



RAI SAHIB MAYA DAS PURI  
RIVERAIN SURVEYS  
1903—1920.

RECORDS OF THE  
SURVEY OF INDIA

Vol. XXIV

**RIVERAIN SURVEYS**

IN

**THE PUNJAB**

**1901 TO 1929**



---

PUBLISHED BY ORDER OF  
BRIGADIER H.J. COUCHMAN, D.S.O., M.C.,  
SURVEYOR GENERAL OF INDIA

PRINTED AT THE GEODETIC BRANCH OFFICE,  
SURVEY OF INDIA, DEHRA DUN, 1934

*Price One Rupee and Eight Annas or Two Shillings and Six Pence.*

*( Copyright reserved )*



# CONTENTS

	PAGE
PORTRAIT. Rai Sahib Maya Das Puri ...	Frontispiece
PREFACE. By the Punjab Government ...	v
INTRODUCTORY NOTE. By Sir Edward Tandy (late Surveyor General of India) ...	1
The Punjab Act of 1899 ...	1
The First Riverain Maps ...	1
Appeal to Surveyor General ...	2
No. 18 Party ...	3
The Impasse ...	3
The Final Solution ...	4
Imperfections ...	5
GLOSSARY of Vernacular Terms used in Punjab Settlement Surveys ...	7
CHAPTER I. Provincial Surveys before 1902 ...	8
CHAPTER II. Riverain Section, No. 18 Party, 1901-10	10
Section 1. 1901-04 ...	10
Section 2. 1904-07 ...	12
Section 3. 1907-10 ...	15
CHAPTER III. Riverain Survey Detachment and No. 22 Party, 1910-29 ...	21
TABLE A. Progress of Punjab Riverain Surveys ...	23
TABLE B. Special Surveys ...	27
APPENDIX. Punjab Government Rules for Riverain Surveys. Financial Commissioner's Standing Order No. 17 ...	28
INDEX MAP to Riverain Surveys of the Punjab, 1907-29	at end



## P R E F A C E

The Punjab Government has much pleasure in contributing a preface to the history of Riverain Surveys in the Punjab, a work which has been in progress for over a quarter of a century since 1903 when Captain E. A. Tandy, R.E. (now Brigadier Sir Edward Tandy), took charge of No. 18 Survey Party with the assistance of Mr. Maya Das Puri.

Before the aid of the Survey of India department was sought, the practice of measuring riverain areas was based on the square system. The surveys were started independently in adjacent districts and the squares thus built up did not join satisfactorily. This caused the utmost confusion in the riverain tracts where all marks are apt to be washed away every year, and led to grave administrative inconvenience, and often to riot and bloodshed. These evils have now been removed by the introduction, in a quarter of a century, of base-line marks throughout the riverain tracts in the five rivers of the Punjab, and the Indus, Jumna and Chakki over 1,871 linear miles of river.

2. The work of the Survey Department has now been finished and they have left base-line marks in all the riverain tracts of the province; the preservation of these is of utmost importance as by them *patwāris* can easily build up their squares without any danger of overlapping or leaving an area unmeasured, and the Standing Orders of the Financial Commissioner provide fully for the inspection of these and other survey marks. This paper, which the Punjab Government commends to the serious consideration of all Revenue Officers, illustrates forcibly the troubles that will follow any attempt to base riverain maps on an inadequate framework. If in spite of all efforts to preserve the results of these surveys, any serious gaps should occur, the demarcated base-lines must be relaid by the agency of the Survey of India.

3. The Punjab Government take this opportunity of placing on record their sense of appreciation for the care, industry and labour with which the Survey of India has solved a most difficult and intricate problem. The initiation of the great work was undertaken by Captain Tandy in 1903 and he held charge of the work (except for 14 months when his brother Captain M.O'C. Tandy acted for him) till 1909. In these 6 years he invented and left working a system organized on sound lines which acquired the confidence of the Punjab Government which it has always retained. Following him the work was pursued until 1920 by Rai Sahib Maya Das Puri and thereafter till its close by Rai Sahib Dhani Ram Varma. The Punjab Government acknowledges with pleasure the tribute which Sir Edward Tandy pays to the services of Rai Sahib Maya Das Puri who was associated with him in the work from its commencement.

