in 1972-73. The gap had been bitterly felt by the Department and ultimately the Punjab Government again decided in the year 1973-74 to reactivate the Central Design Office in Lahore. This office being still in the preliminary stages of establishment was not fully equipped when the problem of designing the regulators arose. In order to have complete reliance on the repaired structure and to facilitate examination of the problem by expert hands, the design work was entrusted to M/s. National Engineering Service of Pakistan Ltd. who very graciously accepted to render the service without any financial liability.

6.74 To design the structure on a sound basis, intimate knowledge of the sub-soil strata is essential. In absence of the basic data and also to determine reliability or otherwise of the undamaged portion (Panjnad Regulator bays 1-8), boring of the area was done and standard penetration tests made as per details given in Plate No. 10. The sub-strata comprised primarily of fine sand and could safely withstand a load of about 1 ton/Sq. ft. Based on this information various alternatives to repair the regulators were considered.

6.75 The most logical and conventional manner to repair the structure was to provide a deep sheet pile line cut off at the end of impervious floor to secure from damages by scouring. The provision of deep sheet piles did not appear practicable because of difficulty in driving them to appropriate levels due to continuous dumping of stone in the scoured pits. The other alternative was to provide only sufficient depth of curtain wall (whether of concrete or sheet piles) has required from the point of view of exit gradient and for scour considerations to provide a deep intermediate sheet pile line at a location free from stone. The details of the plan finally agreed upon and adopted at site are shown in Plate No. 14 as detailed hereunder :—

A- Panjnad Regulator

(*a*) DAMAGED PORTION (Bays 9-12)

(*i*) Max. Head across the structure is not to exceed 17.5 feet *i.e.* water in the left pocket should not exceed RL 341.5 (designed afflux level) unless a corresponding depth of water is provided on the downstream floor.

(*ii*) 16 ft. long sheet piles driven to bottom RL 305 ft. at a distance of 5 ft. downstream of the pier nose. This shall serve as an

intermediate cut off against extraordinary scour and also box up the sub-strata upto the end of glacis portion.

(*iii*) 8 Ft. long sheet piles driven to bottom R.L 315 at the down-stream end of impervious floor. This shall keep the exit gradient within safe limit.

(*iv*) Variable thickness of the downstream floor as required to counter-act the uplift pressure established by Khosla's theory.

(*v*) With the provision of intermediate sheet pile line the existing thickness of 3.5 ft. in the lower part of the glacis was found to be inadequate. The desired thickness of 5 feet was obtained by adding extra concrete on the glacis and the same changed its slope to 1 in 6 instead of existing 1 in 5. The new concrete on the old glacis was laid after thoroughly scrubbing the surface, providing a net work of anchor bars and by coating the old surface with expandite Expandabond (manufactured by Expandite Limited, London) for better adherence and union.

(*vi*) The change of glacis slope in bays 9 to 12 was liable to effect the position of the hydraulic jump in relation to the adjoining bays 1 to 8. A cantilever type reinforced concrete divide wall supported on RCC raft was, therefore, provided between bays 8 and 9 to avoid cross flows and to permit independent function of each side. The R.C.C. divide wall has been designed to withstand a differential head of 11.7 ft. (*i.e.* water upto F.S.L. of Panjnad Canal on one side and empty floor on the other side) although such eventuality is never expected to be experienced unless partial remodelling of the structure is involved in future.

(*vii*) A scheme for attaching some perennial area of Panjnad Canal system to the Abbasia Canal system has been under consideration of the Government long time back. In case the scheme matures at some stage, an increase in the capacity of Abbasia Canal will have to be made. To fecilitate this change (in the future) it was decided to provide foundation for the future divide wall between bays 11 - 12 so that one bay of

Panjnad Regulator can be added to Abbasia Canal system, whenever required. The foundation work as provided in bays No. 11, 12 and extending within the common bank of the two regulators shall permit balance work to be done in the normal period of annual canal closures without resorting to huge arrangements of dewatering, or erection of coffer dams etc.

(*viii*) Four rows of concrete blocks (17 ft. wide) of size 4′×4′×2′ deep laid over inverted filter comprising of 4″ coarse sand, 4″ shingle size 3/16″ – $\frac{3}{4}$″, 4″ shingle size $3\frac{3}{4}$″ – $1\frac{1}{2}$″ and 6″ spawl have been provided on the down stream side of the impervious floor for passage of seepage water.

(*ix*) 43 ft. wide stone apron 3 ft. thick (originally 23′ wide and 2 ft. thick) has been placed in a launched position on the downstream side of the concrete block zone.

(*x*) Sand Grouting below the concrete floor of the glacis portion was done to fill cavities formed by the settlement/movement of the sub-strata on account of deep scour at the time of damage.

(*xi*) Conatct grouting with cement of the area was done around the junction of the new floor with the old structure to seal the joints.

(*b*) UNDAMAGED PORTION (Bays 1 - 8)

Sub-soil investigation as at para 6.74 and Plate No. 10 indicate that there has been some novement of sub-strata possibly due to deep scour in the downstream side. One method of stopping the movement of sub-soil is to provide a deep sheet pile at the end of impervious concrete floor. This will necessitate considerable thickening of the floor, extension of the floor area on the downstream to attain RL 324 corresponding to designed bed of the canal, and relaying of the concrete blocks/stone apron at changed location as required from design consideration. This involved high construction cost and a long time for excution which at the stage of consideration (in March, 1974) did not fit in with the chalked out programme of recommissioning the regulators with effect from 16th April, 1974. Considering all these factors and in view of this regulator having already been tested for discharge more than the

designed capacity (refer Para 6.21) the following interim treatment was agreed upon and implemented at site :—

(*i*) In the original design, the inverted filter zone on the down-stream of impervious floor comprised of only 6 inches spawl under the concrete blocks. This spawl had also adhered to the concrete blocks as noticed subseqently due to non-provision of any blend of a segregating media. In course of time the filtering media had practically choked up. Old concrete blocks were, therefore, removed, cleaned and relaid after providing inverted filter to the specifications for new work *i.e.* 6″ spawl laid over 4″ shingle (size $\frac{3}{4}$″ to $1\frac{1}{2}$″). over 4″ shingle (size 3/16″ to $\frac{3}{4}$″) over 4″ crushed sand.

(*ii*) Stone apron 3 ft. thick was extended by another width of 20 feet with top RL 320 in front of bays 3 to 8.

(*iii*) Stone apron 3 ft. thick was extended by another width of 30 ft. with top level ranging RL 320 to 324 opposite bays 1 to 2.

(*iv*) Intensive sand grouting at the crest was done to fill up the cavities caused by the movement/disturbance of the sub-strata over the long period of operation or due to development of deep scour in the bed of the channel immediately below the regulator.

(*v*) Contact grouting of the horizontal floor with cement was done at the rate of 6 grout holes per bay.

(*vi*) Old concrete around new cracks (1 to 3 millimeter wide was removed in a width of 6″ to 9″ and depth 4″ to 6″ to form a recess, Anchor bars were then embedded in the old concrete within the recess on both sides of the crack line at an interval of 2.5 ft. The cracks within the recess were then sealed with epoxy concrete (Epoxy rasin mortar-Expandite Expocrete manufactured by Expandite Limited, London) and finally filled with rich cement concrete flush with floor level.

(*vii*) Similar to (*vi*) above the old concrete around opened out construction joints (3 to 9 millimeter wide) was removed in a width of about 3″ and depth 3″ to 4″. The joint was then sealed with epoxy concrete and recess finally filled with rich cement concrete.

(*viii*) Tell-tales and glass strips were installed to monitor the behaviour of cracks/joints in the future.

A constant watch on the behaviour of these bays shall be desireable and a thorough inspection necessary during the annual closures. Based on further examinations, additional remedial measures shall be provided in due course if so required.

B—Abbasia Regulator

(*i*) Maximum head across the structure is not to exceed 12.8 ft. i.e. water in the left pocket at RL 341.5 (designed afflux level) with empty floor of the regulators on the downstream side.

(*ii*) 10′ – 8″ long sheet pile has been driven to bottom RL 315 at the end of impervious floor. For a safe exit-gradient, only 6 ft. deep curtain wall with bottom RL 322.7 was sufficient but for scour considerations and to maintain uniformity with the adjoining Panjnad Regulator, a deeper cut off which became possible at site has been provided for.

(*iii*) 16 ft. long sheet pile has been driven to bottom RL 311 (corresponding to bottom of downstream foundation well below the pier) at a distance of 5 ft. on the downstream of pier nose and extending close to the foundation well of the abutment wall. This is to serve as an intermediate cut-off and also confine the sub-strata below the glacis portion.

(*iv*) 16 ft. to 8 ft. long sheet piles have been driven to variable depths from bottom RL 305 to RL 311 around the downstream well of divide wall (having bottom RL 311) for a smooth transition from Panjnad Regulator as per item (*a*) (*ii*) to Abbasia Regulator as per (*iii*) above.

(*v*) 10′ – 8″ long sheet pile has been driven to bottom RL 315 below the Left flank wall upto its junction with the sheet pile line at the end of impervious floor as at (*ii*) above.

(*vi*) 8′ long sheet pile driven to bottom RL 319 below the foundation block of the remaining portion of damaged left flank wall.

(*vii*) Variable thickness of downstream floor as required to counteract the uplift pressure established by Khosla's theory.

(*viii*) Five rows of concrete blocks (22′ wide) of size 4′×4′×2′ deep laid over inverted filter comprising of 4″ coarse sand, 4″ shingle size 3/16″–$\frac{3}{4}$″, 4″ shingle size $\frac{3}{4}$″–1$\frac{1}{2}$″ and 6″ spawl has been provided below the impervious floor for passage of seepage water.

(*ix*) 34 ft. wide stone apron 3 ft. thick on the downstream side of concrete block zone.

C—Divide wall

The original stone masonary wall bifurcating the two regulators resting on wells (upto a distance of 60 ft. from the upstream face of the breast wall) was solid one block, but lower down it bifurcated into two lean walls (resting on shallow open foundations) and the space in between had been filled with sand. As the divide wall was over-topped by the flood water, packed sand was displaced by water and the two lean walls got collapsed. In the modified design, therefore, a solid gravity type stone masonary divide wall has been constructed with independent raft foundation beyond the pier nose as under :—

(*i*) 5′–4″ long sheet pile was driven to bottom RL 314 at the centre line of the divide wall connected on thc upstream with the sheet pile as per item B(*iv*), at an intermediate portion with the sheet pile as per item B(*ii*) and on the downstream side with the sheet pile as per item A(*a*) (*iii*).

(*ii*) RCC raft 24′–5″ wide having bearing load within I ton per Sq. ft. has been provided as foundation to permit independent function of the divide wall in the future. The divide wall is capable of withstanding the worst possible differential head corresponding to water flush upto its top RL 338.5 on Abbasia side and empty floor on the Panjnad regulator side.

(*iii*) The foundation well on the downstream side of the divide wall which had cracked, was dismantled upto the bed of foundation block (RL 318) and the RCC raft as per (*ii*) above was extended right upto the line of pier nose for more solidarity.

D—Common Bank

The transition from solid divide wall to the normal banks of the two canals was established through :—

(*i*) Flared out brick masonary walls resting over impervious floor of variable thicknesses having a sheet pile line cut off (bottom RL 315) on the Panjnad Canal side.

(*ii*) Provision of an independent foundation for the balance portion of the damaged sloping side wall coupled with impervious floor (Minimum width 28.5') of concrete on the Abbasia Canal side.

(*iii*) Balance portion of the damaged sloping side wall on the Panjnad Canal side partly rests on the foundation raft of the future divide wall (as per item A(*a*) (v*ii*) above and partly on independent foundation coupled with variable widths of impervious concrete floor on the pattern of item (*ii*) above. Sheet pile line cut off with bottom RL 315 has been provided at the end of this impervious floor from consideration of exit gradient.

(*iv*) Provision of 2 rows of concrete blacks (9 ft. wide) of size 4'×4'×2' deep laid over inverted filter followed by a concrete curtain wall and 15 ft. wide (3 ft. deep) stone apron beyond the impervious floor on the Panjnad Canal side.

The provision of impervious floors and sheet pile line cut o . (on the Panjnad Canal side) have been made to cater for a differential head of 11.1 ft. *i.e.* water upto full supply level in Abbasia and empty floor on the Panjnad Canal sides.

6.8. Dewatering the Working Area

6.81. For carrying out the work smoothly, it is essential to dewater the area and create dry working conditions. The deepest elevation upto which concrete or stone was designed to be laid is RL 317.0. To create complete dry conditions necessary for smooth movement of materials/machinery and to keep some allowance for the temporary rise of water at time of switch over to stand-by generation (in the event of power breakdown) the sub-soil water table on the down-stream side was lowered and maintained at RL 315.

6.82 The structure in the damaged condition was not found to be safe for a differential head of more than 6 ft. The deepest elevation of excavation for laying concrete near the downstream end of glacis was RL 319.0. This meant the water table in the pocket area had in no case to be more than RL 324.0. As a further safety and in view of cosi-

deration narrated in para 6.81 above, the elevation of water in the pocket area was not allowed to exceed RL 322.

6.83 To depress the water table to RL 315 and RL 322 on the downstream and upstream sides of the reglators, a net work of 15 No. tubewells (twin bores) and 3 No. open pumps, each for a capacity of 2 cusecs, had to be installed. Initially it was felt that the sub-strata shall comprise of fine to coarse sand and would require installation of about 25 No. tubewells (twin bores) and 5 No. open pumps to cater for a sub soil flow of about 50 cusecs. The sub soil, however, was mostly of fine sand and the situation remained under control by pumping a discharge of about 25-30 cusecs with the pumps installed as above.

6.84 The removal of overburden in the working area was of the order of 5 ft. to 10 ft. depth. Shallow tubewells bored upto 50 ft. depth with 30 ft. long coir-rope strainer and 20 ft. long blind pipes were found appropriate for the job. An electric pumping set of 2 cusecs capacity was fixed on two bores to get better efficiency. Shallow boring, helped in installing the tubewells rather quickly and also enabled salvaging of the bored material to a greater extent after completion of the work.

6.9 Clearance of the Working Area

6.91 After collapse of the divide wall and breakage of the floor in the affected bays of the regulators, heavy stone dumping was done to check further damage. For rebuilding the damaged structure and to provide proper foundation, the dumped stone, concrete debris and earth had to be removed to proper levels and grades. The removal of the stone in silted condition was extremely difficult particularly in the alignment of sheet piling and the same hampered the driving operations considereably.

The dismantling of damaged concrete and stone masonry could only be accomplished in stages by making holes with pneumatic rock drills and then blasting them with small charges of explosives. Even then the progress remained very slow and the work had to be continued round the clock for a long period.

7.0 Concreting

7.01 For ease of construction and to avoid development of cracks by mass work, the concreting was done in panels of manageable sizes.

The surface of the old concrete to come into contact with the new works was roughened and provided with small grooves by chiselling with pneumatic hammers for a secure bond. Nominal reinforcement (5/8" dia bars 12" centre to centre both ways) was provided 9" below the finished sarface of the new concrete to check development of surface cracks by temperature effect.

7.02 The mixing ratio of concrete aggregates was established on the advice of Irrigation Research Institute by actual sieve analysis of the materials as under :—

(*i*) Screen analysis of fine aggregates

Description	Percentage pass U.S screen No.							Fineness Modules
	4	8	16	30	50	100	200	
River sand	100	100	100	99.5	16.5	3.7	2.0	1.81
Coarse sand	98.1	91.6	38.1	0.6	0.4	0.2	0.1	3.71
Recommended Blending ratio 3:2	99.24	96.64	75.24	55.9	10.06	2.3	1.24	2.57

The suggested blending was strictly followed for reinforced concrete work, but in case of plain mass concrete only river sand was utilized.

(*ii*) Gradation Data of Coarse aggregates

Descrption	Percentage pass U.S Screen size				Fineness Modules
	$1\frac{1}{2}$	$\frac{3}{4}$	3/8"	3/16	
Shingle size 3/16" to $\frac{3}{4}$"	100	93.2	30.7	6.9	6.69
Shingle size $\frac{3}{4}$" to $1\frac{1}{2}$"	100	24.1	—	—	7.76
Recommended blending ratio 1:1	100	58.65	15.35	3.55	7.23

7.03 Uniform mix of the concrete at 1:2:4 was adopted for attaining suggested cube strength of 2500 to 3000 lbs per square inch at 28 days. The water cement ratio was kept $5\frac{1}{2}$ to 6 gallons/cwt of cement with slump ranging from $1\frac{1}{2}$" to 2". Strict quality control was exercised by stationing qualified staff at each mixer and by resorting to pneumatic wriggling for asolid and homogenous mass. Representative samples of the concrete in

the different panels were preserved in the concrete cubes which on testing in the laboratory of Irrigation Research Institute gave a strength of 1894 to 2688 lbs/square inch at 10 days; 2383 to 3574 lbs/square inch at 14 days; 4033 to 4155 lbs/square inch at 18 days.

7.1 Grouting

7.11 A thorough inspection of the entire structure was carried out and the suspected cavities underneath the impervious floor were filled by grouting with sand and cement as under :—

(*i*) Two to three holes were drilled at the crest of Panjnad Regulator in each bay. The sudden drop of the drilling rod below the concrete floor indicated settlement of the sub-strata in this zone. Sand mixed with water in the ratio of about 1:3, was, therefore, put in the grout holes and the same moved into the cavity by gravity flow. Maximum quantity of sand went into the grout holes of bay No. 3 to 11 which indicated movement of sub-strata due to scourting etc. in this zone. These grout holes have been provided with detachable screw plugs at the top to facilitate intensive sand grouting of the area at time of annual closures in the future.

