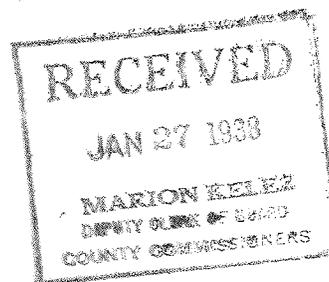


ANNUAL REPORT OF THE CHIEF ENGINEER
FOR THE YEAR ENDING DECEMBER 1937.

TO THE JOINT BOARD,
INTER COUNTY RIVER IMPROVEMENT COMMISSION,
KING AND PIERCE COUNTIES, WASHINGTON.



GENTLEMEN:

We have the honor to submit for your consideration a resume of the work accomplished for the Inter-County River Improvement during the year 1937.

This year witnessed no floods of any consequence upon our rivers. A fairly high stage of water occurred from the 12th to the 15th of April, again on the 8th of November, on the 28th of November and on the 28th of December. The last three mentioned peak flows approximated 20,000 cubic feet per second in the lower Puyallup.

No damage occurred to any of our structures or bank protection during the year except one instance. On the right bank of the river at what is known as the Salisbury place, an experimental type of bank protection failed during the high water in April. Here, for a stretch of about 800 feet, a system of retards, built of rolls of wire laid on the bank and weighted down with concrete blocks had been installed just prior to the high water. To construct these retards a quantity of old wire which had been in our stock for a number of years was used. The design was modeled after a type used largely in California and to some extent on the Mississippi River. It was installed at a cost somewhat less than \$500.00 for the full length of 800 feet. The retards failed to prevent scouring action

and at a number of places the water got in behind them and started to erode the bank. The erosion was stopped at once by placement of a quantity of small concrete tetrahedrons, which we had in stock. By the time of the occurrence of the fall and winter freshets this location had been sufficiently protected with rock rip rap to prevent further erosion.

The major efforts of the organization were directed to two principal projects during the year. One, the production and placing of rock rip rap for bank stabilization, the other the sponsoring and contributing to the federal approved project, Mud Mountain Dam.

BANK STABILIZATION.

Groins: During the first few months of the year a small crew was employed arranging rock in the lower stretches of the Puyallup River which had been hauled and dumped under a W P A project of the previous year. This rock was formed into groins of the most advantageous shape to prevent scour at the toe of the old concrete revetment. In this work a small gasoline driven donkey, mounted on a scow, with a line passing through an A frame at its bow, was used to handle and move the rock into place. Since the completion of these rock groins a very satisfactory silting condition and absence of scour is obtained.

Quarry Development:

About the first of June we began development work at the Orting quarry. The over-burden at the top was stripped back for a distance of about fifty feet and the whole face of the upper quarry was shot down, removing the

most weathered parts. This development work was continued until the 7th of October when the hauling of rock to the river began.

Up to that time we had spent \$8,720.00 upon quarry development. Until the end of the year a considerable amount of development work was required.

Quarrying: When the hauling of rock started the face of the quarry, for somewhat more than half its height, was covered with a pile of materials sloping down on about a one to one slope. This material consisted of the over-burden and weathered face. The over-burden was made up largely of very fine washed sand which we anticipated would furnish an excellent cushion for the rock falling from the higher levels of the quarry face. The weathered quarry face consisted partly of sound rock and partly of weathered material in all stages of weathering even to a fine clay. We planned at this time upon bringing down the upper reaches of the quarry face, anticipating that the rock would roll to the bottom of the slope and there be reclaimed for use. However the sand proved so light that great quantities of rock buried itself in the top of the slope forcing the lower part of the slope out. This condition made it necessary to sift what rock we could from the face of the slope and gradually build a working table adjacent thereto to a higher level until, by the end of the year, we had practically all of the waste material under us and the working table some 20 feet above the starting level. The sifting of the rock and the disposition of the waste was accomplished without undue cost by reason of the fact that only a small fleet of trucks was employed. By this

arrangement only a portion of the shovel time was used in loading trucks and the balance of its time was available for development work.

Loading & Hauling:

The shovel used in the quarry to begin with was the one owned by Pierce County. It is a 3/4 yard Keshring and was operated by the Pierce County runner and oiler whose wages were paid by Inter-County River Improvement.

Five trucks were employed under contract by the Inter-County River Improvement at the rate of \$2.69 per hour. These trucks belong to individuals, owners who drive them. The contract under which each is employed provides for the owner furnishing the gas, oil and maintenance of his equipment and carrying the full responsibility for any damage which may occur to his truck on the job. During the last two months of the year Pierce County also furnished for use of the Inter-County River Improvement two trucks together with drivers and supplies. A credit to Pierce County as a contribution to the Inter-County River Improvement is set up in the annual statement for this equipment.

