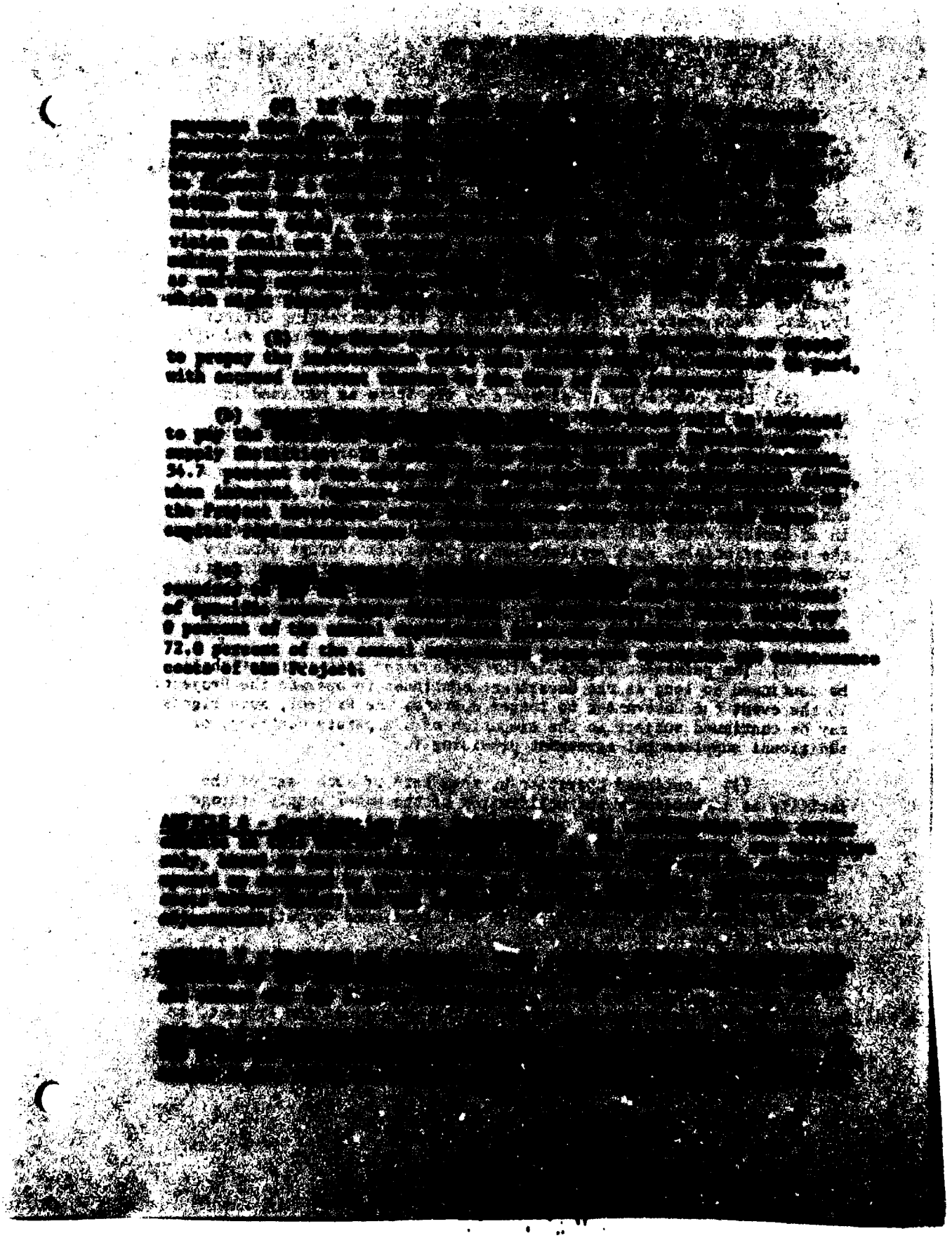