(*ii*) A few holes along the glacis at the centre of road decking in the Panjnad Regulator were also made for sand grouting but appreciable quantity did not flow into them.

(*iii*) Grout pipes left in the new work at the contact point of the old floor were placed in such a manner as to facilitate sand grouting of the substrata in case any cavity had been left un-noticed or the new concrete did not fill the gap comletely. As a first step sand was grouted to fill up the hollows and then the holes were pluged at top after grouting with cement.

(*iv*) Contact grouting below the horizontal impervious floor of the undamaged bays 1-8 Panjnad Regulator was done with cement (mixed with water in the ratio of about 1:3) at the rate of 6 grout holes per bay. The approximate location of the grout holes is shown in the data given on the next page.

(*a*) About 7½, upstream of the construction joint.

(*b*) About 8 ft. below the construction joint but on the upstream side of the new crack.

(*c*) About 10 ft. upstream of the concrete the wall but on the downstream side of the new crack.

7.12 The grouting pressure was kept variable depending upon the thickness of the floor at each location. The operation was done under the direct supervision of qualified staff in day light by keeping the behaviour of adjoining floor under strict watch. The closeness of the grout holes provided added safety against development of excessive pressure as the adjoining holes tended to act as relief valves. The detail of materials pumped into the grout holes is given in Annexure No. III.

7.2 **Concrete Joints**

7.21 As already stated the concreting of the new floor was done in pannels of manageable sizes. In each block of concrete, grooves were left on the sides to wedge the adjoining block which in addition to proper bondage provided a good overlap. Water rubberstop duly anchored in the adjacent blocks were provided all along the construction joints to block passage of seepage water or flow of sub-strata in the event of opening of the joints by shrinkage etc.

7.22 The concrete thickness of the new work as designed by Khosla's theory was more than the thickness of the old floor. This permitted overlaps at the junction of the old work thereby attaining a relatively more secure joint. As a further caution 2 to 3 grout holes extending upto the bottom surface of the old work were also left in each block of new concrete to fill up the cavities if any at the junction point.

7.23 Before laying additional concrete on the Glacis of bays 9—12 Panjnad regulator 2 ft. deep holes were drilled at about 6 ft. interval in the existing floor. ¾ inch diameter anchor bars fitted with steel bolts at the bottom (capable of expanding on winding the screws for a tight grip) were then grouted in these holes. The anchor bars were in turn tied with the temperature reinforcement at the top for attaining a comparatively more secure bond of the new concrete with the old work.

7.24 At Junction of the new concrete with the crest of bays 9-12 Panjnad Regulator old concrete in the form of a wedge was removed in a width of about 5 ft. and depth of about 6" to 12". Anchor bars were then grouted in the recess similar to para 7.23 above for attaining a secure bond at the crest.

7.25 The old surface of concrete and stone work forming union with the additional concrete of Glacis in bays 9 to 12 Panjnad Regulator was thoroughly scrubed, chiselled and painted with coat of Expendabond as already discussed in Para 6.75 A (a) (vi) earlier.

7.26 Old concrete around the new cracks and opened out construction joints of bays 1-8 Panjnad Regulator was removed and re-instated as already discussed in Para 6.75 A (b) (vi) and (vii) earlier.

7.3 Piezometers

7.31 In the hydraulic structure where the pressures due to head across are acting, the behaviour of the sub-soil flow underneath the impervious floor at different points is necessarily required to be kept under watch. To monitor this behaviour, piezometers at suitable locations under the relayed floor of Panjnad and Abbassia regulators have been provided as under :—

(*i*) Four pressure points in the Abbasia regulator—2 located on either side of intermediate pile and 2 at the end of the impervious floor.

(*ii*) Three pressure points under the divide wall—2 located on either side of the intermediate pile on the Abbasia Regulator side and one at the inside cornor of sheet piles on the Panjnad Regulator side.

(*iii*) One pressure point on downstream side of intermediate pile line in bay No. 12,

(*iv*) One pressure point on upstream side of intermediate pile line in bay No. 11.

(*v*) Two pressure points on either side of pile line at the end of impervious floor in bay No. 10.

(*vi*) Four pressure points in bays No. 9 below the foundation block of additional divide wall at location similar to (i) above.

(*vii*) Two pressure points in bay No. 8 below the foundation block of additional divide wall near the intermediate sheet pile line and on upstream of the concrete toe wall at the end of the impervious floor.

(*viii*) Two pressure points on upstream side of the sheet pile line below the impervious floor of common bank (between the Regulators) on Panjnad Canal side.

7.32 The strainer of the pressure points were wrapped in a graded filter composed of spawl, shingle (size $\frac{3}{4}$" to $1\frac{1}{2}$"), shingle (size 3/16" to $\frac{3}{4}$") and coarse sand each having a thickness of $4\frac{1}{2}$". The pressure point fittings and the leading pipes were of PVC material with read-out-points in the two divide walls and left bank of Panjnad Canal.

7.4 Schedule of Construction

7.41 While devising scheme for the repairs to the regulators it was desired that the work be got done through a prequalified resourceful contracting firm. Applications were invited for prequalification of the contractors and although given a wide publicity in the press, the response was found to be extremely poor. This may be on account of the intricate nature of work, rapidly fluctuating market rates and completion required in a limited time. As the working period was very tight, no time could be lost in repeating attempts for prequalification which too could prove futile. Finding no way out it was ultimately decided to execute mechanical/electrical portions of the work departmentally and to entrust civil work to a number of contractors by inviting open tenders. This system entailed lot of preparedness on the part of the department for collecting a large fleet of machinery, tools, plants and other essential materials.

7.42 As the work had necessarily to be completed before the advent of Kharif season *i.e.* 15th April, 1974, all phases of the work were required to be done within specified targets. To have an effective watch on the progress, a detailed working schedule was chalked out and adhered to strictly as per Plate No. 15.

7.43 The magnitude of the work was very large and hurdles in preparing the working area too many. The work had to be continued almost throughout the period in two shifts by deploying a large fleet of machinery and trained crew (see photograph No. 3). Strict control on

quality of work was exercised by enforcing the specifications rigidly. Concreting of the panels in the month of March was organised at evening times or during night to avoid higher temperature during day time.

7.5 Acknowledgements

7.51 The author wishes to record with thanks the co-peration of the field and office staff in compilation of the relevant data and the preparation of the drawings. The author appreciates all the kindness, help and encouragement received from the senior officers of which Messrs Mian Khalil-ur-Rehman (Secretary Irrigation and Power Deptt. Punjab) and Haji Mohammad Akhtar Qureshi (Chief Engineer Irrigation, Bahawalpur Region) deserve a particular mention. The author is indebted to M/s. National Engineering Services Pakistan Ltd. (Designers for Regulators) for rendering prompt and able services. The author was particularly impressed by the skill, devotion to work and planning capabilities of M/s. Shamsher Khan Bhatti, Mohammad Ashraf, Executive Engineers and Mohammad Alim, Abdul Latif Pasha, Sub Divisional Officers. Their association made this extremely difficult and intricate job to be accomplished in a tight schedule very smoothly.

Annexure—I

IMPORTANT DATA OF PANJNAD HEADWORKS

RIVER UPSTREAM OF WEIR

1.	Afflux Level	= R.L. 341.5	
2.	Pond Level :		
	Summer	= R.L. 337.5	
	Winter	= R.L. 334.0	

RIVER DOWNSTREAM OF WEIR

3.	Assumed H.F.L.	= R.L. 338.5	
4.	Assumed Lowest water level General	= R.L. 319.0	
5.	Differensial head acoass the weir :		
	Designed	= 18.5	Ft.
	Restricted in the year 1957	= 16.0	Ft.
6.	Total water-way (47 bays of 60' each)	= 2,820	Ft.

GENERAL

7.	Total width of weir between extreme abutments	= 3,400	Ft.
8.	Crest level	= R.L. 325.0	
9.	U.S. Impervious floor level	= R.L. 320.0	
10.	Level of Pacca floor D/S (Bays 1-33)	= R.L. 316.0	
	(Bays 34-47)	= R.L. 315.0	

ROAD BRIDGE

11.	Width of roadway	= 10	Ft.
12.	Permissible loading	= 18	Tons

PUNJNAD CANAL

13.	Discharge (2832 Perennial+6735 N.P.)	= 2567	cusecs
14.	Waterway-10 bays of 26 ft. each and 2 bays of 18 ft. each	= 296	Ft.
15.	Cill level	= R.L. 332.5	
16.	Bed level/D/S impervious floor level	= R.L. 324.0	
17.	Designed full supply level	= R.L. 335.7	
18.	Bed width at Regulator	= 340	Ft.

19.	Designed bed width of the channel	=	240 Ft.	
20.	Edge of Impervious floor D/S of breast wall face			
	(Bays 1-8)	=	117.06 Ft.	(Original)
	(Bays 9-11)	=	120.5 Ft.	(As reconstructed)
	(Bay 12)	=	163.5 Ft.	—do—
21.	Edge of concrete blocks D/S of Breast wall face :			
	(Bays 1-8)	=	137.06 Ft.	(Original)
	(Bays 2-11)	=	140.5 Ft.	(As reconstructed)
22.	Edge of Flexible stone apron D/S of breast wall face :			
	(Bays 1-12)	=	160.0 Ft.	(Original)
	(,, 1-2)	=	190.0 Ft.	(As reconstructed)
	(,, 3-8)	=	180.0 Ft.	—do—
	(,, 9-11)	=	183.5 Ft.	—do—
23.	Differeutial head across the structure	=	17.5 Ft.	

ABBASIA CANAL

24.	Discharge (426 Prennial+638 N.P.)	=	1064	cusecs
25.	Water-way—2 bays of 20 ft. each	=	40	Ft.
26.	Cill level	=	R.L. 330.0	
27.	Bed level D/S impervious floor level	=	R.L. 328.7	
28.	Designed full supply level	=	R.L. 335.1	
29.	Edge of Impervious floor D/S of breast wall face	=	94	Ft. (As reconstructed)
30.	Edge of Concrete blocks D/S of breast wall face	=	119	Ft. —do—
31.	Edge of flexible stone apron D/S of breast wall face	=	12.8	Ft. —do—
32.	Differential head across the structure	=	12.8	Ft.

Annexure—II

STATEMENT SHOWING YEARWISE PEAK DISCHARGES AT PANJNAD

Sr. No.	DATE	Discharge (Cusecs)	Sr. No.	DATE	Discharge (Cusecs)
1.	4.8.1922	2,90,416	27.	21.8.1948	4,89,634
2.	24.8.1923	3,32,305	28.	6.8.1949	3,12,426
3.	3.8.1924	3,05,000	29.	27.9.1950	**6,76,722**
4.	4.8.1925	4,04,554	30.	17.8.1951	2,45,630
5.	25.8.1926	3,30,439	31.	11.8.1952	3,34,108
6.	10.8.1927	4,06,863	32.	17.7.1953	2,78,508
7.	7.9.1928	4,96,054	33.	2.10.1954	3,81,636
8.	4.9.1929	**5,49,106**	34.	15.10.1955	**5,50,000**
9.	15.7.1930	3,46,248	35.	7.8.1956	3,86,891
10.	29.8.1931	3,00,653	36.	2.9.1957	**5,59,000**
11.	9.8.1932	3,00,000	37.	13.8.1958	**5,72,670**
12.	26.8.1933	3,39,665	38.	12.7.1959	4,93,368
13.	21.8.1934	2,55,193	39.	18.7.1960	3,55,268
14.	19.8.1935	3,17,247	40.	14.8.1961	3,87,816
15.	11.7.1936	2,52,478	41.	2.9.1962	2,16.004
16.	1.8.1937	1,71,947	42.	27.8.1963	2,37,554
17.	21.8.1938	2,52,282	43.	23.8.1964	4,41,018
18.	30.8.1939	2,10,000	44.	2.8.1965	2,88,136
19.	15.8.1940	2,23,472	45.	16.9.1966	4.15,410
20.	18.8.1941	1,48,799	46.	11.8.1967	1,55,152
21.	30.8.1942	4,34,680	47.	30.8.1968	2,13,082
22.	2.9.1943	3,32,639	48.	15.8.1969	2,91,286
23.	18.8.1944	2,79,112	49.	7.9.1970	1,44,992
24.	31.7.1945	2,25,702	50.	17.8.1971	2.61,381
25.	7.8.1946	2,36,448	51.	19.7.1972	1,61,713
26.	7.10.1947	2,09,873	52.	16.8.1973	**8,02,516**

Note : Data copied from Bund Manual page 205 (Statement IX) for the years 1922-31 and thereafter from the history of Panjnad headworks.

1	2	3	4	5	6
6.	Crest	1	23.0	..	Gravity
	Centre of Decking		0.50	...	,,
	U/S of Construction joint	1	...	0.10	5 lbs/□"
	,, ,, ,,	2	...	0.10	,,
	Upstream of Crack	1	...	0.10	3 lbs/□"
	,, ,, ,,	2	...	8.0	,,
	Down stream of Crack	1	...	0.10	,,
	,, ,, ,, ,,	2	...	0.10	,,
7.	Crest		1.4	...	Gravity
	U/S of Construction joint	1	...	0.25	5 lbs/□"
	,, ,, ,,	2	...	0:50	,,
	Upstream of crack	1	...	0.50	3 lbs/□"
	,, ,, ,,	2	...	0.50	,,
	Downstream of Crack	1	...	0.50	,,
	,, ,,	2	...	41.00	,,
8.	Crest	1	18.5	...	Gravity
	,,	2	16.8	...	,,
	,,	3	23.3	...	,,
	Along foundation) block of divide) wall at Junction) of old and new) concrete)	1	...	5.0	Gravity + 5 lbs/Sq. Inch
	)	2	...	1.0	,,
	)	3	3.4	0.75	Gravity + 3 lbs/Sq.Inch
	)	4	0.6	0.25	,,
	)	5	2.3	0.25	,,
	)	6	1.4	38.0	,,
	U/S of Construction joint	1	...	1.0	5 lbs/□"
	,, ,, ,,	2	...	26.5	Gravity
	D/S of Construction joint	...	...	0.75	3 lbs/□"
9.	Crest	1	42.7	...	Gravity
	,,	2	12.0	...	,,
	,,	3	10.1	...	,,
	3.5' below pier at Junction with old floor	1	1.0	0.25	Gravity & 5 lbs/□"
	—do—	2	3.37	1.00	,,

1	2		3	4	5
10.	Crest	1	5.0	...	Gravity
	,,	2	12.3	...	,,
	,,	3	16.8	...	,,
	3.5′ below pier at junction with old floor	1	16.5	0.25	Gravity & 5 lbs/□″
	—do—	2	...	0.25	,,
11.	Crest	1	0.50	...	Gravity
	,,	2	11.10	...	,,
	,,	3	5.90	...	,,
	3.5′ below pier at junction with old floor	1	0.20	0.25	Gravity & 5 lbs/□″
	—do—	2	0.20	0.25	,,
	—do—	3	27.0	0.25	,,
2.	Crest	1	18.5	...	Gravity
	,,	2	2.8	...	,,
	,,	3	1.7	...	,,
	3.5′ below pier at junction with old floor	1	0.28	0.25	Gravity & 5 lbs/□″
	—do—	2	9.50	0.25	,,
	—do—	3	5.5	0.25	,,

1

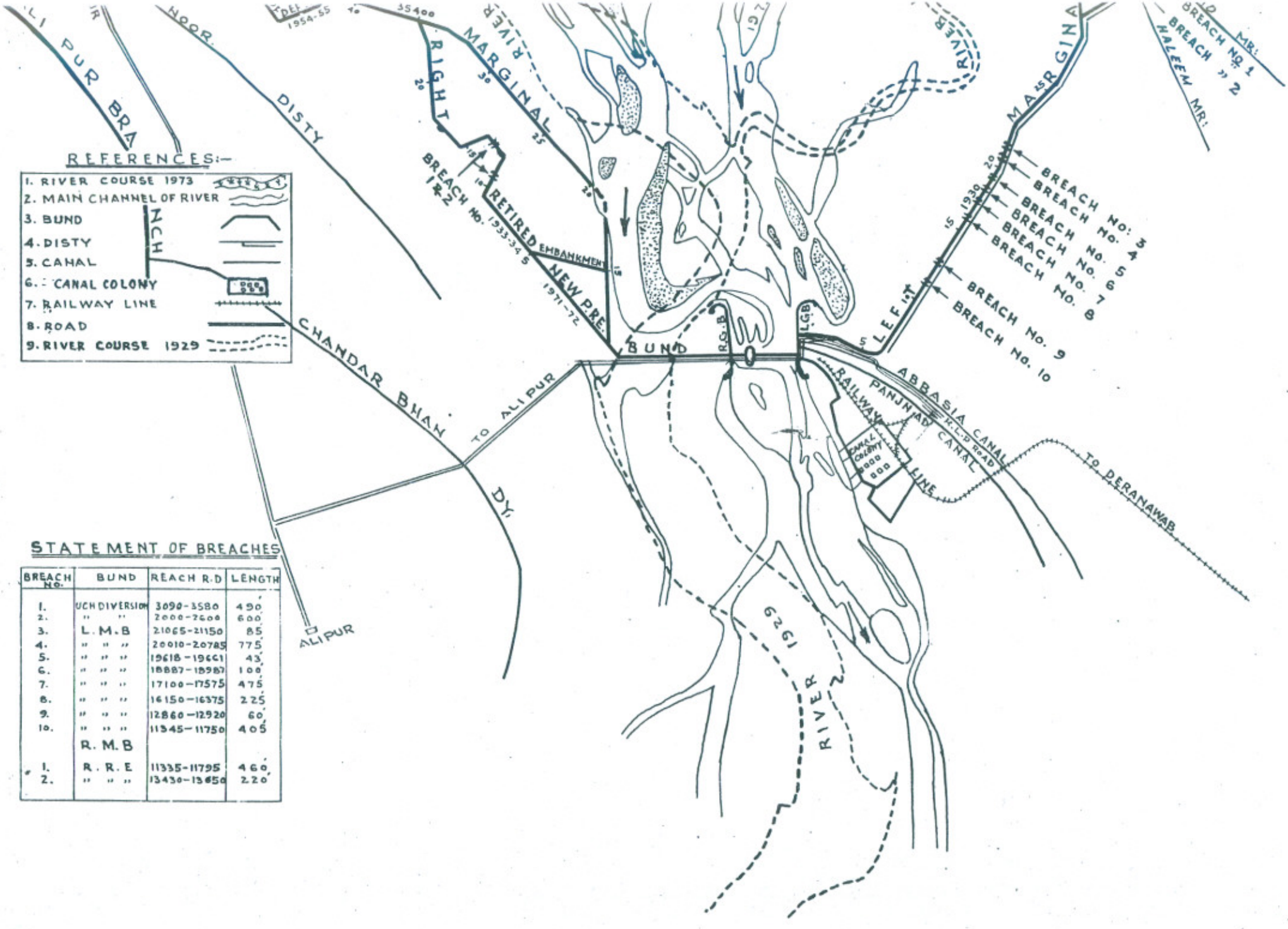
B. ABBASIA REGULATOR

1.	2.5 ft. below pier at junction with old floor	1	9.0	6.5	Gravity & 5 lbs/□″
2.	Centre of boy at junction with old floor	2	0.50	0.25	,,
	—do—		10.60	0.25	,,