During the last two months of the year Pierce County also had two trucks in the quarry most of the time hauling rock for bank protection on the upper Puyallup River. Payment for the rock secured by Pierce County for this purpose was made in the form of development such as hauling waste from the quarry.

The Pierce County shovel was not entirely satisfactory as rock handling equipment. The shovel is too small to begin with, is somewhat slower than more modern equipment and the operator was without sufficient

experience in quarry work to obtain the desirable results, consequently after a thorough trial another shovel was rented and the county shovel moved out. This new shovel belongs to Frank McHugh, of Tacoma, is a 1½ yard Thew-Lorraine. It is contracted for with the owner under a written agreement whereby he furnishes the shovel and operator, maintains it in first class operation and carries all the responsibility for any damage whatsoever, which may occur to his equipment while working. The Inter-County furnishes the fuel and oils and necessary replacement of line and pays to the owner \$700.00 per month for 8 hours a day, 5 days a week. This shovel has proved entirely satisfactory, the operator is an expert and the task of sorting usable rock and disposing of waste is no longer a problem. The total production of rock from the quarry, its cost and the distributed cost per foot of bank is shown in the following tables.

ANALYSIS OF ROCK COSTS.

Quarry Expenditures to Jan. 1, 1938	\$19,658.78
Development charges distributable in 1938 (which equals cost to date of beginning to haul)	8,720.00
Quarry costs during 1937 (This covers loading and sorting)	<u>10,938.78</u>

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Rock Produced

I C R I	5,236 c.y.
Pierce County	<u>1,900 " "</u>
Total	7,136 " "

Cost per c.y. to Quarry and Load

$$10938.78 \div 7136 = 1.532$$

Cost per c.y. to place on river

$$389.28 \div 5236 = .076$$

Truck Costs

Expended by I C R I	\$5,396.85
Contribution by Pierce	<u>825.83</u>
Total	6,222.68

Rock Hauled 5,236 c.y.

$$6222.68 \div 5236 = 1.19$$

RECAPITULATION

Quarrying and Loading	1.532
Hauling	1.19
Placing	<u>.076</u>
TOTAL COST ON RIVER	\$ 2.798

ANALYSIS OF ROCK COST cont.

PRESENT COST OF ROCK BEING PRODUCED

QUARRYING

Quarrying at rate of 5,000 c y per month	
5000 @ 3/4# = 3800 # powder @ 15.00	570.00
Gas 1000 gals. @ .105	105.00
Equipment rental	300.00
Payroll	1925.00
Tools & Miscellaneous	100.00
	<u>\$3000.00</u>

5000 c y rock for \$3,000.00 = .60 c y

DEVELOPMENT CHARGE TO FUTURE PRODUCTION

Undistributed development cost to date \$8,720.00
 Estimate of yardage available under
 present development is 25,000 c y

8,720 ÷ 25,000 .35 " "

SORTING & LOADING

Shovel Rental per mo.	700.00
Gas, oil & supplies per mo.	100.00
Fitsman & Oiler	<u>200.00</u>
Total monthly	\$1,000.00

Rate of production in c y 2,000
 Cost per c y to load & sort .50 " "

FUTURE COST ON THE TRUCKS LOADED \$1.45 " "

HAULING TO RIVER

5 trucks 800 truck hrs. @ 2.69	\$2150.00
Rate of hauling per month	2000.00
Cost per c y to haul	<u>1.075 cy</u>

Total present cost including development charges \$2.525 cy

PLACEMENT ON RIVER BANK

One man per month	120.00
Sundries	<u>30.00</u>
Rate of placing 2000 c y mo.	150.00

Cost per c y to place .075 "

FUTURE TOTAL COST OF ROCK IN PLACE \$2.60 c y

COMPARISON OF COSTS OF QUARRYING ROCK

ITEM	A 1936	B Present	C Assumed Costs out of Electron Quarry
1 Quarrying per cu y	.45	.60	.40
2 Loading & Waste Disposal	.26	.50	.83 = $\frac{1000}{1200}$
3 Development35	.15 = $\frac{3000}{20000}$
4 Hauling	1.19	1.08	1.78 = $\frac{2150}{1200}$
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Total on River Bank	1.90	2.53	3.16
5 Placing	.20	.07	.12
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Total cost in place	2.10	2.60	3.28

Column "A" shows the costs during the combined operation of the W P A and I C R I during the year 1936, when the operation was extended on a scale which produced at the rate of about 7000 cu. yds. per month, and quarrying was performed by the coyote hole method. The present method is by benching, used for the reason that it is a safer method of operation.