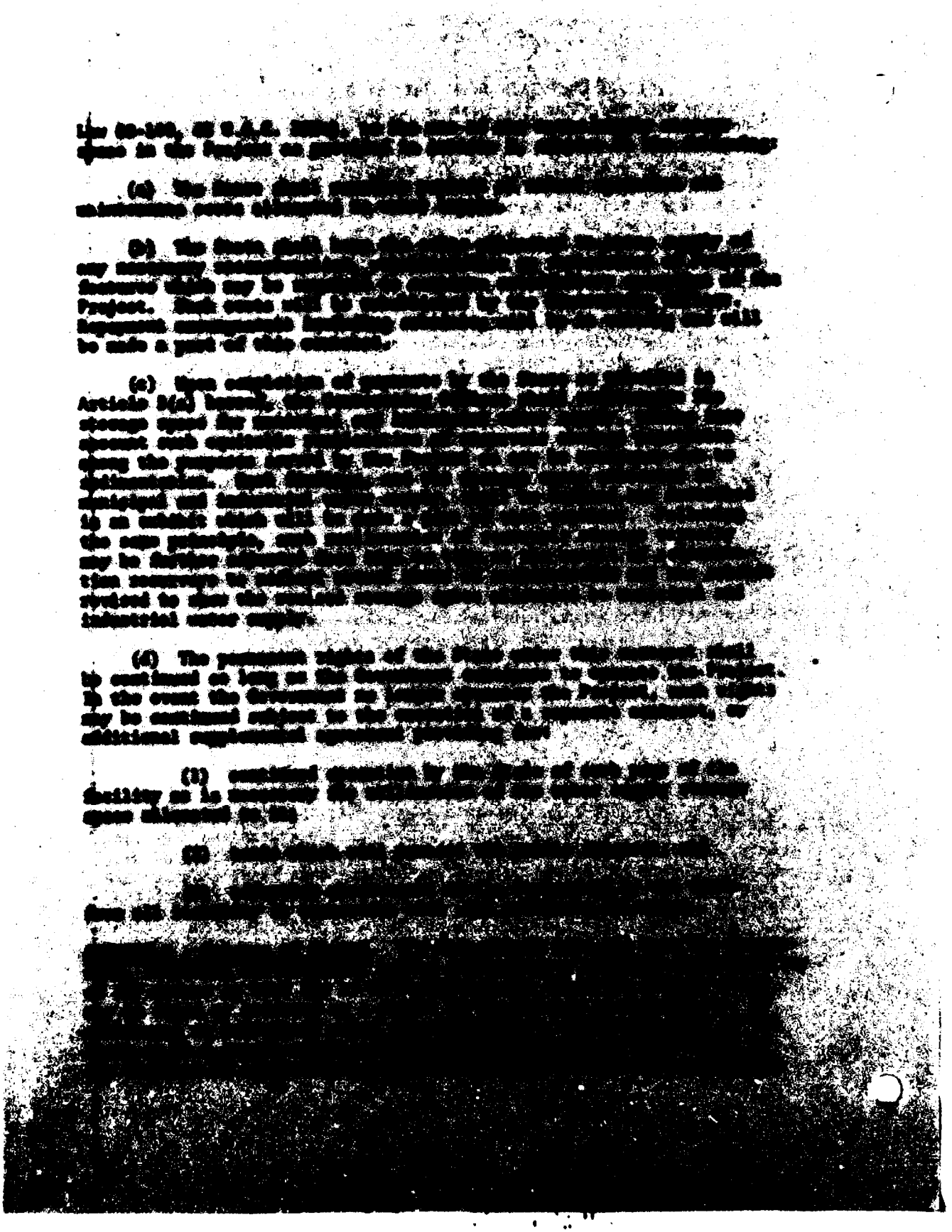