STATEMENT SHOWING
CEMENT/SAND GROUTING IMPERVIOUS FLOOR OF PANJNAD AND ABBASIA CANAL REGULATORS

Bay No.	Location of Hole		Extent of Grouting		Grouting Pressure
			Sand (Cft)	Cement (Cwt)	
1	2		3	4	5
	A. PANJNAD REGULATOR				
1.	Crest	1	2.25	...	Gravity
	,,	2	0.25	...	,,
	Centre of Decking		4.75	...	,,
	U/S Construction joint	1	...	0.75	5 lbs/□"
	,, ,, ,,	2	...	0.25	,,
	D/S Construction joint	1	...	0.50	3 lbs/□"
	U/S of crack	1	...	1.00	,,
2.	Crest	1	9.00	...	Gravity
	,,	2	8.50	...	,,
	,,	2	16.00	...	,,
	Centre of Decking		0.75	...	,,
	U/S of Construction joint	1	...	1.00	5 lbs/□"
	,, ,, ,,	2	...	0.50	,,
	D/S of Construction joint	1	...	0.25	3 lbs/□"
	,, ,, ,,	2	...	0.50	,,
	Upstream of Crack	1	...	3.00	,,
	,, ,, ,,	2	...	0.50	,,
	Downstream of Crack	1	...	0.50	,,
	,, ,, ,,	2	...	0.50	,,

1	2	3	4	5	
3.	Crest	1	34.2	...	Gravity
	,,	2	11.5	...	,,
	,,	3	24.0	...	,,
	U/S of Construction joint	1	...	0.50	5 lbs/□"
	,, ,, ,,	2	...	1.00	,,
	D/S of Construction joint	1	...	0.50	3 lbs/□"
	Upstream of crack	1	...	1.50	,,
	,, ,, ,,	2	...	2.00	,,
	Downstream of crack	1	...	0.50	,,
	,, ,, ,,	2	...	0.50	,,
4.	Crest	1	34.0	...	Gravity
	,,	2	8.8	...	,,
	,,	3	26.0	...	,,
	Centre of Decking		0.12	...	,,
	U/S of Construction joint	1	...	22.0	5 lbs/□"
	,, ,,	2	...	0.10	,,
	Upstream of Crack	1	...	0.10	3 lbs/□"
	,, ,, ,,	2	...	0.10	,,
	Downstream of crack	1	...	0.10	,,
	,, ,, ,,	2	...	0.25	,,
5.	Crest	1	32.50	...	Gravity
	,,	2	10.25	...	,,
	,,	3	29.25	...	,,
	U/S of Construction joint	1	...	0.25	5 lbs/□"
	,, ,, ,,	2	...	0.10	,,
	Upstream of crack	1	...	0.25	3 lbs/□"
	,, ,, ,,	2	...	0.10	,,
	Downstream of crack	1	...	0.10	,,
	,, ,, ,,	2	...	0.25	,,



STATEMENT OF BREACHES

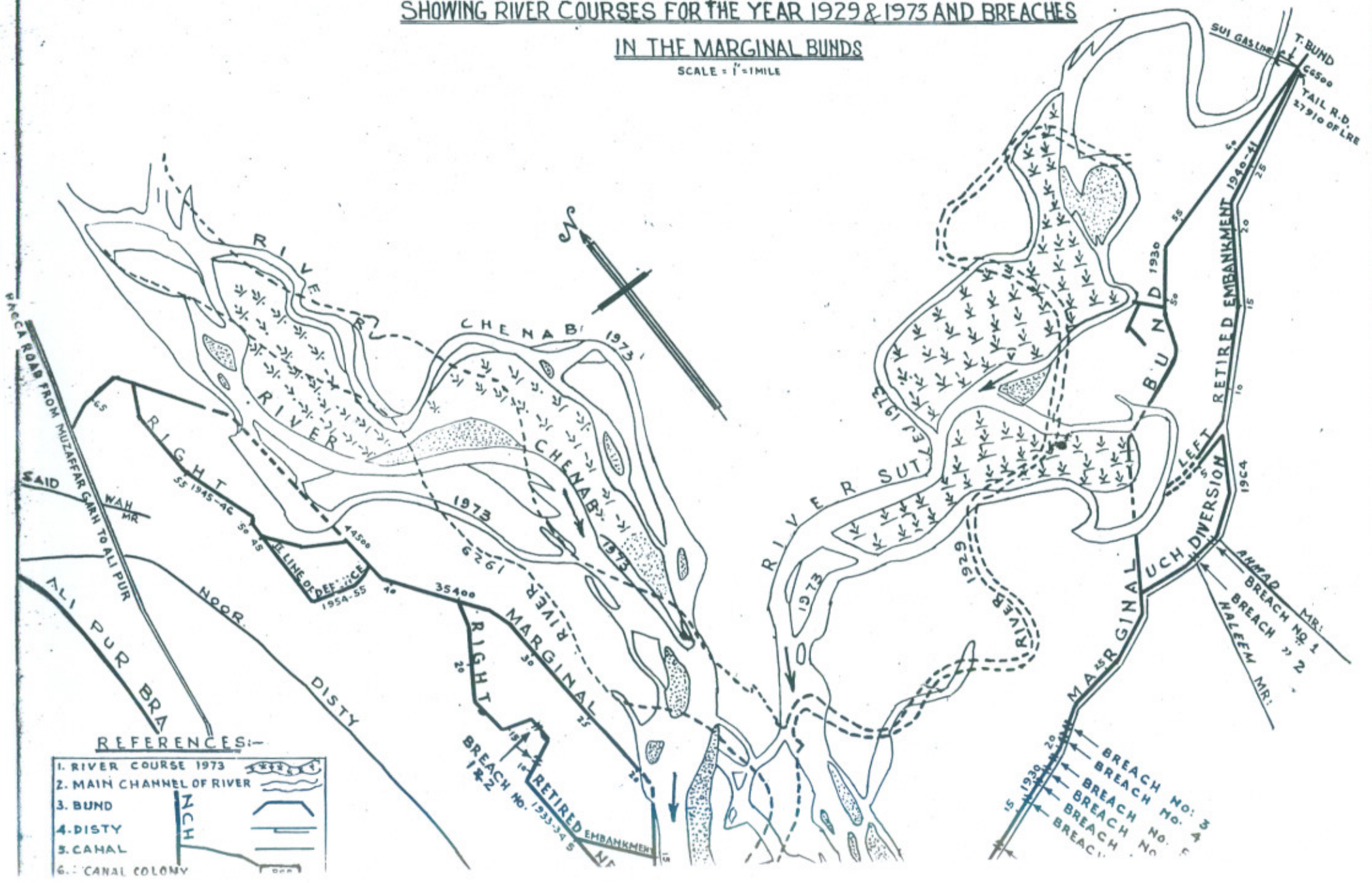
BREACH No.	BUND	REACH R.D	LENGTH
1.	UCH DIVERSION	3090-3580	490'
2.	" "	2000-2600	600'
3.	L.M.B	21065-21150	85'
4.	" " "	20010-20785	775'
5.	" " "	19618-19661	43'
6.	" " "	18887-18987	100'
7.	" " "	17100-17575	475'
8.	" " "	16150-16375	225'
9.	" " "	12860-12920	60'
10.	" " "	11345-11750	405'
	R.M.B		
1.	R.R.E	11335-11795	460'
2.	" " "	13430-13650	220'

PLATE NO: 1

INDEX PLAN OF PANJNAD HEAD WORKS

SHOWING RIVER COURSES FOR THE YEAR 1929 & 1973 AND BREACHES IN THE MARGINAL BUNDS

SCALE = 1" = 1 MILE



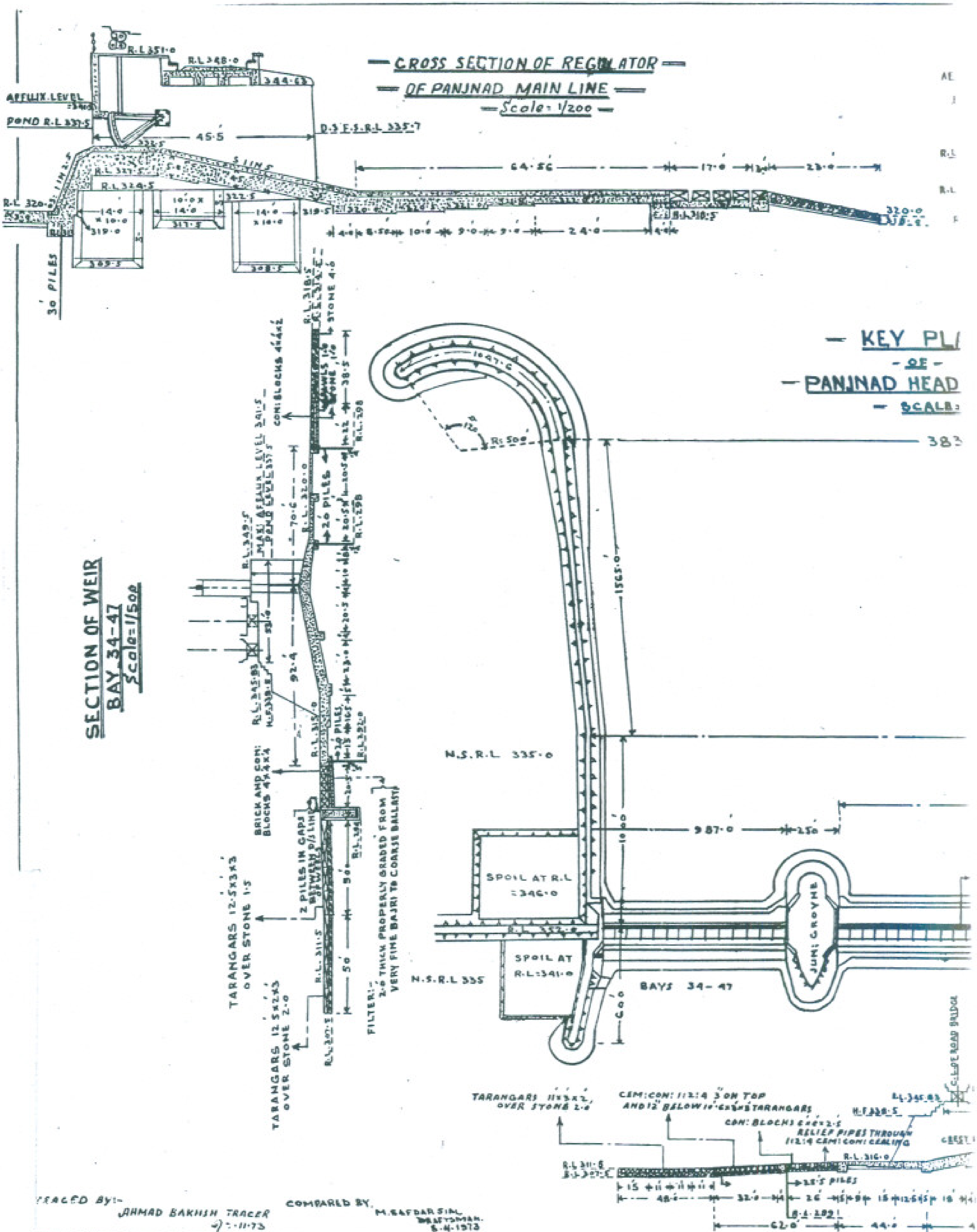

CROSS SECTION OF REGULATOR
OF PANJNAD MAIN LINE
Scale= 1/200
AFFLUX LEVEL
POND R.L 337.5
R.L 351.0
R.L 348.0
344.63
D.S F.S.R.L 335.7
45.5
64.56
17.0
23.0
R.L 320.0
30' PILES
320.0
KEY PL
OF
PANJNAD HEAD
SCALE
SECTION OF WEIR
BAY 34-47
Scale=1/500
CON: BLOCKS 4x4x2
26 PILES
20 PILES
92.4
70.6
38.5
BRICK AND CON: BLOCKS 4x4x2
2 PILES IN GAPS BETWEEN D/S LINE OF WELLS
TARANGARS 12.5x3x3 OVER STONE 1.5
TARANGARS 12.5x2x3 OVER STONE 2.0
FILTER:- 2-0 THICK PROPERLY GRADED FROM VERY FINE BAJRI TO COARSE BALLAST
50'
R.L 311.5
N.S.R.L 335.0
N.S.R.L 335
1565.0
1000
987.0
250
600
383
SPOIL AT R.L =346.0
SPOIL AT R.L=341.0
BAYS 34-47
JUN: GROYNE
C.L OF ROAD BRIDGE
TARANGARS 11x3x2 OVER STONE 2.0
CEM:CON: 1:2:4 3" ON TOP AND 12" BELOW 10'x3'x2' TARANGARS
CON: BLOCKS 6x6x2.5
RELIEF PIPES THROUGH 1:2:4 CEM:CON: CEALING
R.L 316.0
H.F 338.5
R.L 345.83
CREST
R.L 311.5
25.5 PILES
15
48.0
32.0
26
62.0
44.0
TRACED BY:- AHMAD BAKHSH TRACER 4-11-73
COMPARED BY. M.SAFDAR SIAL DRAFTSMAN. 5-11-1973