Column "B" shows the present costs which will probably maintain thruout the year 1938.

Column "C" shows the estimated costs which would maintain at the Electron Quarry where we have been urged to move.

Remarks on Costs : Quarrying is more expensive now by reason of the fact that we are benching rather than coyoting, and because we are working on smaller scale. It is possible that more waste is developing as we proceed.

Loading costs are higher because it takes the same equipment to load 5 trucks as 20 .

Hauling and placing have been reduced in cost.

ROCK DISTRIBUTION.

	Salisbury Farm	Auburn Bridge	Orvitts Road	McGee Farm
Cubic Yards	2280	2380	48	528
Cost per location	\$6640.00	\$6925.91	\$140.00	\$1539.00
Length of protection	1000 ft.	1000 ft.	40 ft	200 ft
Cost per ft.	\$ 6.84	\$ 6.93	\$ 2.50	\$ 7.70

In addition Pierce County was furnished 1900 cu. yd. of rock for which they paid in development work such as hauling away waste.

The cost per lineal foot for bank protection shows higher in these figures than will ordinarily maintain for our work. This is due to the fact that the particular places at which we have been working are either high banks with deep water adjacent, or long slopes of gravel levy, which require great quantities of material. As an instance showing the unusual conditions, the McGee property shown in the foregoing tables developed in the placing of the rock an extremely deep water under a 20 foot high bank. At one point the trucks backed in upon the same track and dumped rock over the bank in one hole until 100 cu. yds. had been placed before the rock showed above the water, which was then at low stage. This condition was caused by an eddy created by a so called brush retard which had been placed therein former years.

Value of Small Scale Operation:

While the cost of rock as is shown by work of the last few months of the year is somewhat higher than during previous jobs, working from the same quarry, such additional cost was to be expected by reason of the fact that we were operating upon a much smaller scale than formerly. Naturally the question has arisen in our own minds as whether

or not to endeavor to put on a few more trucks hauling, and thereby procure somewhat larger quantity of rock during the year with the funds available or to continue upon the present set up. It stands to reason, that if we had a fleet of 20 trucks running and operating upon a sufficient basis to maintain that fleet, that we could probably save 35 or 40 cents in the cost of rock and approach the figure determined by last years work. However such an operation would mean that the full years budget for the organization would be exhausted in about three months work and the operation of the Inter-County River Improvement shut down for the balance of the year. It seems to us that by working upon a smaller scale and extending our work throughout the year a sufficiently greater efficiency will be procured from the rock placed as to more than off-set the additional cost per unit. There are still many miles of raw banks or failing revetment within our jurisdiction. The weak places develop and become apparent with each fluctuation of river stage. By being on the job continuously and making it a maintenance proposition as well as a construction proposition, these weak places can be picked up as soon as they become apparent and repaired at a far smaller cost than should they be permitted to pass through high water stages.

Quality of Rock: Another question which has held our attention refers to the proper size of rock to use for our particular job. The percentage of rock which we are using that runs about one or two cubic feet in size is much greater than the ordinary specifications for rip rap. Of course if we could protect our banks with rock running from one to two cubic yards in size, as the average, and build a blanket of such rip rap from the toe of the slope to the

top we would have a job, about which there could be no possible question as to permanance. On the other hand if we reduce the size of this rock to a third the diametrical dimension naturally the blanket on the slope of the bank will require only a third as much rock. If this smaller rock performs the duty required and develops at least a degree of permanance it should be as satisfactory as the larger rock. The advantage to be gained then by using this smaller rock is that we get three times as much work done with the annual appropriation as otherwise, and considering the great amount of work to be done on the river it seems advisable to make the funds stretch as far as possible. We must admit that some of the work partakes of the nature of experiment. However we firmly believe that the degree of permanance obtained is sufficiently high. We are not unaware that the character of rip rap, for instance used by the railroads in the protection of their bridges and exposed grades in the mountains of this district, is much greater in size, also the rip rap used by Army Engineers in the construction of jetties and harbor protection on the sea coast uses rock very much greater in size than we are using. However when the question of velocities of mountain streams and the consequent erosive character of their waters and the fact that every foot of railroad track must be kept in operable condition or the whole system is crippled; or when we consider the erosive power of storms against rock laid on the sands of the sea shore, we know that we have an entirely different set of conditions from what confronts the Inter-County River Improvement. Economy and the greatest footage of bank protection for a given sum with a reasonable degree of permanance are the controlling factors in our work. It is for this reason that we have not attempted to imitate in

every detail the precedent set by the railroads and government in rip rap construction.