LAHORE: }  
19th January, 1934. }

MILES IRVING,  
*Financial Commissioner*  
*and Revenue Secretary,*  
*Punjab Government.*



## Introductory Note

BY BRIGADIER SIR EDWARD TANDY  
(LATE SURVEYOR GENERAL OF INDIA)

### THE PUNJAB ACT OF 1899.

(i). As in all alluvial plains, the rivers of the Punjab change their courses annually during the flood season, so that when the water level falls in the autumn the arable lands of the previous season are often hardly recognizable through the formation of new channels and islands. These changing tracts include areas of very rich land for the winter crop, so that ownership is often hotly contested and very difficult to decide, especially as the rivers usually determine the boundaries between districts and states, and each side has to appeal to a different authority to support its claims.

In many areas the riverain villages used to adopt in the old days some form of "deep-stream" rule, by which the deepest channel was accepted as the boundary, which was thus very variable. Other villages used to try to maintain a permanent boundary, in so far as the land was recognizable, regardless of the fluctuations of the river. With rivers liable to flow in several deep channels the former method sometimes caused hopeless difficulties, while, on the other hand, a fixed boundary can only be maintained if it is correctly defined on good maps and if mark-stones are available on the high banks, out of the reach of floods, from which the boundaries can be relaid whenever required.

Constant free-fights, riots and bloodshed used to arise from these difficulties. The Punjab Government therefore passed Act No. 1 of 1899, which laid down that fixed boundaries, independent of the vagaries of the rivers, were to be defined in all riverain areas and relaid each season by the help of maps and mark-stones. Special officers were to be appointed to settle these riverain boundaries and were to be given the necessary powers to deal simultaneously with the separate districts or states involved in most of riverain areas.

### THE FIRST RIVERAIN MAPS.

(ii). These were prepared by the Punjab Settlement Officers placed on special duty for the purpose under the above Act. They carried out different sections of the work covering all the rivers in the Punjab plains. Fixed boundaries were laid out on the ground and recorded on special riverain maps usually on the scale of about 24 inches to 1 mile.



Unfortunately the Punjab had been for many years severed from all connection with our Revenue Survey branch, which was then administered from Calcutta for all India. The Punjab had, therefore, evolved its own survey system, which entailed the building up of a series of squares from a single base-line. Since not only the sides, but also the diagonals, of the squares had to be measured, this was a very extravagant method, besides being most deceptive and unreliable. Its great cost was not immediately evident because villagers were compelled to do all the necessary chaining without payment.

Maps based on this system may look all right, however bad they really are, as the larger accumulated errors can be pushed into areas of waste land.

Although valuable diagrams of fair accuracy were produced by this method in favourable circumstances, as in Sir Edward Maclagan's Multān settlement, the results in many districts were almost useless, as may be seen from the recent reports of the settlement officer of Peshāwar district, (1928-30).

In any case the method is wildly unsuitable for riverain surveys covering wide expanses of waste, scrub, and water, with occasional islands and patches of very rich ground. The special settlement officers deputed for this riverain work were therefore faced with difficulties quite beyond the powers of their survey staff, excepting at a prohibitive cost of time and labour. As an extreme result of their attempts, we found later that between Bahāwalpur State and Dera Ghāzi Khān district, where the Indus was widest, the riverain maps, purporting to cover the whole area, showed a hiatus of about  $2\frac{1}{2}$  miles in length and 1 mile in breadth completely unaccounted for.

#### APPEAL TO SURVEYOR GENERAL.

(iii). When the *patwāris* came to use these indifferent maps for relaying boundaries by measurement from mark-stones on the high banks, they often found serious discrepancies. These might be amicably adjusted in the case of a hiatus, which enabled both sides to secure more ground than was allotted to them on the maps; but where an overlap was found, due to the real area being less than that shown on the maps, neither side could get its legal rights without defrauding the other, and in some cases there was, I believe, violent fighting with manslaughter.