PLATE NO. 2

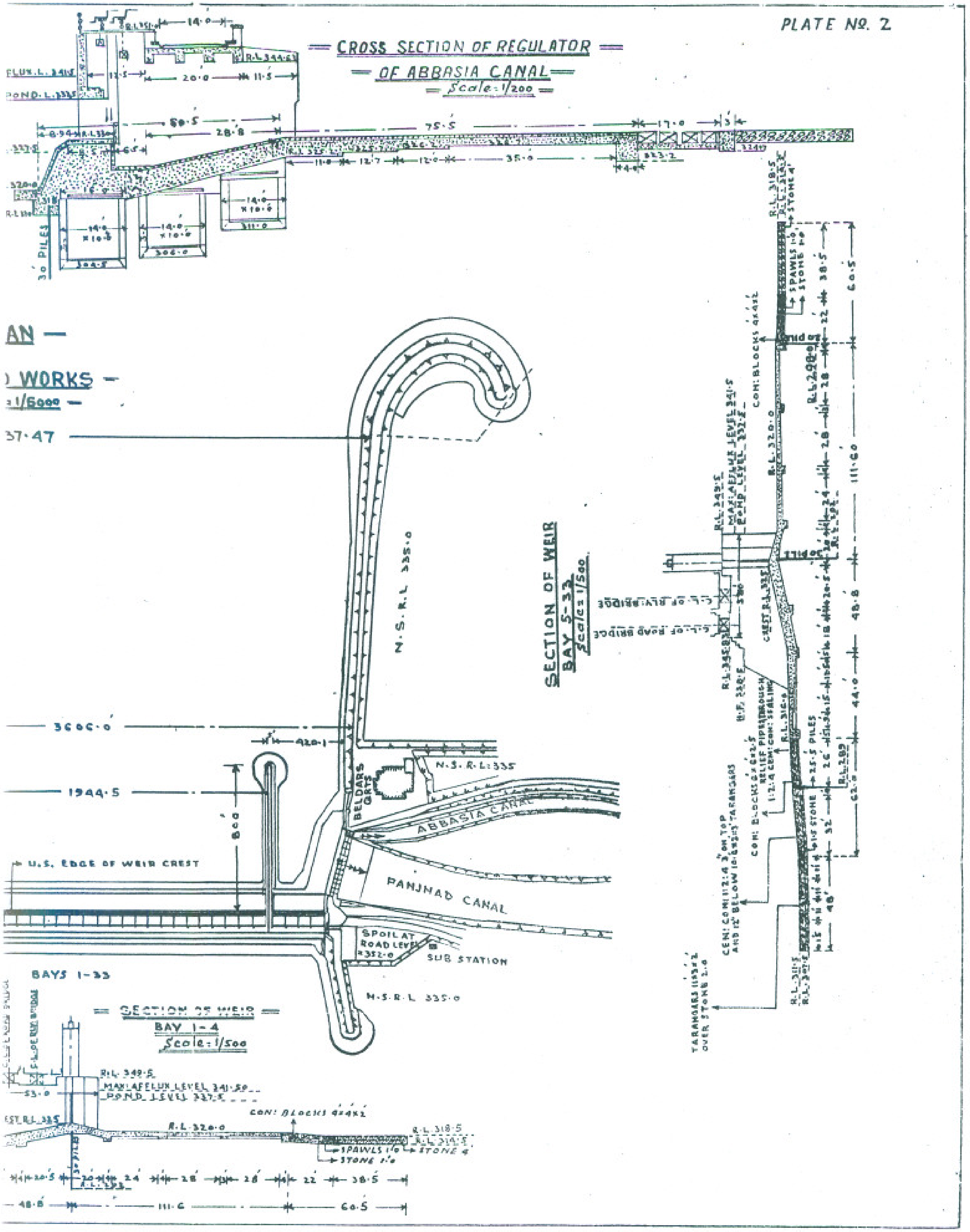
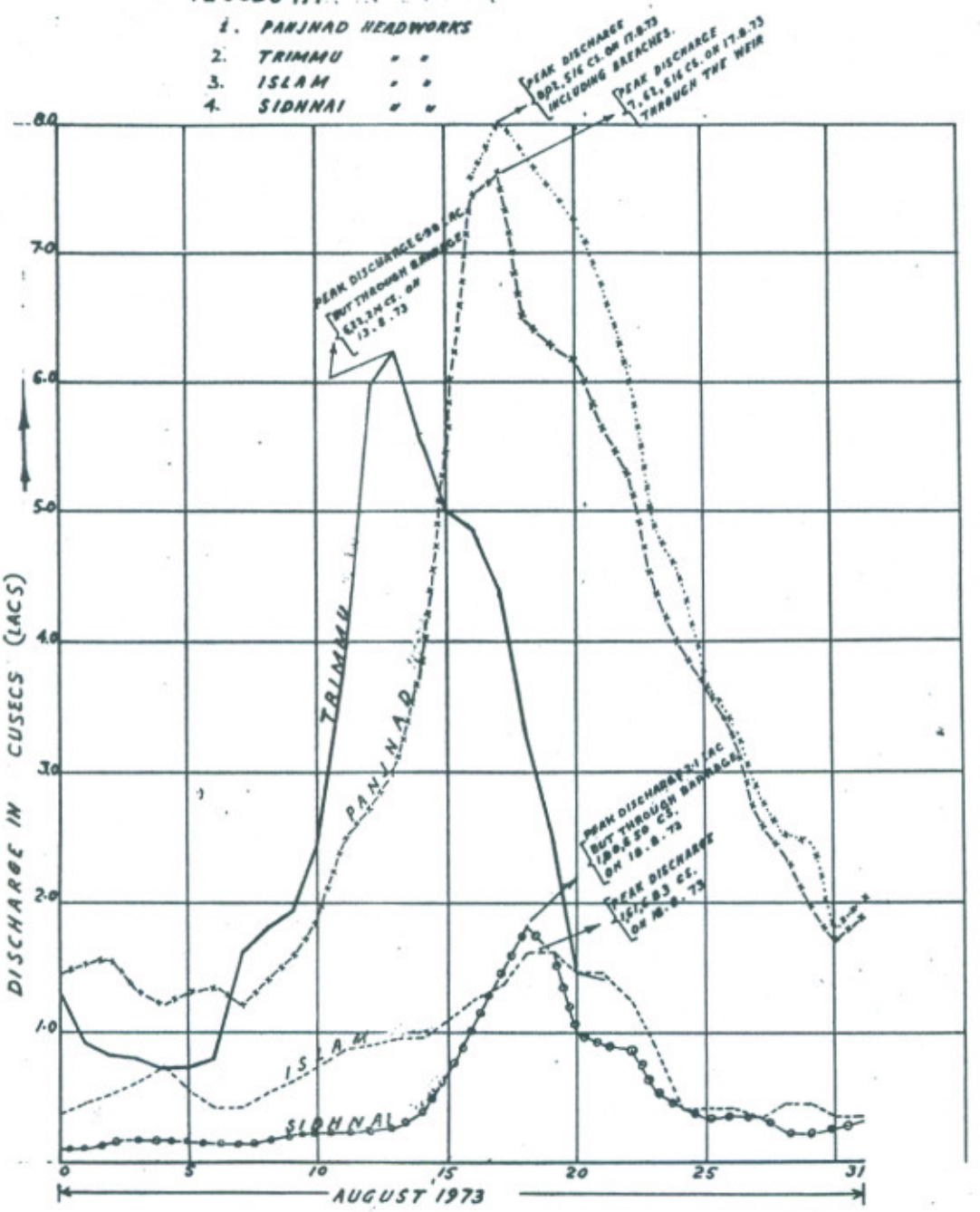

CROSS SECTION OF REGULATOR
OF ABBASIA CANAL
Scale: 1/200
30 PILES
AN —
WORKS —
1/6000 —
37·47
3606·0
1944·5
800
920·1
U.S. EDGE OF WEIR CREST
N.S.R.L 335·0
N.S.R.L:335
BELDARS QRTS
ABBASIA CANAL
PANJNAD CANAL
SPOIL AT ROAD LEVEL 352·0
SUB STATION
BAYS 1-33
SECTION OF WEIR
BAY 1-4
Scale: 1/500
R.L. 349·5
MAX: AFFLUX LEVEL 341·50
POND LEVEL 337·5
R.L. 320·0
CON: BLOCKS 4'x4'x2'
R.L. 318·5
SPAWLS 1'·0
STONE 1'·0
STONE 4'
SECTION OF WEIR
BAY 5-33
Scale: 1/500
C.L. OF ROAD BRIDGE
C.L. OF RLY: BRIDGE
CREST R.L. 335
R.L. 349·5
MAX: AFFLUX LEVEL 341·5
POND LEVEL 337·5
CON: BLOCKS 4x4x2
R.L. 290·0
CON: BLOCKS 6x6x2·5
RELIEF PIPES THROUGH
1:2:4 CON: SEALING
R.L. 289
25·5 PILES
CEN: CON: 1:2:4 3" ON TOP AND 12" BELOW 16·6x3x5 TARANGARS
TARANGARS 11x3x2 OVER STONE 2·0
60·5
111·60
48·8
44·0
62·0

PLATE NO. 3

HYDROGRAPH SHOWING PEAK DISCHARGES DURING 1973 FLOODS AT

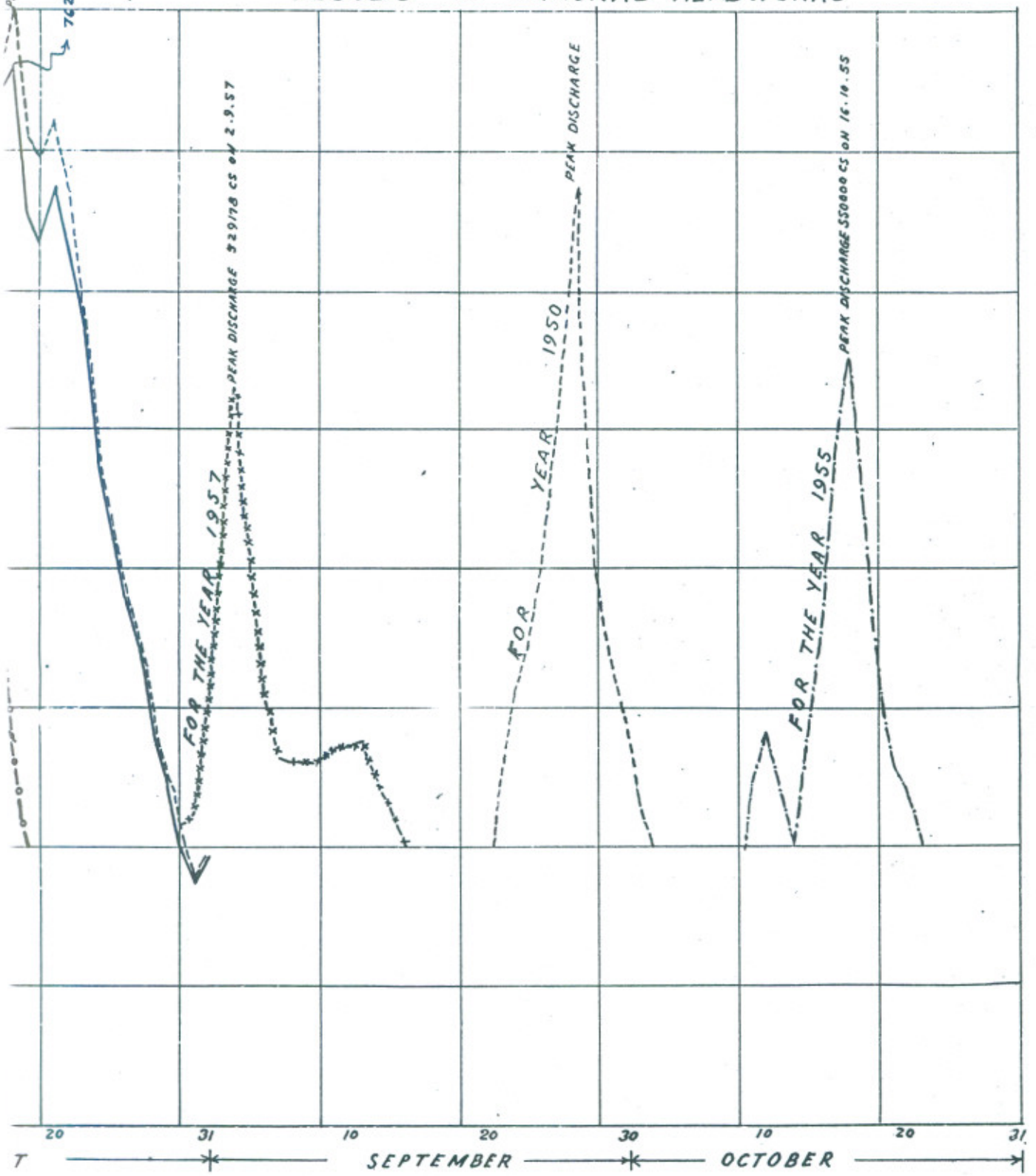
1. PANJNAD HEADWORKS
2. TRIMMU " "
3. ISLAM " "
4. SIDHNAI " "

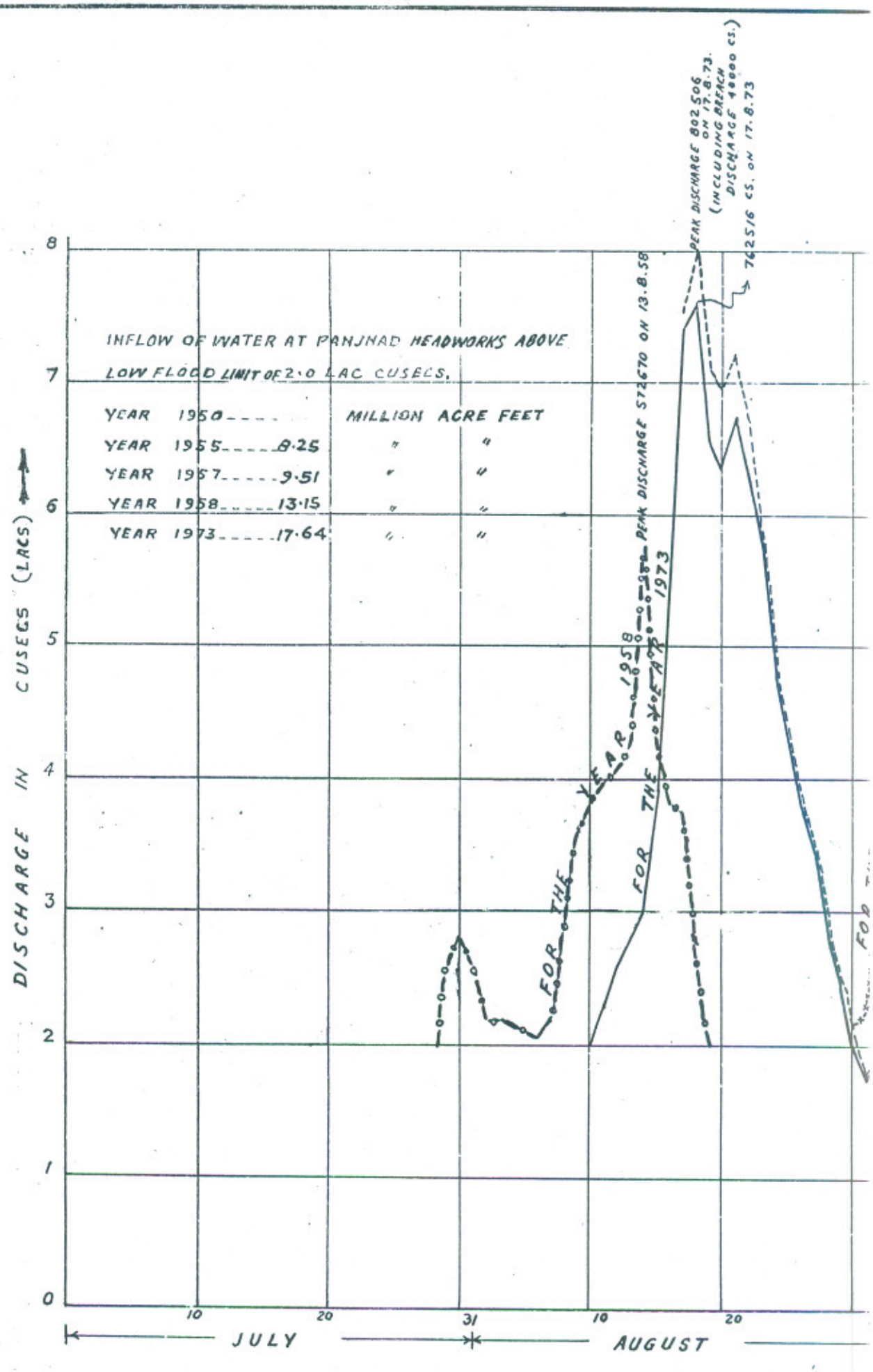


TRACED BY
Muhammad Ahmad
22.2.1974

PLATE NO 4

HYDROGRAPH SHOWING
PEAK DISCHARGES DURING 1950, 1955, 1957, 1958 & 1973
FLOODS AT PANJNAD HEADWORKS



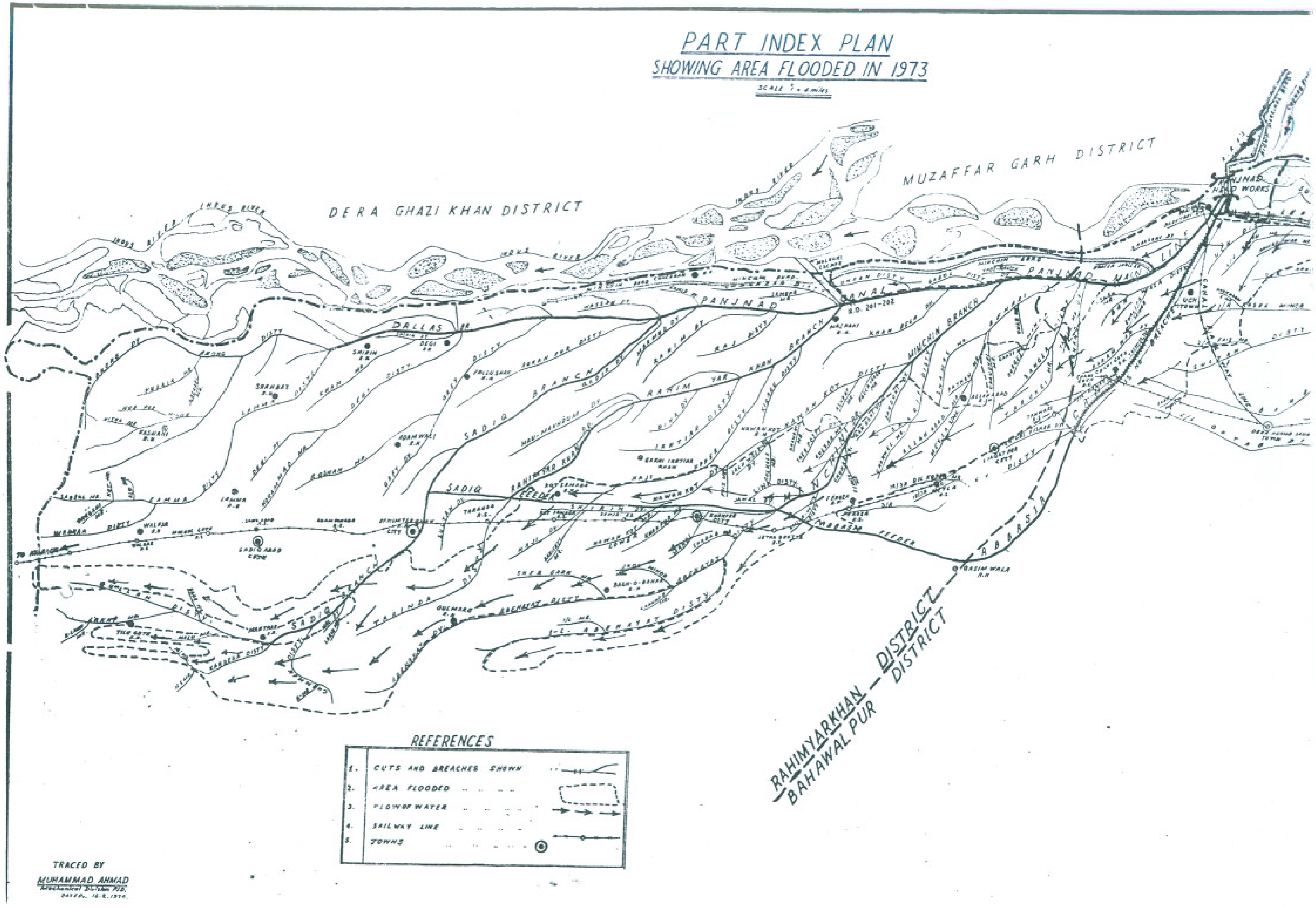


TRACED BY:
MUHAMMAD AHMAD
(TRACER)
26.2.74

PLATE NO:- 5

PART INDEX PLAN
SHOWING AREA FLOODED IN 1973

SCALE 1" = 4 miles


PART INDEX PLAN
SHOWING AREA FLOODED IN 1973
DERA GHAZI KHAN DISTRICT
MUZAFFAR GARH DISTRICT
INDUS RIVER
PANJNAD HEAD WORKS
PANJNAD MAIN LINE
PANJNAD CANAL
R.D. 201-202
DALLAS BR
SADIQ BRANCH
RAHIM YAR KHAN BRANCH
MINCHIN BRANCH
SADIQ FEEDER
ABBASIA FEEDER
ABBASIA
RAHIMYARKHAN — DISTRICT
BAHAWALPUR — DISTRICT
REFERENCES
1. CUTS AND BREACHES SHOWN
2. AREA FLOODED
3. FLOW OF WATER
4. RAILWAY LINE
5. TOWNS
TRACED BY
MUHAMMAD AHMAD