327-333); and Title 29, Code of Federal Regulations, Part 3.

(b) The Grant Recipient, as part of [illegible] (Exhibit "C") that it will comply with Title VI [illegible] of 1964 (78 Stat. 241, 42 U.S.C. 2000d et seq.) [illegible] Executive Order 11246 issued pursuant thereto and published in Part 60 of Title 41, Code of Federal Regulations.

ARTICLE II - Definitions

(a) Joint-use costs - The costs of [illegible] and [illegible] more project purposes.

(b) Project Purposes, costs - The several uses of the Project, including: land acquisition; conservation, control, [illegible] on the value of land, labor, and materials [illegible] and construction of the Project.

(c) Specific costs - The costs of project features [illegible] only one particular project purpose.

(d) Interest during construction - In the case of [illegible] except as [illegible] the period [illegible] the project purpose [illegible] only available [illegible]

ARTICLE III - [illegible] of the Project, [illegible]

In witness whereof, the parties [illegible] as of the day and year first [illegible]

The United States of America

By [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

This agreement is reviewed and approved for legal sufficiency as a binding legal obligation on the State of North Carolina consistent with Title III of Public Law 88-500, and with Chapter 1971 of 1967 North Carolina Session's Laws (General Statute 143-324).

APPROVED:

By _____ (Assistant Attorney General)
ATTORNEY GENERAL
State of North Carolina

Date _____

APPROVED:

By _____
[redacted]

Date _____

EXHIBIT A

DETERMINATION OF CHARGES TO STATE OF SOUTH CAROLINA

I - Project Features

Purpose	Elevations (feet, above m.s.l.)	Storage (acre-feet)
Flood control	1076.5-1120.0	35,000
Conservation	1020.0-1076.5	23,000
Water supply		18,400
Regulation of streamflow		600
Inactive	975.0-1020.0	4,000
Total	975.0-1120.0	58,000

II - Project Costs

Total Project Costs

Construction expenditures	$21,000,000
Interest during construction	[illegible]
Investment	$22,[illegible]
Specific flood cost	4,[illegible]
Joint-use flood cost	17,050,000
Joint-use interest during construction	
[illegible] x 1,000,000	[illegible]
Joint-use investment	$18,[illegible]

State of South Carolina Costs

Specific flood cost	$ 0
[illegible]	3,765,000
[illegible]	3,765,000
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	54.7

III - [illegible]

[illegible] $[illegible]

EXHIBIT A (Continued)

Annual charges are based on FY 75 interest rate applicable to water supply of 4.371 percent, a 50-repayment period, 49 with interest and a capital recovery factor of 0.047470.

IV - Annual Operation & Maintenance Costs

Total project joint-use annual operation and maintenance costs	$100,000
O&M costs allocated to water supply (72.0 percent of total)	72,000

Estimated O&M charges to state of North Carolina.

Period		Annual Charge
1982-Life of Project	100/100 x $72,000	$72,000

[illegible]