The Punjab Government therefore consulted the Surveyor General, Colonel Gore, and it was arranged in 1901 that No. 18 Party of the Survey of India should form a riverain detachment to lay out a proper traverse framework over the riverain areas and thus to fix trijunction pillars and other marks, on which the riverain maps, reduced to the scale of 4 inches to 1 mile, could be compiled and adjusted.

Unfortunately at the time, there was no realization of the magnitude of the task, which ultimately required a staff larger than that of an ordinary survey party, working continuously for a period of nearly thirty years.

#### No. 18 PARTY.

(iv). I was appointed to the charge of this party about May 1903, and remained in charge until 1909, excepting for an interval on furlough, when my brother, Captain M.O'C. Tandy, R. E., carried on in my place. Under me was Mr., afterwards Rai Sahib, Maya Das Puri, to whom the whole success of our riverain work was primarily due. He was quite young and had lately joined when I took over the party, and had been rather ignored as difficult to fit into the work. One or two incidents soon showed me he had outstanding qualities, and that, being a Punjabi himself, he understood the riverain problem better than the rest of us. There were two sides to this problem, the survey side, which we alone understood, and the settlement side, known to the settlement staff. Mr. Maya Das Puri was the only man who thoroughly understood both sides. By 1904 I had taken the unusual step of putting him in sole charge of all riverain work at an age when he would normally have been kept at the grind of perfecting himself as a topographer.

My chief contribution to riverain surveys was to give him scope and support. He proved himself to be a man of extraordinary energy and resource, and one who was ready to stand up against me or any one else in the interests of his work.

No account of Punjab Riverain Surveys would be complete without a full acknowledgment of the debt which the whole Punjab owes to this remarkable officer. If this small tribute of mine should be printed, I trust the Punjab Government will very kindly see that his children and relatives are furnished with copies, since he is no longer alive to receive one himself.

Special acknowledgment is also due to the late Mr. Amar Singh, head clerk of the party, a man of extraordinary industry and ability, without whom I could not possibly have faced my difficulties. I was glad to get him well-deserved advancement later, but he died when Head Assistant of the Northern Circle, from a stroke which may well have been due to overwork.

#### THE IMPASSE.

(v). During the field season 1903-04 Mr. Maya Das Puri had charge of the reduction and compilation of the thousands of large scale *musāvis* (vernacular maps) covering the areas traversed in the previous seasons. The original agreement between the Surveyor General and the Settlement Commissioner had laid down that we

were first to traverse each riverain area, as well as the high banks on either side, so as to fix the positions of trijunction pillars and other points, and to plot these points on the scale of 4 inches to 1 mile. Then all the large scale (generally 24-inch) *musāvis* were to be obtained and reduced by pantograph to the 4-inch scale, separately for each village, on to pieces of tracing paper. These village traces were then to be fitted as exactly as possible to the plotted points on the 4-inch maps, and the whole inked up after all discrepancies had been adjusted.

We soon began to find discrepancies far larger than had been expected, and of a kind whose adjustment, unless made on the ground itself and legally attested by a settlement officer, would be quite valueless in a court of law.

I therefore reported to my administrative officer, Colonel J.R. Hobday, in Calcutta, that the riverain procedure laid down was likely to prove useless, and obtained his permission to take up the matter with the Settlement Commissioner in Simla, next recess.

After prolonged discussions with Mr. J. M. Douie, Settlement Commissioner and author of the Punjab Manual on the Square System, and Mr. L. French, I worked out a scheme, based on proposals made by Mr. Maya Das Puri, which was eventually sanctioned.

#### THE FINAL SOLUTION.

(vi). The main idea of this scheme was to obtain the close co-operation of the settlement staff. Instead of trying to dispose of the discrepancies found in compilation, we should show these on 24-inch *musāvis*, by enlargement from our 4-inch compilations. The two discrepant boundaries would then be laid on the ground, where they should be settled on the spot by a regular settlement officer and duly shown on *musāvis* attested by him and thus valid in a court of law. We were also to mark selected "bases" by mark-stones on the high banks, so that *patwāris* could run out lines of squares from them, according to their own system, and thus relay the boundaries wherever required.