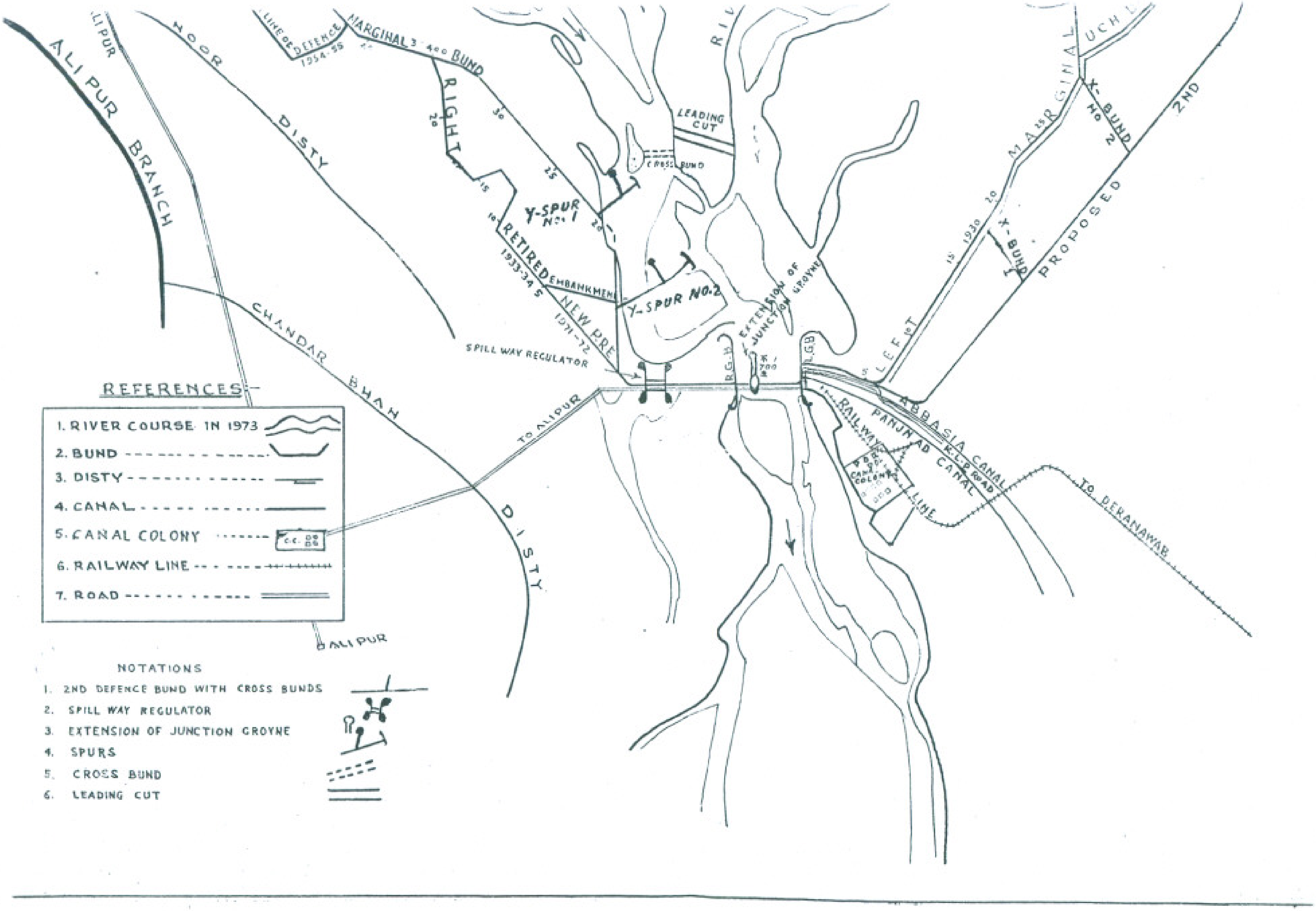

ALIPUR BRANCH
ALIPUR
NOOR DISTY
LINE OF DEFENCE 1954-55
MARGINAL 3-400 BUND
RIGHT
LEADING CUT
CROSS BUND
Y-SPUR No. 1
RETIRED EMBANKMENT 1933-34
NEW PRE 1971-72
Y-SPUR NO. 2
EXTENSION OF JUNCTION GROYNE
SPILL WAY REGULATOR
CHANDAR BHAH DISTY
R.G.B
L.G.B
TO ALIPUR
LEFT MARGINAL
X-BUND No 2
X-BUND
PROPOSED 2ND
ABBASIA CANAL
PANJNAD CANAL
K.L.P. ROAD
RAILWAY LINE
TO DERANAWAB
UCH
REFERENCES
1. RIVER COURSE IN 1973
2. BUND
3. DISTY
4. CANAL
5. CANAL COLONY
6. RAILWAY LINE
7. ROAD
ALIPUR
NOTATIONS
1. 2ND DEFENCE BUND WITH CROSS BUNDS
2. SPILL WAY REGULATOR
3. EXTENSION OF JUNCTION GROYNE
4. SPURS
5. CROSS BUND
6. LEADING CUT

PLATE NO: 6

INDEX PLAN OF PANJNAD HEAD WORKS

SHOWING PROPOSED WORKS

SCALE = 1" = 1 MILE

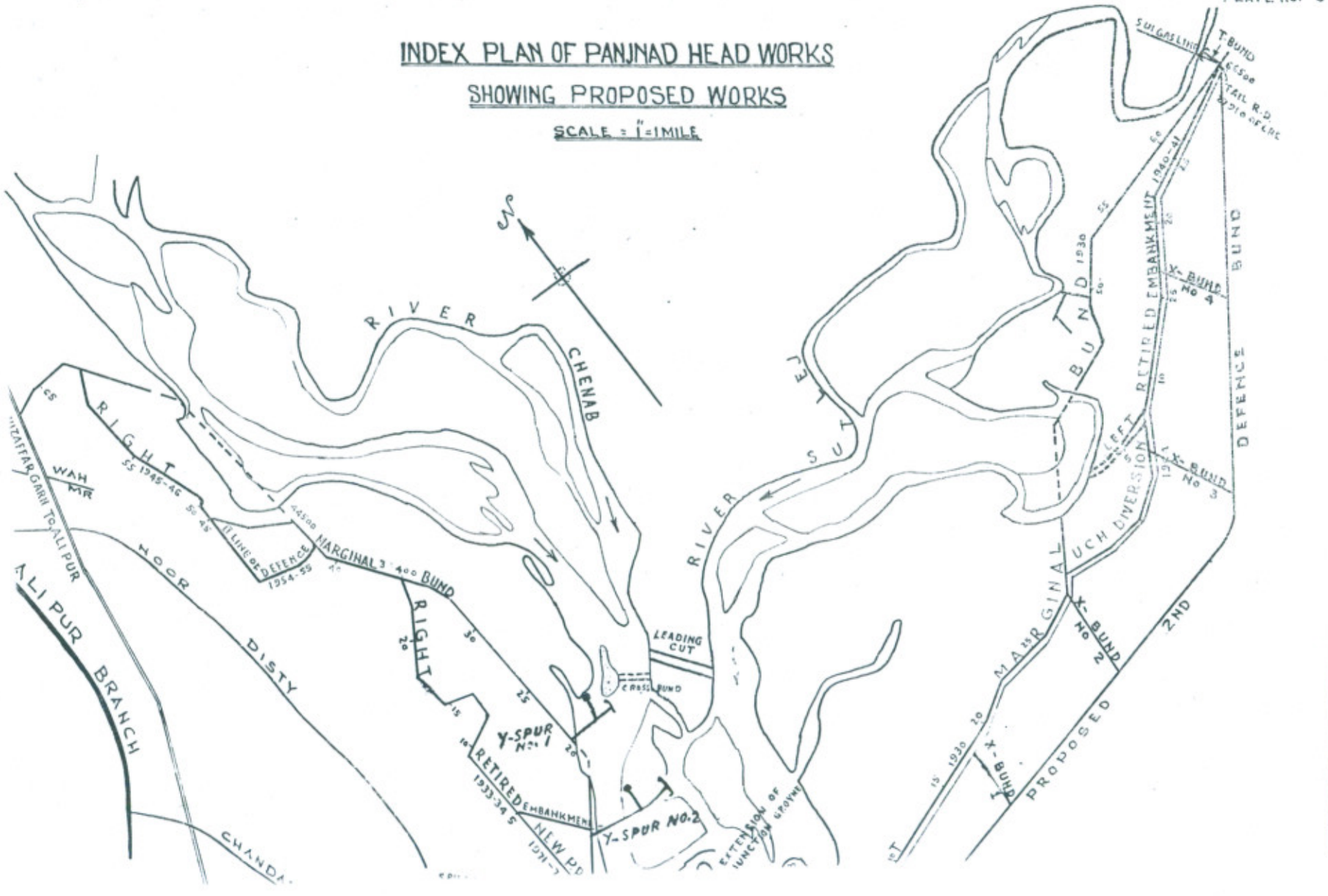
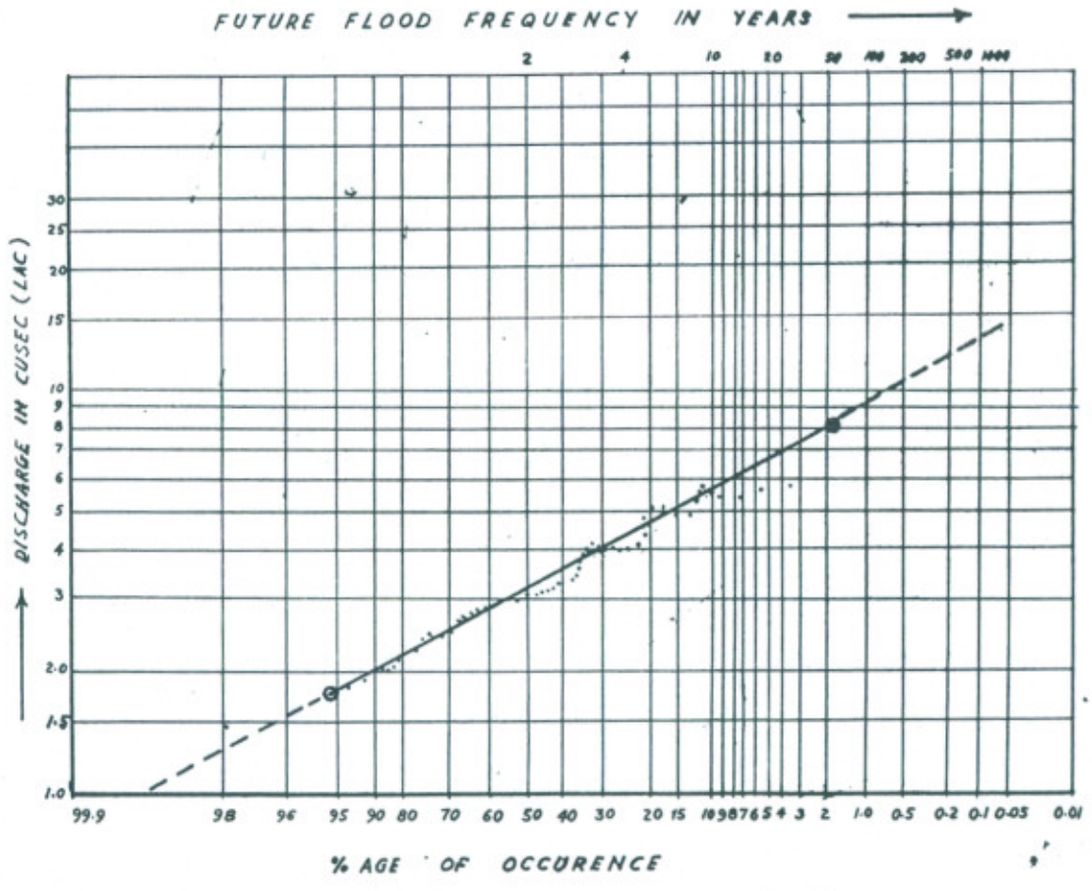


PLATE NO: 7



PROBABILITY CURVE
OF
PANJNAD BARRAGE
YEAR
1922 TO 1973

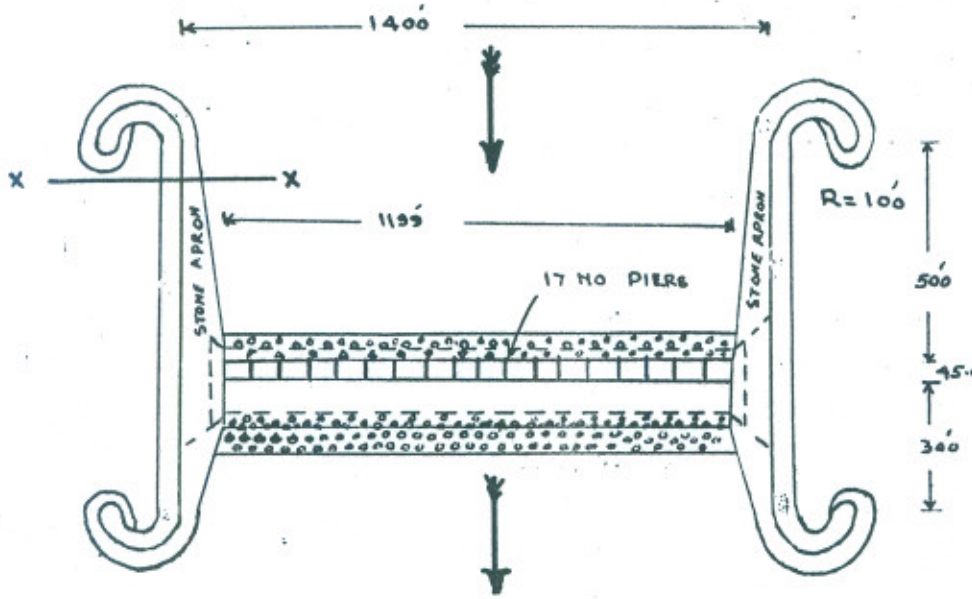
TRACED BY
MUHAMMAD AHMAD
19.3.74

PLATE N

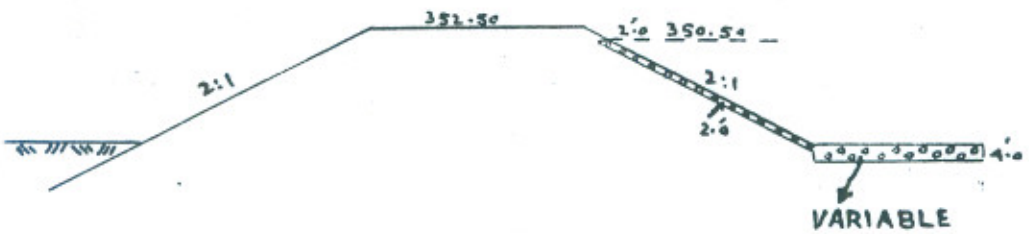
KEY PLAN OF SPILL WAY REGULATOR (PROPOSED)