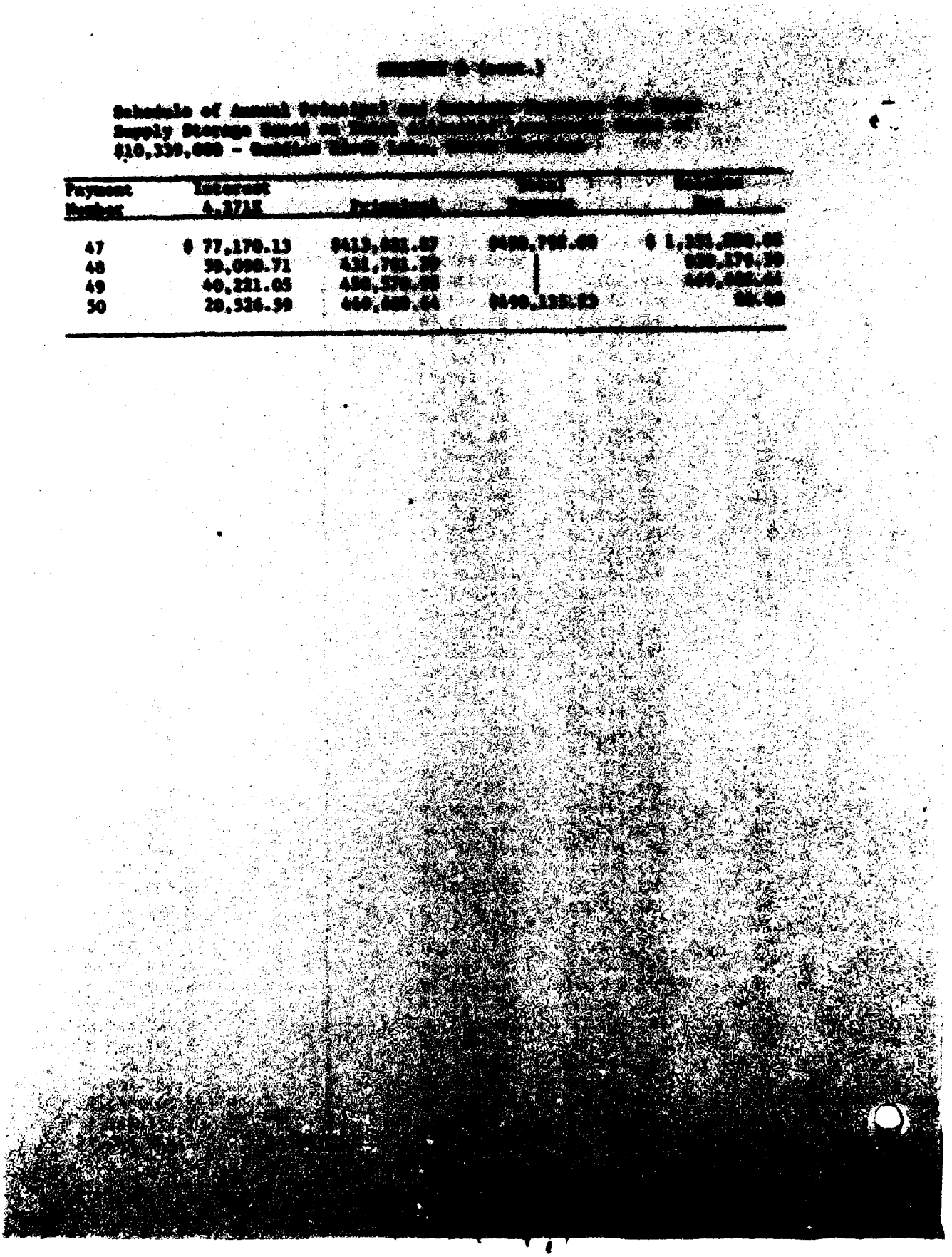
Schedule of Annual Principal and Interest Payments for Water Supply Example Bond on Bond Authorized Hereunder Issue of $10,330,000 - Bobbins Water Lake, North Carolina