I pointed out, both to the Settlement Commissioner and the Financial Commissioner of the Punjab, that by far the cheapest and quickest way of doing the work would be to appoint special settlement officers for the purpose. They thoroughly appreciated this, but there were legal and administrative difficulties, and they decided that it would be best on the whole to call on the ordinary district settlement officers to settle the riverain boundaries of each district at the time when they came under settlement.

This meant that when two districts were on opposite sides of a river, as is generally the case, we had to run traverses over the whole riverain area of both districts as well as the high banks on both sides, at the time the first district came under settlement, and then

had to repeat most of this work years later when the other district came under settlement. Also the work had to be carried on in a piecemeal patchy way as different districts on different rivers came under settlement. And since districts only come under settlement once in twenty years, there was no hope of completing the whole work until something over 20 years had passed.

This disjointed system often made proper supervision of the scattered bits of riverain work very difficult, and gave us varying quantities of work in different seasons, with a very hurried rush to be faced one year and perhaps inadequate work for the staff in the following year. It probably also caused difficulties of settlement which could have been avoided if the whole work had been run off continuously, river by river. These considerations had to give way to legal and administrative difficulties, but it is only fair to remember that they were clearly realized from the outset.

#### IMPERFECTIONS.

(vii). We had therefore, in those early days, to settle such questions as the origins of computation and the closing of traverses on G.T. stations, in a rough and ready way, and to recognize that a high standard of accuracy was less important than the necessity of having results always ready in time for the settlement officers, and of keeping costs as low as possible.

This involved the adjustment of errors which would never be allowed in straightforward survey, but we knew that our work at its worst must still be far better than the accumulative errors which develop unnoticed under the square system, since we could always know the sort of errors we were accepting, and could keep them well distributed over the whole work. It is very desirable that survey officers who may have to handle the results at some future date should realize the conditions under which the work was carried out.

The first season's work on the new system (in 1904-05 with Mr. Maya Das Puri in charge) included the Sutlej river between Ludhiāna and Jullundur districts. This was peculiarly troublesome owing to a slight difference of length in the standard *karams* of those two districts, so that their *musāvis* were on different scales of survey. I believe Mr. Maya Das Puri spent many a night in camp persuading and instructing the settlement *tahsildārs* and others who were deputed to work with him, in addition to solving all the minor difficulties inseparable from the launching of a new system.

We luckily had two season's work in which to establish confidence in the minds of settlement officers before 1906, and it was possible to preserve control of this work in spite of the decision of the Indian Survey Committee in that year, that the Survey of India would no longer be responsible for the cadastral surveys required by local governments.

Until 1910, this riverain work was carried out by a section of No. 18 Party, under Mr. Maya Das Puri, which was numerically stronger than many of the topographical parties; it was not till May 1909 that suitable accommodation was found for this section in Lahore, where it could be in close touch with Punjab officials.

In July 1910 the Riverain Detachment was officially created an independent unit permanently located in the Punjab.

I have written this note from memory after retirement, but still have a vivid recollection of the anxious time we had in getting the work started, and winning the cordial co-operation of the settlement officers, and the approval of my own department.