AT PANJNAD HEADWORKS

SCALE = 1/5000



X-SECTION AT X-X



X-SECTION OF SPILL WAY REGULATOR

SCALE: 1/500

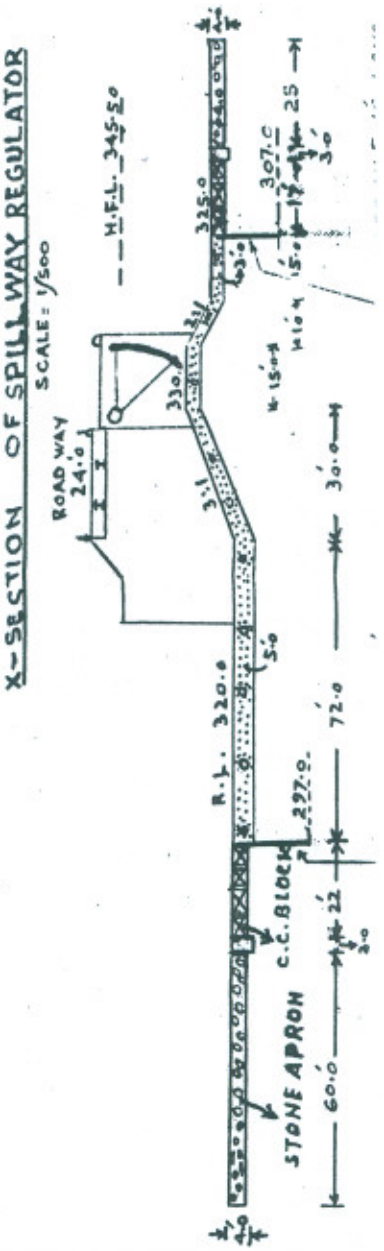
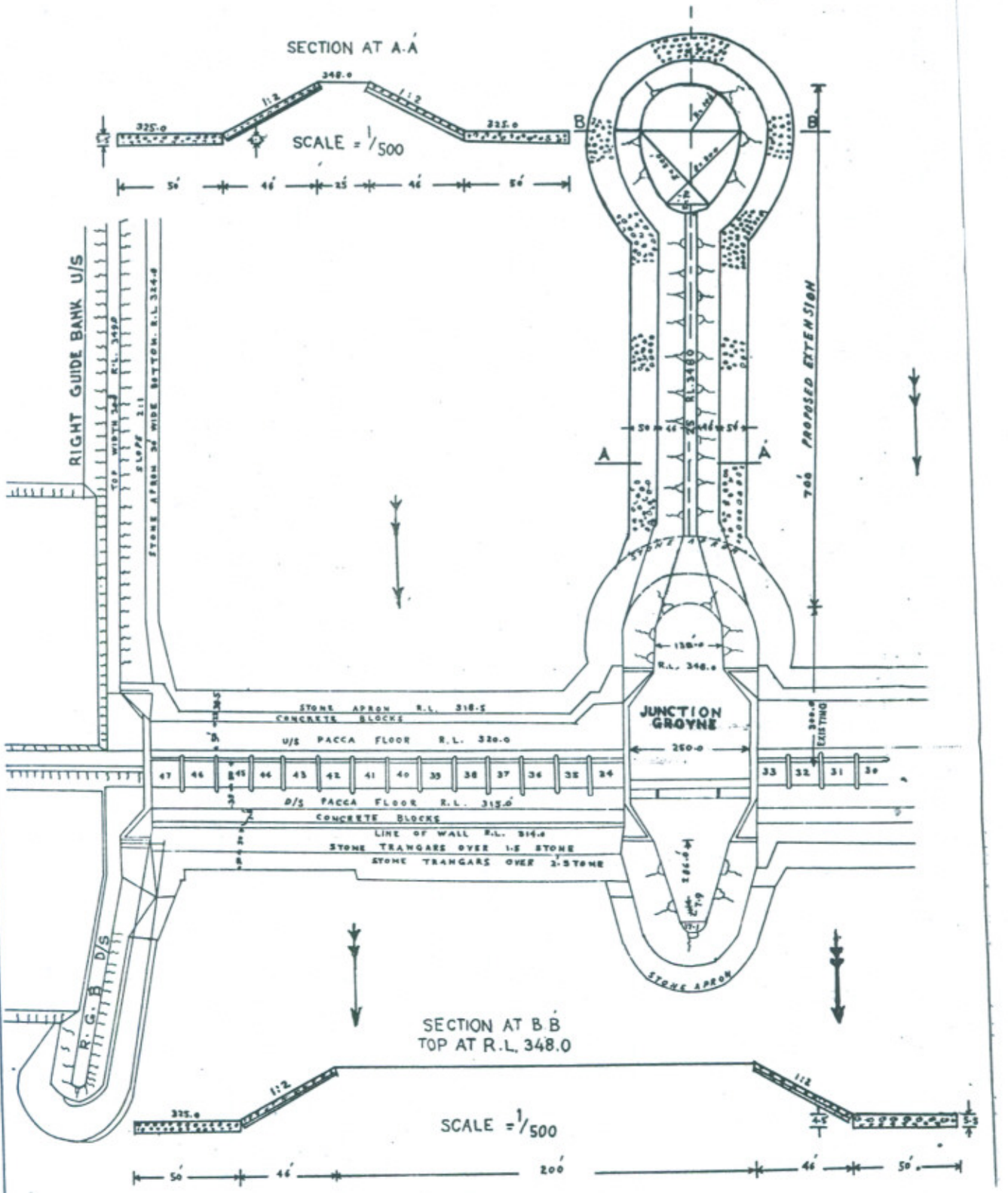


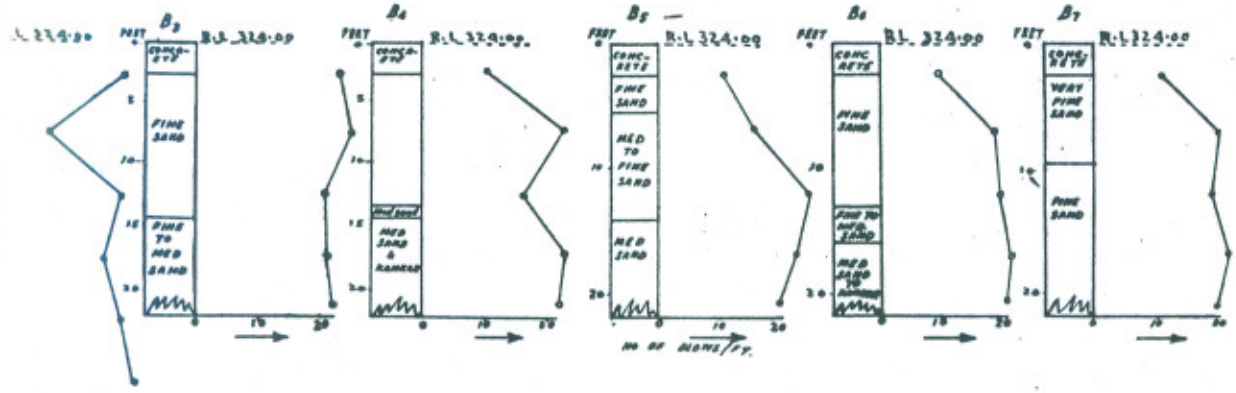
PLATE NO: 9

PROPOSED EXTENSION OF JUNCTION GROYNE AT PUNJNAD HEAD WORKS

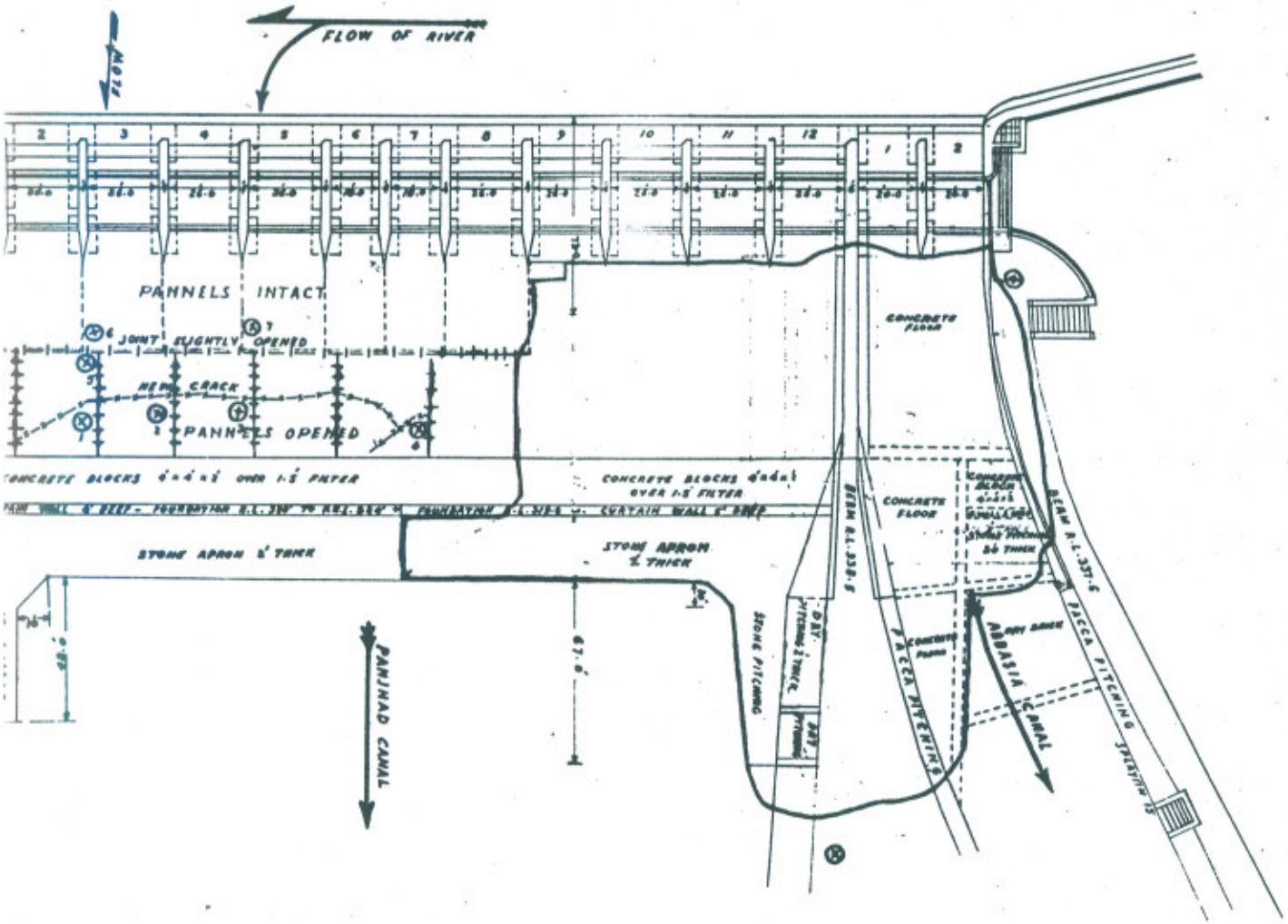
SCALE = 1/2000



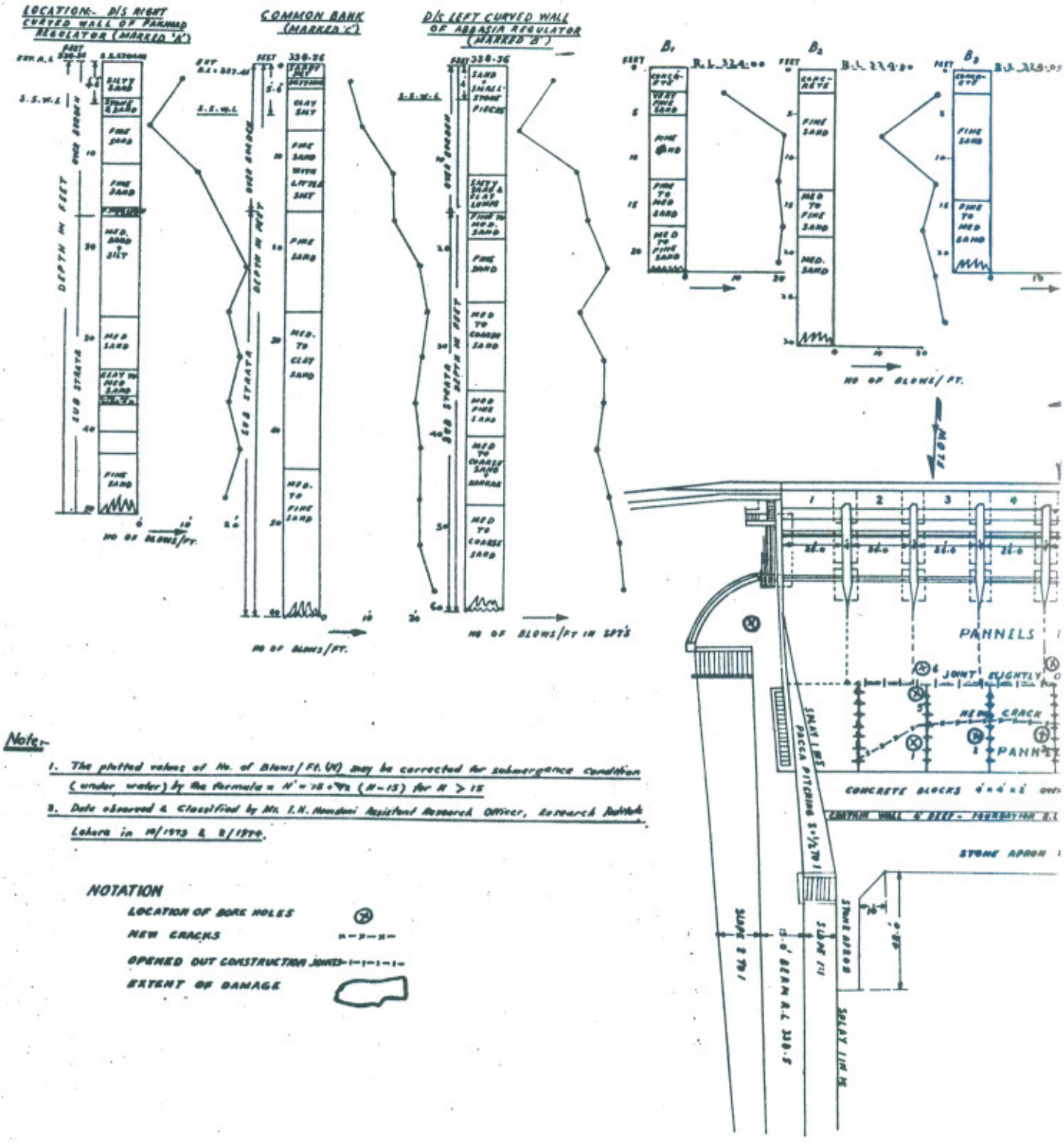
PLORATION AND STANDARD PENETRATION
PANJNAD & ABBASIA CANAL REGULATORS
GE TO THE STRUCTURE



GENERAL LAY OUT PLAN



DRAWING SHOWING SUB-SOIL EXPLORATION AND
TESTS FOR THE DESIGN OF PANJNAD & ABBASIA
AND EXTENT OF DAMAGE TO THE STRUC



Note:-

1. The plotted values of No. of Blows / Ft. (N) may be corrected for submergence condition (under water) by the formula $n = N' = 15 + \frac{1}{2}(N-15)$ for $N > 15$
2. Data observed & Classified by Mr. I.H. Hamdani Assistant Research Officer, Research Institute Lahore in 10/1973 & 2/1974.

NOTATION

LOCATION OF BORE HOLES ⊗

NEW CRACKS

OPENED OUT CONSTRUCTION JOINTS

EXTENT OF DAMAGE

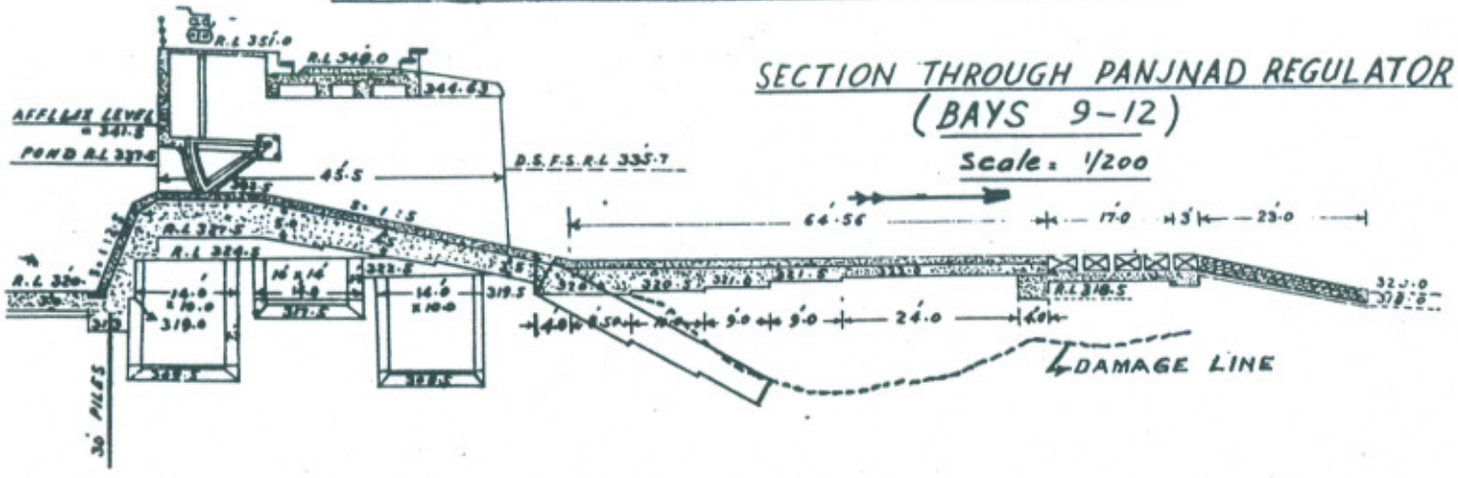
TRACED BY
MUHAMMAD AHMAD
dt. 11.3.1974

PLATE No II

PLAN SHOWING NATURE OF DAMAGE TO REGULATOR, BY 1973 FLOODS AT PANJNAD

SECTION THROUGH PANJNAD REGULATOR (BAYS 9-12)

Scale: 1/200



SECTION THROUGH ABBASIA REGULATOR (BAYS 1-2)