Payment Number	Interest	Principal	Amount	Balance
				$10,330,000.00
1	-	$100,700.00	$100,700.00	9,846,300.00
2	$430,445.17	99,334.83		9,747,965.17
3	427,838.29	65,963.71		9,734,917.46
4	425,676.17	65,713.83		9,659,203.63
5	422,288.74	69,388.26		9,590,615.38
6	419,285.71	71,358.29		9,519,257.08
7	416,676.67	74,715.33		9,444,311.85
8	412,818.86	77,981.14		9,366,330.54
9	409,482.31	82,209.69		9,284,060.85
10	405,844.76	84,967.24		9,199,993.61
11	402,131.72	88,668.28		9,111,325.33
12	398,256.58	92,255.42		9,018,797.71
13	393,221.65	96,380.35		8,922,217.36
14	388,089.12	100,681.88		8,821,415.48
15	383,384.87	105,099.13		8,716,987.35
16	378,885.43	109,501.57		8,607,485.78
17	374,185.79	114,099.21		8,493,386.57
18	371,176.35	119,413.65		8,373,179.12
19	365,847.95	124,984.05		8,247,333.07
20	360,491.82	130,359.18		8,117,034.09
21	354,795.56	135,991.44		7,981,097.65
22	348,851.16	141,960.84		7,839,896.81
23	342,646.92	148,141.08		7,690,951.73
24	336,171.50	154,686.50		7,536,331.23
25	329,413.04	161,578.96		7,374,952.27
26	322,359.16	168,435.84		7,206,516.43
27	314,996.96	175,791.04		7,030,724.39
28	307,312.96	183,675.04		6,847,245.35
29	299,293.60	192,106.40		6,655,244.44
30	290,923.66	200,677.34		6,454,677.11
31	282,186.39	209,865.61		6,244,971.31
32	273,066.34	219,787.66		6,025,017.75
33	263,546.50	229,607.50		5,795,810.25
34	253,610.03	239,971.97		5,555,838.13
35	243,239.86	250,810.14		5,305,027.99
36	232,418.66	262,131.34		5,042,896.65
37	221,128.78	273,921.22		4,768,975.43
38	209,352.48	286,197.52		4,482,777.91
39	197,071.68	298,978.32		4,183,799.59
40	184,268.46	312,281.54		3,871,518.05
41	170,924.16	326,124.84		3,545,393.21
42	157,019.72	340,528.28		3,204,864.93
43	142,536.43	355,511.57		2,849,353.36
44	127,454.77	371,096.23		2,478,257.13
45	111,755.21	387,303.79		2,090,953.34
46	95,417.00	404,157.00		1,686,796.34
47	78,419.34	421,678.66		1,265,117.68
48	60,741.24	439,892.76		825,224.92
49	42,361.58	458,823.42		366,401.50
50	23,258.08	366,401.50		-

[redacted] (cont.)

Schedule of Annual Principal and [redacted]
Supply Storage Bond of [redacted]
$10,320,000 - [redacted]

Payment Number	Interest 4.371%	Principal	[redacted]	[redacted]
47	$ 77,170.13	$413,821.87	$490,992.00	$ 1,155,000.00
48	59,098.71	431,743.29		650,171.29
49	40,221.05	450,570.95		449,600.34
50	20,326.59	449,600.34	$490,126.93	[redacted]



[illegible] 3 (cont.)

Schedule of Annual Payments
for Water Supply Bonding
Baldhill Dam Lake, North Dakota

Payment Number	Principal and Interest on $10,330,000	Annual Operation & Maintenance	Annual Major Replacements	Total Annual Payment
1	$450,792.50	$72,000	$14,000	$536,792.50
49	$450,792.50	$72,000	$14,000	$536,792.50
50	$450,135.23	$72,000	$14,000	$536,135.23

[redacted]

The State of North Carolina (hereinafter called the State) HEREBY AGREES THAT it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352) and all requirements imposed by or pursuant to the Directive of the Department of Defense (32 CFR, Part 300, Issued as Department of Defense Directive 5500.11, August 28, 1964) issued pursuant to that title, to the end that, in accordance with Title VI of that Act and the Directive, no person in the United States shall, on the grounds of race, color, or national origin be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the State receives Federal financial assistance from the Department of the Army and HEREBY GIVES ASSURANCE THAT it will immediately take any measures necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the State by the Department of the Army, this assurance shall obligate the State, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the State for the period during which the Federal financial assistance is extended to it by the Department of the Army.

THIS ASSURANCE is given in consideration of and for the purpose of obtaining any and all Federal grants, loans, contracts, property, discounts or other Federal financial assistance extended after the date hereof to the State by the Department of the Army, including installment payments after such date on account of applications for Federal financial assistance which were approved before such date. The State recognizes and agrees that such Federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the State, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign this assurance on behalf of the State.

[redacted]

SANGE-D 14 March 1975

POST AUTHORIZATION CHANGES

1. Project: Reddies River Lake, North Carolina

2. Authorization: Flood Control Act of 24 July 1946 (Public Law 526, 79th Congress, 2nd Session).

3. Nature of change:

a. Addition of project purposes (water supply storage and recreation development).

b. Increase in flood control benefits.