E. A. T.

**Glossary**  
OF  
VERNACULAR TERMS USED IN PUNJAB SETTLEMENT SURVEYS

---

<i>Band-o-bast</i>	the settlement.
<i>Band-o-bastī Sanad</i>	deed of settlement.
<i>Banjar</i>	barren or unproductive land.
<i>Chāndā</i>	a mark on the ground indicating the position of a traverse station.
<i>Chāllān</i>	a mark on the ground indicating the direction of a traverse line.
<i>Doāb</i>	the land lying between two rivers.
<i>Hadd-bast</i>	a boundary demarcated on the ground.
<i>Hadd-mustaqil</i>	a fixed settled boundary.
<i>Kachcha</i>	applied to land which is liable to be washed away by flood.
<i>Kānūngo</i>	a trained supervisor of a group of <i>patwāris</i> .
<i>Karam</i>	a unit of measurement, the length of a double pace. It varies from one part of the country to another, from 57 to 65 inches.
<i>Khasra</i>	settlement of property.
<i>Kila-bandi</i>	the subdivision of land into rectangles.
<i>Kishtwār</i>	cadastral survey.
<i>Mauza</i>	a village and its land.
<i>Mujmili</i>	a map compiled on reduced scale.
<i>Murabbabandi</i>	the demarcation of an area into square plots.
<i>Musāvi</i>	a sheet of the settlement survey map.
<i>Pakka</i>	as applied to land, indicates that which is not liable to be washed away by flood.
<i>Partāl</i>	a check survey to test the accuracy of the original survey.
<i>Patwāri</i>	the revenue surveyor resident in a village.
<i>Shajra</i>	a copy of the <i>musāvi</i> made on cloth, for use on the ground by the <i>patwāri</i> .
<i>Tarmim</i>	revision survey.
<i>Thal</i>	an area of sandy waste, definitely applicable to Sind Sāgar Doāb.
<i>Thakbast</i>	settlement of demarcated boundaries.
<i>Tika</i>	a subdivision of a village area, in the hills.

## CHAPTER I

### Provincial Surveys before 1902

1. The state of affairs which led to the Survey of India taking over professional control of the surveys of the riverain areas of the Punjab has been described fully in Sir Edward Tandy's introductory note.

The officers of the Settlement Department had found that their surveys based on the "square" system and started independently in adjacent areas, did not join up satisfactorily; this caused particular confusion in the riverain tracts, where all marks are washed away every year. They could not get a reliable map of the tract, nor any firm authority on which to rely boundaries or settle disputes. This trouble was in the first place due to the "square" system of measurement, employed in the Punjab since 1883, which entailed the accumulation of errors which were subject neither to control nor determination. This system was based on the unsound principle of building up a series of squares from a short base, by simple chain measurement of sides and diagonals. The average error has been proved to be about 15 yards in a mile.

2. The Punjab Act No. 1 of 1899 abolished the use of the deep-stream boundary which varied from year to year, and made the fixed boundary system universal. Though this system was already in force in many localities, sometimes continuously throughout whole *tahsils* and districts, yet even in these cases, there might be groups of two or three villages which had never accepted it; while there were other tracts, where the fixed boundary system was nowhere recognized as determining the rights to property. Moreover the Act could not be enforced on Indian States; and though these for the most part acquiesced in its provisions, occasionally the fixed boundary had only been accepted by them for the purpose of jurisdiction, and the owners of the estates refused to relinquish their old usages as to the boundaries of property.

After the passing of this Act, Settlement Officers were sent to those tracts where the fixed boundary system was to be introduced, and in determining these boundaries they had to arrange all sorts of exceptions, whereby arable ground should continue in possession of its recognized owners in spite of the new settled boundary, until such time as it should be finally washed away. There were also many other difficulties arising from the fact that the whole principle of fixed boundaries was opposed to local usage.

The Riverain Settlement Officers had therefore a great deal to consider besides survey, though they had to make maps of some

sort, on which to record their decisions and enable future measurements to be made. Their usual system was to divide the river into sections of a few miles each, and to lay out, over each section, a single system of squares to include the villages on both sides of the river; but there were several other varieties of procedure in use.

3. These riverain surveys only included the state or district boundary and its immediate vicinity, so that sometimes large villages on the boundary were not surveyed in their entirety; the interior boundaries having generally been surveyed and mapped at an earlier district settlement. It is obvious that the riverain settlement would have become extremely laborious and involved many extraneous difficulties, had any attempt been made to link it up with the old surveys. Amongst such difficulties, it may be mentioned that a district surveyed by the old "*patwāri*" system of triangulation frequently adjoined another surveyed by the "square" system; the *karam*, or unit of measurement, was sometimes different in two adjacent districts, for several different *karams*, varying from  $4\frac{1}{2}$  feet to  $5\frac{1}{2}$  feet in length, are in use in the Punjab. The Riverain Settlement Officers, moreover, often left out several riverain villages, where the fixed boundary system was already established and shown in the old district settlement surveys.