Scale: 1/200

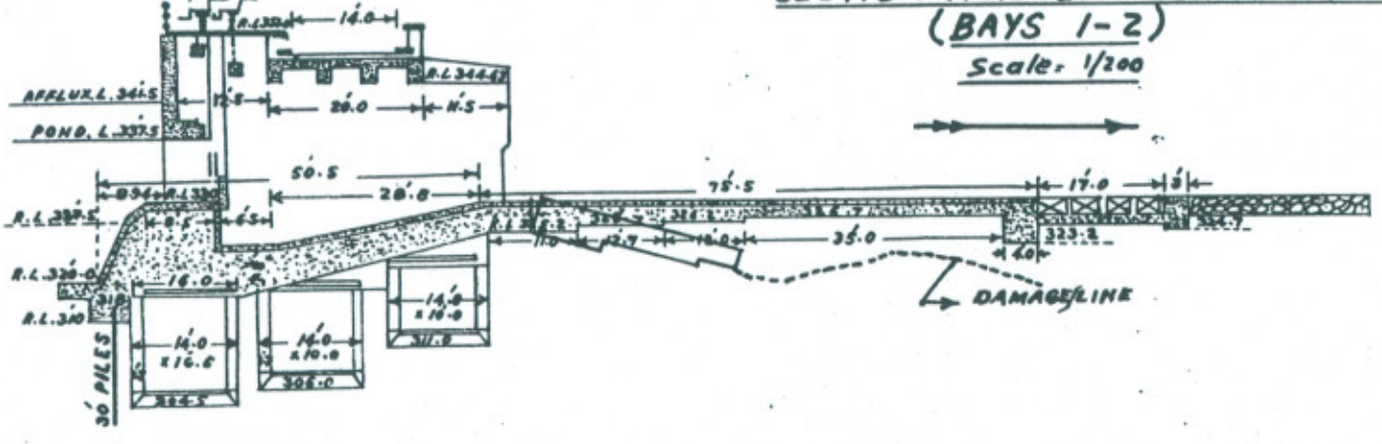


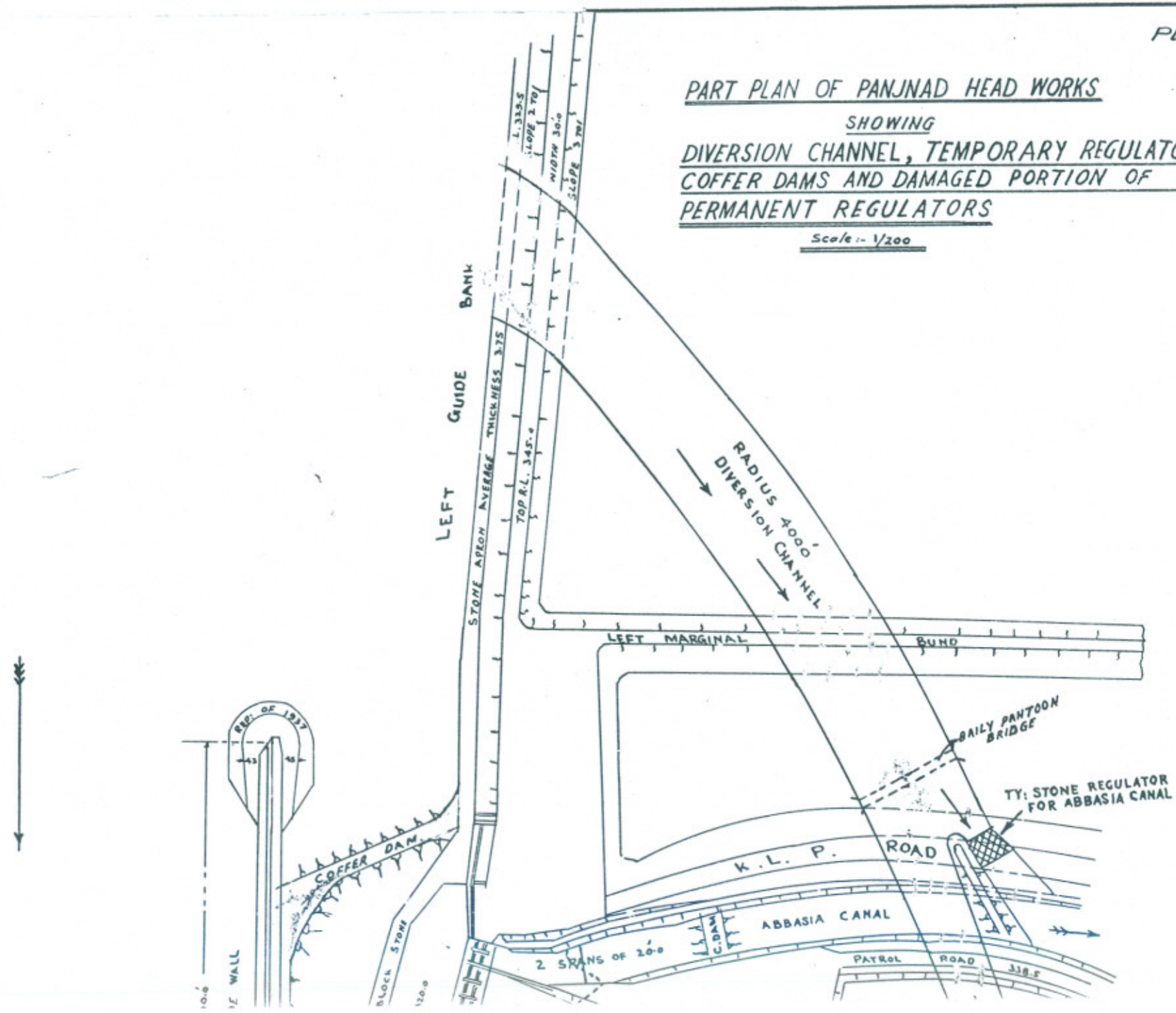
PLATE NO 12

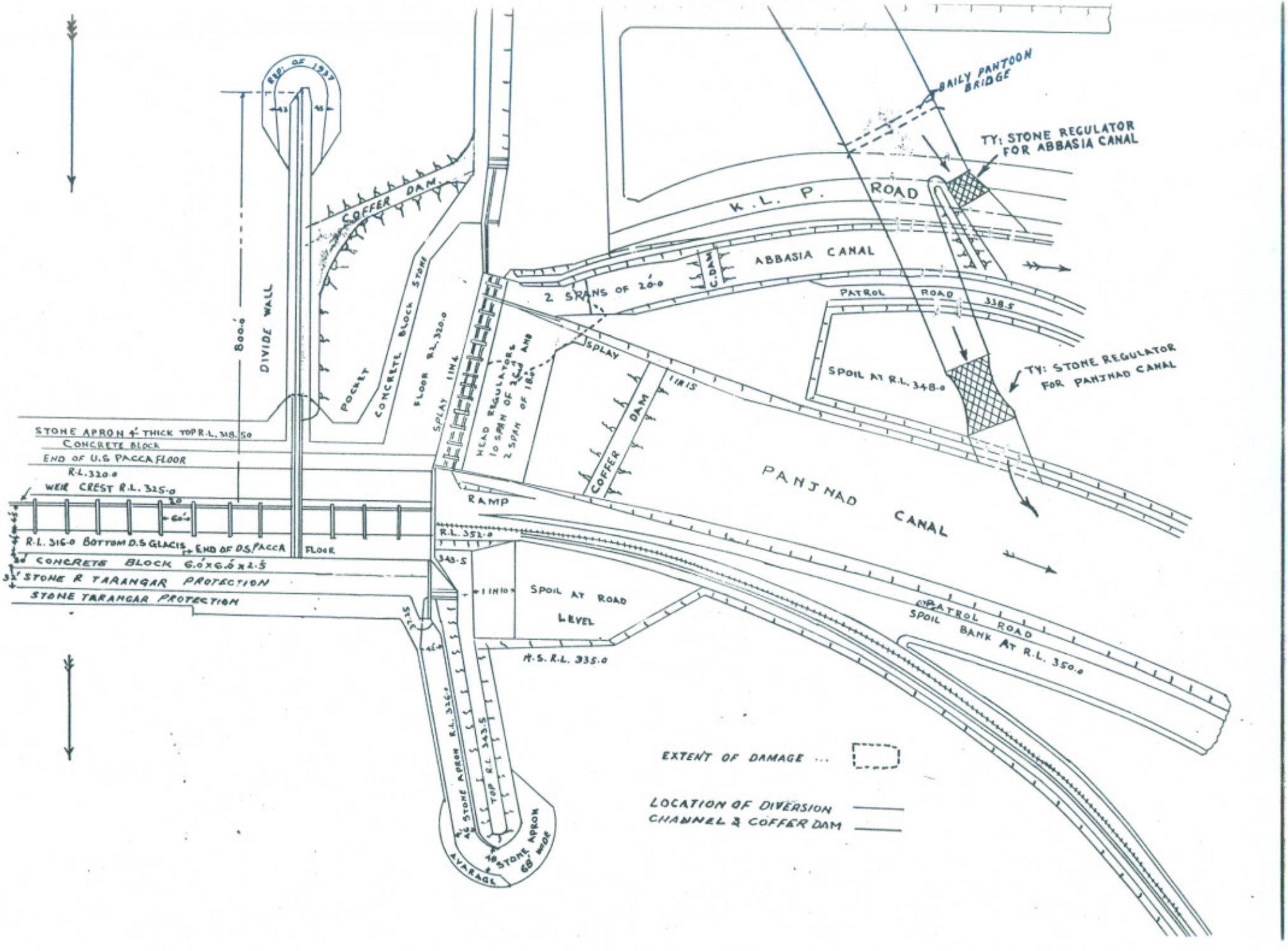
PART PLAN OF PANJNAD HEAD WORKS

SHOWING

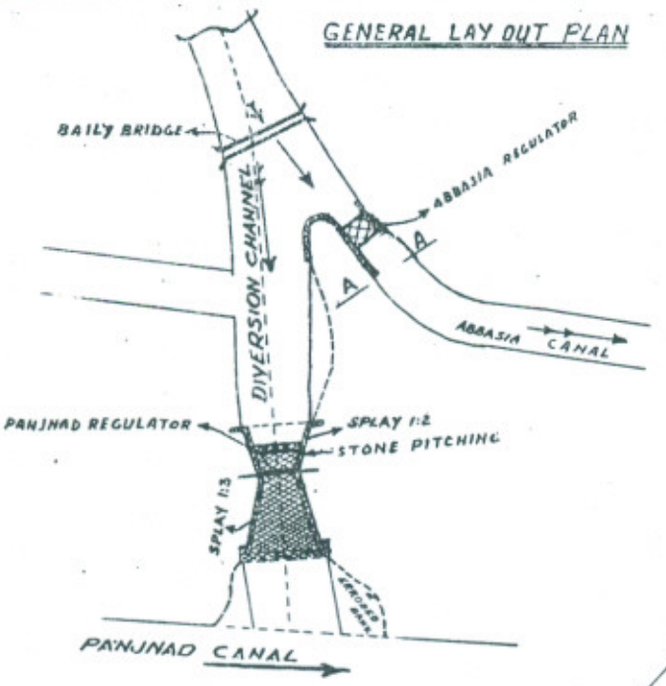
DIVERSION CHANNEL, TEMPORARY REGULATORS, COFFER DAMS AND DAMAGED PORTION OF PERMANENT REGULATORS

Scale :- 1/200

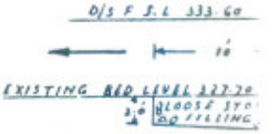



BAILY PANTOON BRIDGE
TY: STONE REGULATOR FOR ABBASIA CANAL
K. L. P. ROAD
ABBASIA CANAL
C.DAM
2 SPANS OF 20-0
PATROL ROAD 338.5
TY: STONE REGULATOR FOR PANJNAD CANAL
SPOIL AT R.L. 348-0
SPLAY
IRIS
COFFER DAM
HEAD REGULATORS 10 SPAN OF 36-0 AND 2 SPAN OF 18-0
SPLAY LINK
POCKET
CONCRETE BLOCK STONE
FLOOR R.L. 320-0
DIVIDE WALL
800-0
COFFER DAM
STONE APRON 4' THICK TOP R.L. 318.50
CONCRETE BLOCK
END OF U.S PACCA FLOOR
R.L. 320-0
WEIR CREST R.L. 325-0
60'-0
R.L. 316-0 BOTTOM D.S GLACIS
END OF D.S. PACCA FLOOR
CONCRETE BLOCK 6.0'x6.0'x2.5'
STONE TARANGAR PROTECTION
STONE TARANGAR PROTECTION
RAMP
R.L. 351-0
343-5
1 IN 10
SPOIL AT ROAD LEVEL
PANJNAD CANAL
PATROL ROAD
SPOIL BANK AT R.L. 350-0
M.S. R.L. 335-0
STONE APRON R.L. 326'
TOP R.L. 343.5
STONE APRON AVARAGE
STONE APRON 60' WIDE
EXTENT OF DAMAGE ...
LOCATION OF DIVERSION CHANNEL & COFFER DAM

GENERAL LAY OUT PLAN

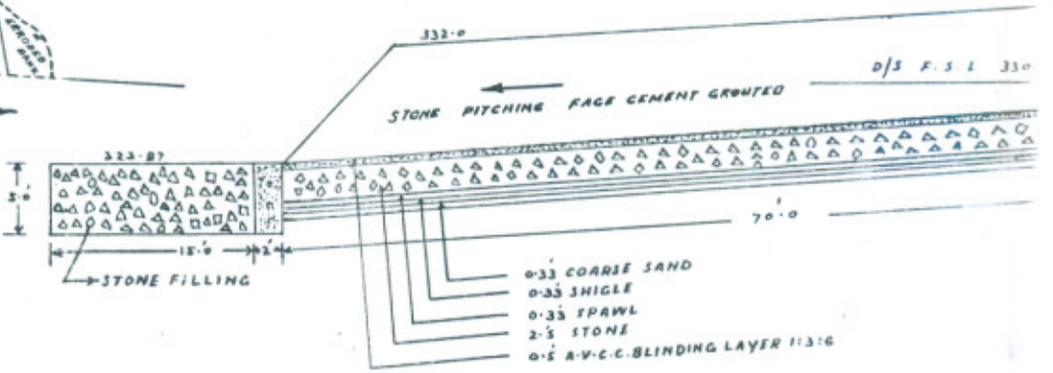


X-SEC



ORIGINAL SECTION OF TEMPORARY R
(DAMAGED ON INITI

SCALE : 1/100



MODIFIED SECTION OF TEMPORARY REGU
OF PANJNAD CANAL

SCALE : 1/100

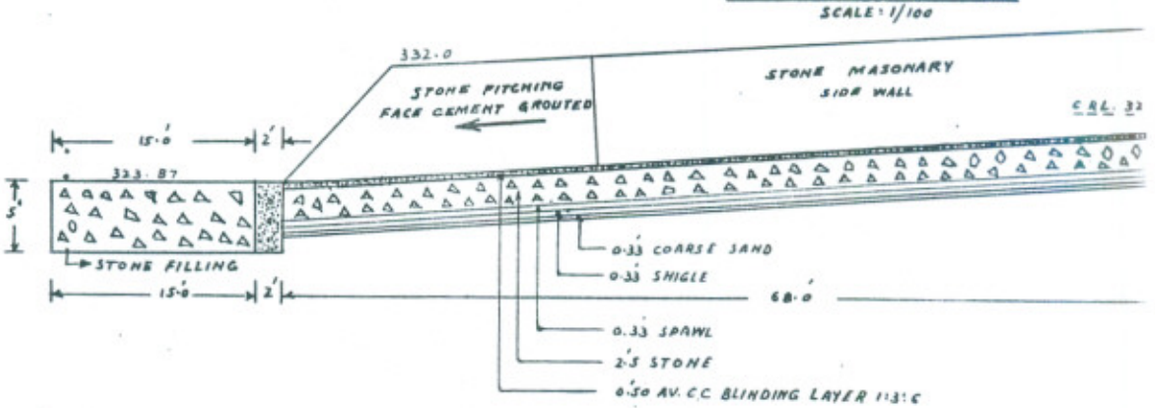
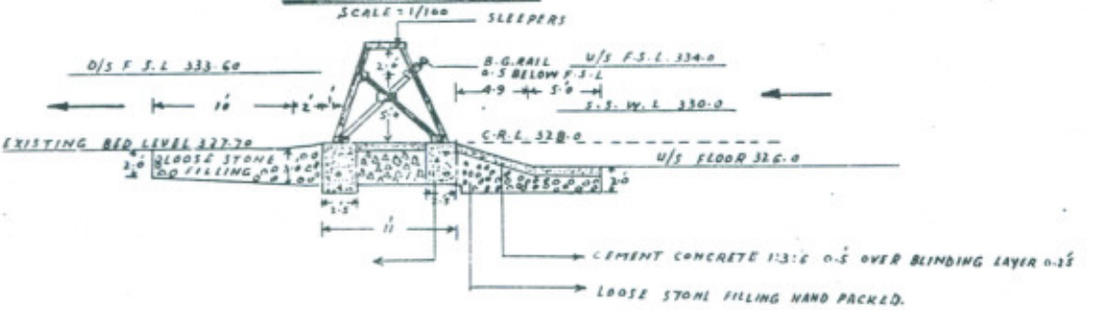


PLATE NO: 13

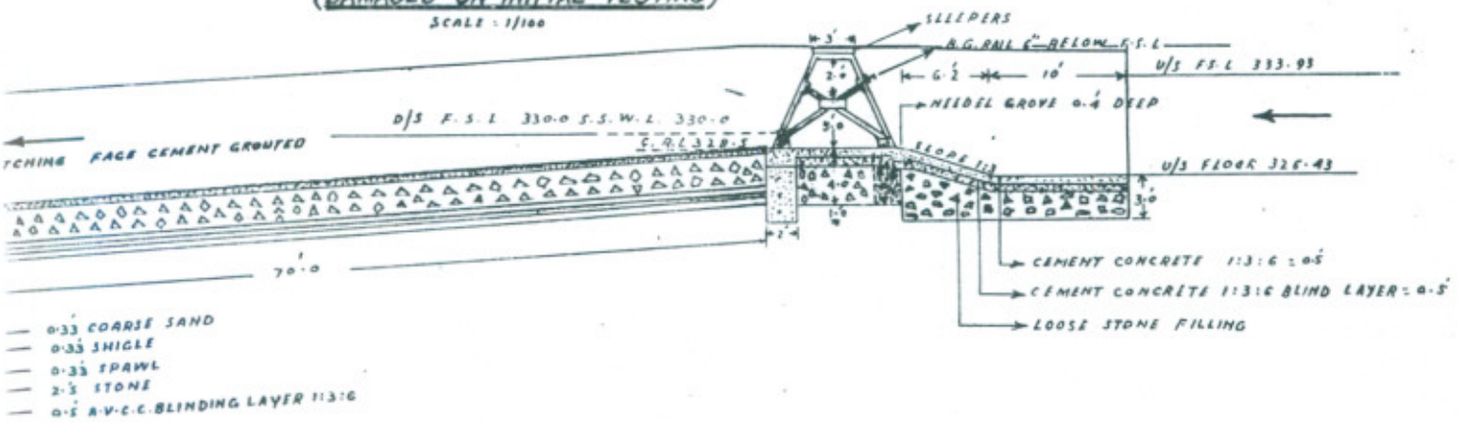
X-SECTION OF TEMPORARY REGULATOR FOR ABBASIA CANAL