4. B/C Ratio: Previous - 0.4
New - 1.3
As Authorized - 0.6

5. Interest rate: Previous - 3 1/
New - 5 7/8 2/
As Authorized - 3 1/

1/ Economic life of 50 years.
2/ Economic life of 100 years.

6. Date of previous estimate: November 1950

7. Costs:

	Federal	Non-Federal	Total
As Authorized	$2,150,000	-	$2,150,000 1/ 2/
Previous Estimate	3,065,000	-	3,065,000
Price Level Increase	8,435,000	-	8,435,000
Other Changes	-1,400,000 4/	$11,780,000	10,380,000
New Estimate	10,100,000	11,780,000	21,880,000 3/

1/ Of the total authorized cost for the four reservoir system, ($7,194,000) the amount of $2,150,000 was for the two projects on Reddies River and is considered the authorized amount for the single Reddies River Reservoir which is the lineal descendent of both Reddies Numbered 1 and Reddies Numbered 3 authorized by the Flood Control Act of 1946.

2/ The Definite Project Report on Reddies Dam and Reservoir, dated 15 March 1950. This was a single purpose flood control dam. The cost estimates appear on pages marked "revised, November 1950."

3/ July 1974 price levels and annual economic costs are $1,710,000.

4/ This negative change reflects the decrease in Federal cost allocated to Flood Control. Federal cost allocated to Flood Control is less in a multi-purpose dam than in a single purpose dam.

8. Benefits:

	Previous	New	As Authorized
Flood Control	$58,667	$ 424,000	$56,000
Water Supply	-	1,023,000	-
Recreation	-	665,000	-
Area Redevelopment	-	144,000	-
TOTAL	$58,667	$2,256,000	$56,000

9. Reason for change: The addition of water supply storage and recreation development to a project originally authorized by Congress as a single purpose dam for flood control. These additional purposes result in a multi-purpose dam with a favorable benefit-cost ratio. Also in the period since project authorization, the flood control benefits have increased significantly.

10. Comments:

a. The Flood Control Act of 1946 authorized four detention reservoirs at Wilkesboro, Upper Wilkesboro, Reddies Numbered 1 and Reddies Numbered 3 sites. In response to this authorization, the Definite Project Report on Reddies River Dam and Reservoir, dated 15 March 1950, was prepared. This report recommended only one earthfill dam at Reddies Numbered 1 site and this modification was approved by the Chief of Engineers, 28 August 1950. The DPR also showed that the estimated annual benefits were less than the project annual costs and the project was classified as "inactive." Later as a result of investigations for the Office of Appalachian Studies of the water resource needs of the Upper Yadkin River Basin, it was concluded that the Reddies River project should be expanded in purpose to better meet the water resources needs of the area. The addition of water supply storage and recreation development to Reddies River Lake meet these needs. The State of North Carolina, in a letter dated 23 September 1974, signified its intent to assume the role of sponsor for recreation development in accordance with the provisions of the Federal Water Project Recreation Act, Public Law 89-72. In a letter dated 26 November 1974, the State signified its intent to assume the role of sponsor for water supply storage in accordance with the provisions of the Water Supply Act of 1958, Title III of Public Law 85-500. The need for this project exists and it fulfills the desires of the local interests.

b. The significant increase in the flood control benefits are attributable to several reasons. There has been a significant increase in price levels in the 27 years since authorization. There has been more than normal development in the flood plain, especially since the construction of the nearby W. Kerr Scott Reservoir, a project which has given the public an unwarranted feeling of safety from flooding. This is most noticeable in the urban areas of Wilkesboro-North Wilkesboro and Elkin-Jonesville. Because of the recent rapid growth, the projections of normal future growth have increased. The urgent need for land suitable for development has increased the enhancement benefits for the project. No windfall benefits are expected to occur.

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