Economic Value of Bank Protection:

One of the important points that we must bear in mind always is the economic value of the work we are doing, that is, a comparison of the property protected as against the cost of work. The direct and first result of bank stabilization is the prevention of erosion of the property adjacent to the stream. Upon our rivers that property is largely farm lands. Let us assume, for instance, a stretch of land 1,000 feet long and lying next to the river, the value of this land is probably \$200.00 per acre. Assume again that the bank is unprotected and erosion permitted to take place without ~~the~~^{any} interference ~~of~~^{with} nature's system. It is probable that in the course of several years, passing through several high floods that this land would be washed out back to say 300 feet from the starting bank. The area of this stretch of land 300 feet wide and 1,000 feet long is about seven acres, its value \$1400.00. Consider then the period of time suggested above which might be one generation, to spend more than \$1400.00 in stabilizing this particular stretch of bank we would be spending the full value or more, of the land protected. Economically it would be far cheaper for the counties to buy the land and let the flood take it. Of course we are not recommending that such procedure be followed for if we did, ultimately the whole valley would probably be destroyed. It is the existence of these facts that argues toward a system of bank stabilization held to as low cost as possible and certainly some experimentation, to determine the smallest size of rip rap feasible, is in line with good economy.

Channel Capacity:

While bank stabilization has occupied our attention mostly throughout the past year we would not have it understood that it is the only feature of importance or even of prime importance. The first principal of flood control is to provide a channel large enough to carry away the waters of a great flood and we would emphasize the fact that it is the great and all the great floods that should be designed for because it is during the time of the extreme high floods, when the waters become outlaw, that the greatest destruction to life and property occurs. It is a patent fact that man encroaches upon the natural flood channels of our rivers during the years when no floods or small floods occur, not only with his dwellings and factories but even with his systems of bank protection to prevent erosion. This reduces the channel capacity and increases the value of lands which should be normally kept as river channel for flood flows. Any system of flood control which provides only for the smaller floods naturally encourages man to encroach more upon the river channel required for the great floods, which occur at much longer intervals of time. The result is that when these great floods come the destruction and damage is much greater than had a system been used which provided the evacuation of the large flood channel.

The efforts of the Inter-County River Improvement in the past few years were directed towards the provision of a sufficient channel by clearing all debris, stumps and former protection, which encroached upon the channel, to the extent that during the past winter the flood waters have run off without damage to either riparian lands or protective structures. Channel capacity may be increased by deepening in places, widening in others and always by removal of obstructions. This latter point is of fundamental importance.

We have applied it to the point of even removing formerly installed pile jetties or log cribs where they impaired capacity to a detrimental degree.

MUD MOUNTAIN DAM.

At the beginning of this year the government was making surveys and diamond drilling the dam site under the direction of the Corps of Engineers, U. S. Army. They completed this work in the early part of the year and began the preparation of plans in the Division Office at Portland. In the latter part of June, Mr. McAlpin, Chief Designing Engineer out of Washington City called upon your Chief Engineer and discussed the details of the plans and the general design of the project.

It was determined at that time that considerable amount of investigation work should be performed before the final design of the dam could be determined upon. Congress provided a fund of \$200,000 which was to be used for engineering purposes.

In July work started at the dam site putting down calyx drill holes, with two drills which were purchased for the job by the Army Engineers.

The calyx drill is a 36" steel cylinder made of about 3/8" plate, and about 3 feet long. The lower edge is cut out at intervals with saw-like notches.

It is then faced with hard material. The upper end of the cylinder is provided with a head and means of attaching a shaft to cause the whole to rotate. Shot are fed under the lower or cutting edge and the revolving motion slowly grinds into the rock leaving a core inside the cylinder. When the length of the cylinder or cutting head is reached the drill is withdrawn and the core removed with dynamite and a small drill .

This work was done under the direction of Col. Wild with Mr. Charles Smith in immediate charge. By the end of the year four of these holes had been completed to a depth varying from 60 to 80 feet. Dr Edwin T. Hodge was employed as Consulting Geologist. He recommends that the dam site is of sufficient quality to support a gravity type dam. The gravity type seems to be favored by the Army Engineers due to the fact that it is the type having the highest factor of safety. At the close of the year sufficient data is now at hand to determine the final design of the dam. This data together with "An Analysis of Design" and a series of blue prints have been submitted to your engineers inviting our comment thereon. A study of these plans is now under way and it is the intention of your engineers to prepare a criticism which will be in effect an approval of the general design, together with most of the details, with recommendations for specific changes in other details. This will take a good many hours time for both of us.