SCALE = 1/100



ORIGINAL SECTION OF TEMPORARY REGULATOR OF PANJNAD CANAL (DAMAGED ON INITIAL TESTING)

SCALE = 1/100



MODIFIED SECTION OF TEMPORARY REGULATOR OF PANJNAD CANAL

SCALE = 1/100

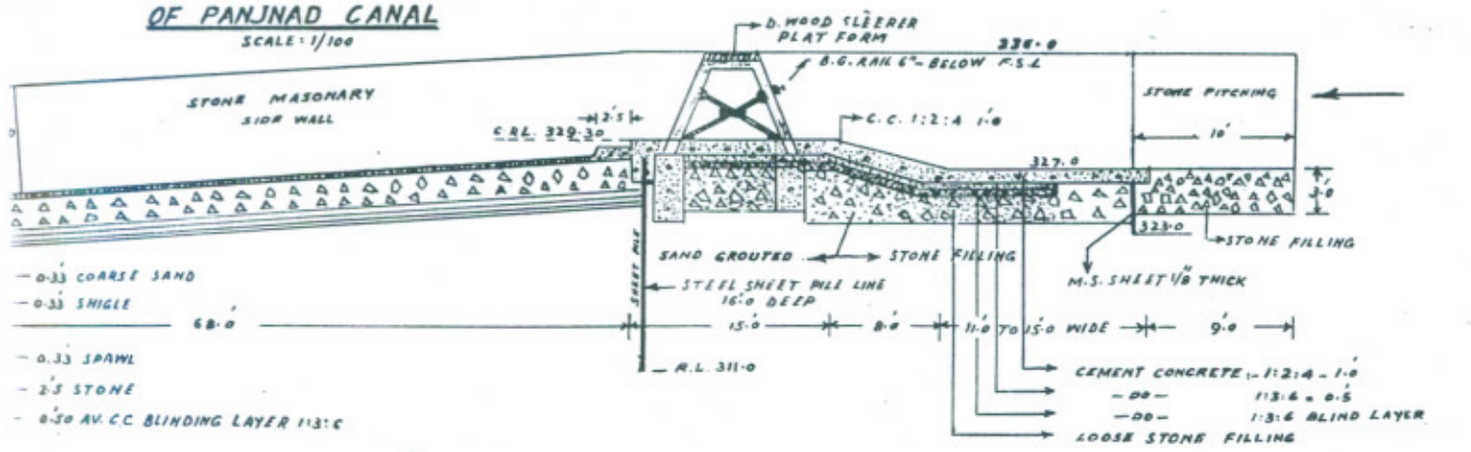
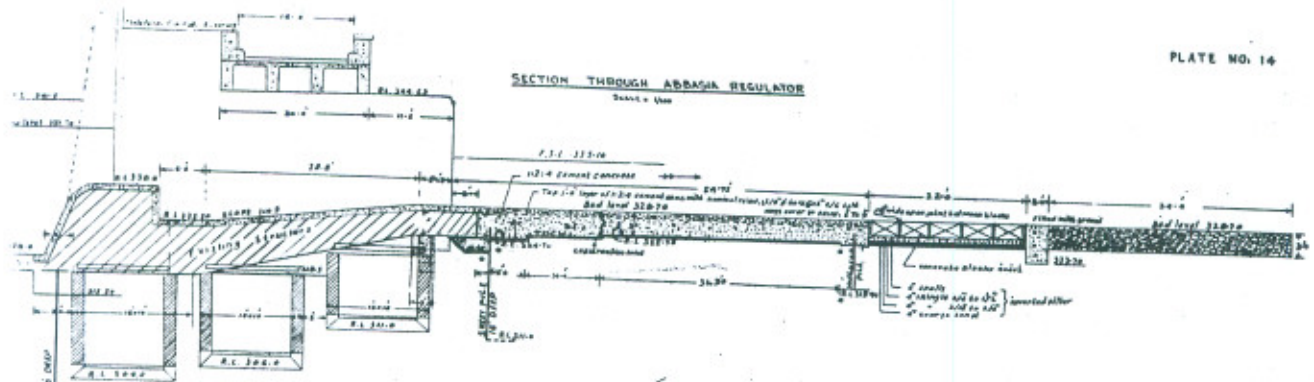
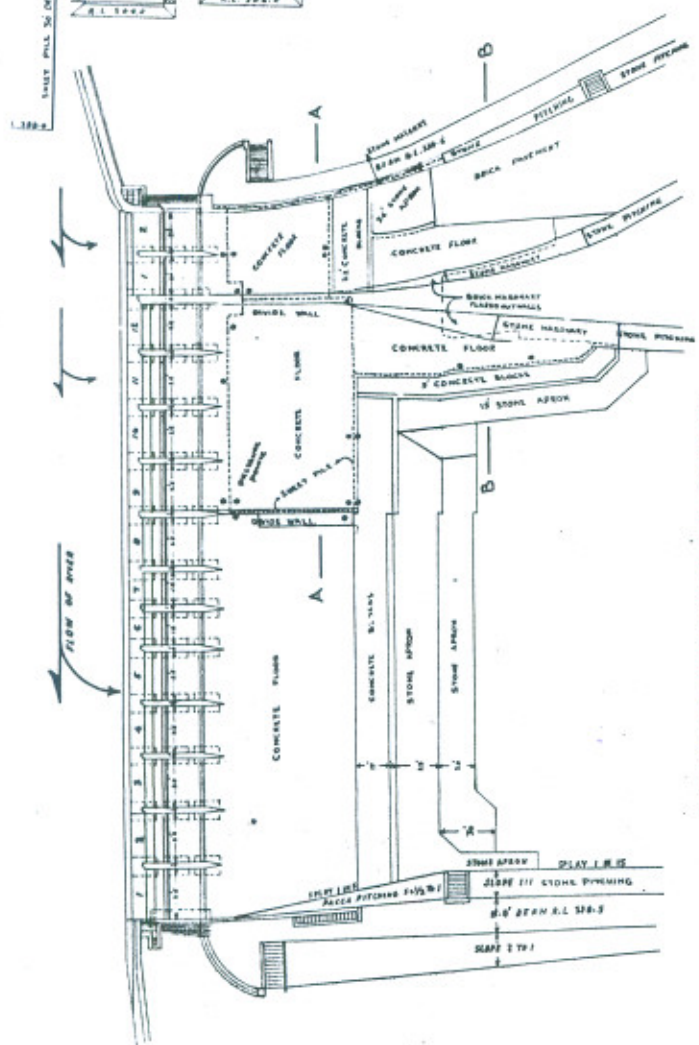
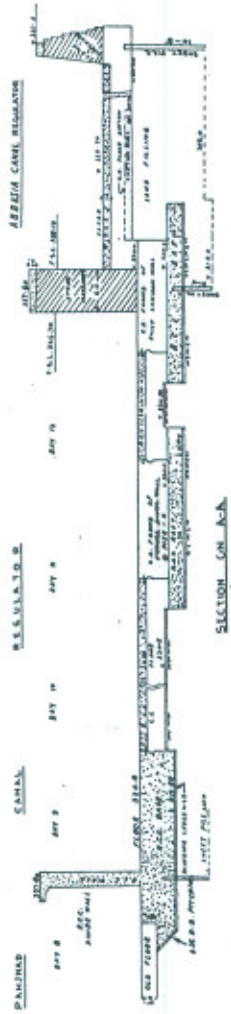


PLATE NO. 14



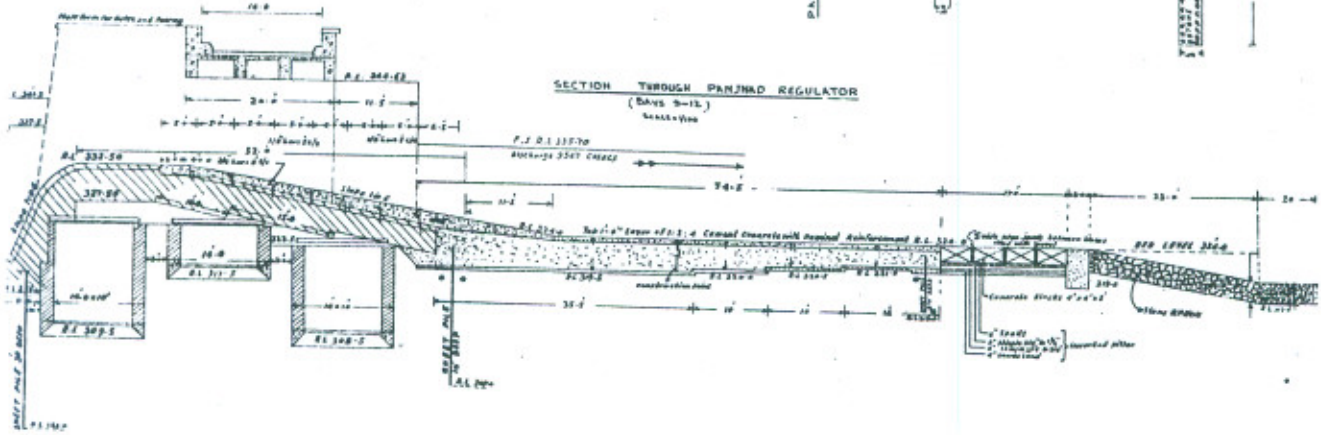


PLAN OF PANJNAD AND ABBASIA REGULATORS
(NEW WORK SHADED)



SECTION ON A-A

SECTION ON B-B



	FROM AHMADPUR TO PANJNAD.			
8	CONSTRUCTING BAILY PANTOON BRIDGE OVER DIVERSION CHANNEL ON KLP ROAD. AND RE-METTALLING THE ROAD	STONE WORK (Cft)	7000	0.67
		RE-METALLING	300 Lft.	
9	CONSTRUCTING COFFER DAMS			6.32
	(A) ON U/S OF REGULATORS	EARTH WORK (CFT)	21,12,000	
	B) ON D/S ABBASIA CANAL REGULATOR 2 Nos.	EARTH WORK (CFT)	1,15,000	
	C) ON D/S PANJNAD CANAL REGULATOR	EARTH WORK (CFT)	9,26,000	
10	DEWATERING THE WORKING AREA			4.34
	(A) L.T. LINE	LENGTH (FT)	4,500 FT.	
	(B) OPEN PUMPING	PUMPS	10 Nos	
	(C) INSTALLING TUBEWELLS	BORES	50 Nos	
	(D) PUMPING FOR DEWATERING	PUMPS	25 Nos	
11	REMOVING EARTH, STONE, DEBRIS AND CLEARING THE WORKING AREA	1. EARTH WORK (CFT)	543000	0.18
		2. STONE WORK (CFT)	136000	
		3. DISMENTLING CONC: (CFT)	35,000	
12	PROVIDING SHEET PILE D/S OF Regulators	Length :- (FT)	650	4.33
13	RELAYING CONC. FLOOR, DIVIDE WALL AND LEFT FLANK OF ABBASIA Regulator.	(1) Dismentling conc. & Stone masonry (CFT)	5000	9.68
		2) Cement conc. (CFT)	45,000	
		3) MASONRY (CFT)	18,000	
		4) EARTH WORK (CFT)	1,00,000	
14	RELAYING FLEXIBLE PROTECTIONS OF ABBASIA REGULATOR	1) Concrete (Cft)	2900	0.64
		2) Stone work (Cft)	6,000	
15	RELAYING CONC. FLOOR IN BAYS 9 TO 12 OF PANJNAD REGULATOR	(1) Dismentling Concrete (CFT)	2000	6.47
		(2) Cement Conc. (Cft)	56,000	
16	RELAYING FLEXIBLE PROTECTIONS IN BAYS NO. 9 TO 12 OF PANJNAD Regulators	(1) Concrete (Cft)	8600	2.63
		(2) Stone work (Cft)	25,000	
17	PROVIDING ADDITIONAL STONE APRON IN BAYS 1-8 PANJNAD REGULATOR.	(1) Stone work (CFT)	18,000	0.40
18	RECONSTRUCTING FLARED OUTWALLS & COMMON BANK, BETWEEN PANJNAD AND ABBASIA REGULATORS.	1) EART Work. (Cft)	200,000	0.31
		2) Stone work (Cft)	11,000	
		3) Cement masonry (Cft)	6000	
		4) Sheet Piles. (FT)	130	
19	INSPECTION, REPAIRING & GROUTING THE FLOOR OF REGULATORS AND LEFT POCKET	1) Earth work (Cft)	300,000	0.2
		2) Sand Grouting (Cft)	500	
		3) Cement Grouting (Cwt)	100	
		4) Treatment of Joints & Cracks (FT)	540	
20	CLEARING THE WORKING AREA, REMOVAL OF T/WELLS MACHINARY ETC.	Lumpsum.		0.1
21	REMOVAL OF COFFER DAMS	Earth work. (Cft)	300,000	0.3
22	RESTORATION OF K.L.P ROAD, (EMBANKMENT) L.M.B, L.G.B. AND COMMON BANKS BETWEEN THE CANALS.	Earth work (Cft)	20,00,000	3.5
		Stone work (Cft)	30,000	

CLOSURE WORKS
CANALS CLOSURE effected FROM
10 TO 20 APRIL 1974

Traced by

TOTAL :- Rs

REPAIRING PANJNAD AND ABBASIA CANAL REGULATORS DAMAGED BY 1973 FLOODS

( )

NOTATION

ACTUAL EXECUTION ——

SCHEDULE OF CONSTRUCTION

NO.	DISCRIPTION	ESTIMATED QUANTITIES	AUGUST 1973			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER			JANUARY 1974			FEBRUARY			MARCH			APRIL			ESTIMATED COST Rs. (LAC)
			1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21-30	
	DUMPING STONE IN THE DAMAGED BAYS OF PANJNAD & ABBASIA CANAL REGULATORS.	STONE WORK (CFT) 103,000																												2.72
	MAKING PERVIOUS STONE BUND TO SEGREGATE THE DAMAGED BAYS OF ABBASIA & PANJNAD Canals	STONE WORK (CFT) 87,000																												2.22
	ERECTING BUND TO SEGREGATE ABBASIA & PANJNAD REGULATORS.	EARTH WORK (CFT) 276,000																												0.37
	EXCAVATING DIVERSION CHANNEL	EARTH WORK 37,00,000 (CFT)																												6.67
	CONSTRUCTING TEMPORARY REGULATORS TO FEED THE PANJNAD & ABBASIA CANALS ETC.	1. Earth work 219,000 (CFT) 2. Tubewells 18 Nos 3. Stonework 84,000 (CFT) 4. Sheet piling 105 (CFT) 5. Conc. work 15000 (CFT)																												5.85
	COMPLETION & OPERATION OF (A) ABBASIA REGULATOR (B) PANJNAD REGULATOR																													
	PROVIDING 11 K.V. TRANSMISSION LINE FROM ALIPUR TO PANJNAD.	LENGTH 2.75 miles																												1.22
	PROVIDING 11 K.V. TRANSMISSION LINE FROM AHMADPUR TO PANJNAD.	LENGTH 1.00 mile																												1.28
	CONSTRUCTING BAILY PANTOON BRIDGE OVER DIVERSION CHANNEL ON KLP ROAD. AND RE-METALLING THE ROAD	STONE WORK (CFT) 7000 RE-METALLING 300 Lft.																												0.67
	CONSTRUCTING COFFER DAMS																													6.32
	(A) ON U/S OF REGULATORS	EARTH WORK (CFT) 21,12,000																												
	B) ON D/S ABBASIA CANAL REGULATOR 2 Nos.	EARTH WORK (CFT) 1,15,000																												
	C) ON D/S PANJNAD CANAL REGULATOR	EARTH WORK (CFT) 9,26,000																												
	DEWATERING THE WORKING AREA																													4.34
	(A) L.T. LINE	LENGTH (FT) 4,500 FT.																												
	(B) OPEN PUMPING	PUMPS 10 Nos																												
	(C) INSTALLING TUBE WELLS	BORES 50 Nos																												
	(D) PUMPING FOR DEWATERING	PUMPS 25 Nos																												
	REMOVING EARTH, STONE, DEBRIS AND CLEARING THE WORKING AREA	1. EARTH WORK (CFT) 543000 2. STONE WORK (CFT) 136000 3. DISMENTLING CONC: (CFT) 35,000																												0.18
	PROVIDING SHEET PILE D/S OF Regulators	Length :- (FT) 650																												4.33
	RELAYING CONC. FLOOR, DIVIDE WALL AND LEFT FLANK OF ABBASIA Regulator.	1) Dismentling conc. & Stone masonry (CFT) 5800 2) Cement conc. (CFT) 45,000 3) MASONRY (CFT) 18,000 4) EARTH WORK (CFT) 100,000																												9.68
	RELAYING FLEXIBLE PROTECTIONS OF ABBASIA REGULATOR	1) Concrete (CFT) 2900																												0.64