Rights of Way: During the year, after starting suit in both counties for condemnation of lands lying within the dam site and retarding basin area, an agreement was finally reached between the Inter-County River Improvement Commission and the owners of the lands for a settlement by negotiation. Under this agreement the Inter-County paid the owners \$14,000.00 for about 2200 acres of land, together with the timber on the 160 acres at the dam site. The final settlement was reached and the decrees entered in the month of September. About this time Col. Wild notified us that the federal government required that we deed all the lands to it. We pointed out that we had complied with the Flood Control Act of 1936 which authorized

this project and that this Act did not require that the lands be deeded to the federal government. During our many conversations it transpired that the National Resources Committee at Washington, D. C. had ruled that this project possessed potential power possibilities and that, therefore, the project could not proceed without a transfer of title to the real estate.

Accordingly opinions were sought from the Prosecuting Attorneys of each county. After considerable study they agreed and advised in writing that the Inter-County River Improvement had the legal right to transfer the property to the federal government and that this transfer would in no way abrogate the previous arrangement between the Inter-County River Improvement and the federal government, designating the federal government as the agency to construct and the Inter-County River Improvement as the agency to operate and maintain after completion. In October the District Engineer and the Division Engineer of the U. S. Army gave approval of the description of the lands required as the proper area for the dam site and retarding basin of the project.

The question was then raised as to assurances that the project would be built and that construction thereof would not be delayed because of lack of ownership of one small parcel of land in the retarding basin belonging to M. L. Frost. Assurances were finally received through Col. Wild that the project would proceed immediately if the Commission would deed the lands to the federal government. Accordingly on the 17th day of December the Joint Board met and passed a resolution providing for the conveyance of all lands owned for the project, such conveyance to be made in consideration for the construction of the

project. Shortly after the first of the year 1938 the deeds in quintuplicate, one set from Pierce County and one set from King County, covering all lands owned by the counties acquired for the project, together with a map showing the location and description of each parcel, was delivered to Col. Wild. At the time of this writing Col. Wild informs us that an early visit of the Board of Reviews of the U. S. Army Engineers is anticipated and that the purpose of this visit is to give final approval for authority to immediately let a contract for the construction of the project. This information is as yet not available for publication.

It is the intention of your Engineers to continue the close cooperation which has marked our past dealings with the Army Engineers to the end that the interests of the two counties shall be properly protected in the consumation of this project.

Construction Road to Dam: Shortly after the announcement that \$200,000 had been made available for work at the dam your engineers suggested to Col. Wild that the construction road be built into the dam site immediately and paid for out of this sum. Through the efforts of your engineers the State Highway Department furnished a complete set of plans and specifications for the best possible location of the road into the dam site connecting the State Road No. 5 at the top of Ingalls' Hill with the site. More than half the length of this location lies on the new location made for State Road No. 5 and contemplated for early construction by the State Highway Department. Approval of this location was sought and obtained from the Army Engineers as the construction road to the dam. Permission for immediate construction of the road was refused, at first, on the grounds that the Inter-County River Improvement Commission

had not complied with the demands of the federal government in transferring the lands and again on the grounds that the money provided was intended for engineering and investigation purposes only and was not to be used for construction work. However your engineers proceeded to acquire the necessary easements over the State Highway location and insisted on the necessity of early completion of the road and at the end of the year Col. Wild advised us that he had received authority to proceed with the construction of the road. The construction of this road will require a few months and as no work on the main contract can proceed without the road its early completion may avoid some delay in the final completion of the whole job.

LAW SUITS PENDING.

Two suits are pending against the Inter-County River Improvement. The case of Short vs. Pierce County and King County claiming damages in the amount of \$3750.00 was tried in the Superior Court of Pierce County June 10th, 1937 and was non-suited for lack of sufficient evidence on the part of the plaintiff to show cause for damages. Guy E. Kelly, of Tacoma, represents the plaintiff in this matter and appealed the case to the Supreme Court. Mr. J. E. Belcher who has been and still is representing the counties filed a brief in answer and the case was argued January 11, 1938. At this writing the case rests in the Supreme Court for an opinion.

The case of Frank J. McHugh et al against Pierce and King Counties in the amount of about \$10,000 for damages to a shovel was instituted more than a year ago. This case was set for trial in the Superior Court of King County during October 1937 but was stricken from the calendar on the motion

of the plaintiff due to the absence of Mr. L. J. Dowell,
one of the plaintiffs. It will be set for trial again during
the early part of the ensuing year. Mr. Floyd M. Reischling,
Deputy Prosecuting Attorney, of King County is representing
the counties in this matter. Financial statements follow.

Respectfully submitted,



B. F. Thomas, Chief Engineer



R. H. Thomson, Consulting Engineer