4. The aid of the Survey of India was eventually called for, that they might make a complete and well-fitting compilation, so tied to permanent marks that it would always be possible to relay disputed boundaries with reasonable accuracy, whatever changes occurred in the river-bed.



## CHAPTER II

### Riverain Section, No. 18 Party, 1901-10

5. This chapter is divided into three sections.

The first section covers the period 1901 to 1904, during which the Survey Section worked with no definite programme and with little idea of the magnitude and difficulty of the task.

The second section covers the period 1904 to 1907, during which the survey produced valuable 4-inch maps of practically the whole riverain area; assembling all riverain boundaries on to one traverse framework, and showing all discrepancies that were due to faulty survey or unsettled disputes. During this period much work was done, in an unsystematic way, to help settlement officers in deciding and surveying riverain boundaries.

The third section covers the period 1907 to 1910, during which a successful experiment was carried out in Gurdāspur, of co-operating closely with the district settlement officer in producing complete and reliable settlement maps of his whole riverain area. From this experiment started a regular programme which proceeded systematically from one district settlement to another.

#### SECTION 1. 1901-04

**6. Traverse framework.** The Survey of India first started work on these Riverain Surveys during the field season of 1901-02, a small section of eleven traversers being formed for the purpose in No. 18 Party.

The first task was to lay down a reliable framework of theodolite traverse, connected to trigonometrical stations and to all trijunctions and other permanent marks found on the ground.

During field season 1901-02, the section worked from the Lahore-Amritsar boundary on the Sutlej, down the Sutlej, Panjnad, and Indus rivers, to the Sind boundary. Main traverses were run down both banks and connected to 19 G.T. stations; cross connecting lines were run about every ten miles; mark-stones were embedded to supplement existing trijunctions and base-line stones that were picked up on the higher ground.

**7. Compilation from old musavis.** These traverses were plotted on the scale 8 inches to a mile, and the existing village *musāvis* (scale about 24 inches to a mile) were reduced by pantograph, and fitted on to the plots by means of the trijunctions and base-lines, and the boundaries drawn up.

As a result of this first year's work, it was decided to reduce the scale of the plot to 4 inches to a mile: the old *musāvis* were not accurate enough for the 8-inch scale, and it was difficult to fit so many sheets into the new traverse framework, as the riverain tracts were often six miles wide. It was also decided to strengthen the traversing by further interior traverse lines, and to send the plots into the field after compilation that boundary discrepancies might be settled so far as possible on the ground by the surveyors.

**8. Early programme.** During field season 1902–03, besides the interior traversing and plane-tabling referred to above, fresh traversing was carried out on the Indus in the Muzaffargarh district. As a measure of economy the erection of mark-stones along the high ground was abandoned.

Work was continued in 1903–04, but was scattered all over the Punjab in a fragmentary and most unsatisfactory way: it was not till March 1904 that traversers were first sent to work with a settlement officer whilst he was at work, this being whilst the Jullundur boundary was being laid down along the Sutlej river.

**9. Compilation of 4-inch riverain maps.** The scheme of work during this period was therefore as follows:

- (a) The survey built up a traverse framework connected to old trijunction points, base-line stones of the old "square" system, and recognizable points on boundaries, and plotted this work on to 4-inch sheets.
- (b) They then reduced the old *musāvis* by pantograph to the 4-inch scale, and fitted these tracing paper reductions as well as possible to the plotted framework. Nearly 10,000 *musāvis* were dealt with in one season alone.
- (c) These 4-inch plots were then taken on the ground by plane-tablers, who surveyed the main channels of the river, and did what they could to adjust discrepancies on the ground.
- (d) The 4-inch plots were then fair drawn by the Riverain Drawing Section, boundary discrepancies being finally adjusted during the process. The intention was to publish these as authoritative riverain maps.

**10. Early difficulties.** Adjustment on the ground was found most unsatisfactory, for the old *musāvis* contained no indication of their true geographical position, and it was almost impossible to fit them together with any certainty, discrepancies being sometimes as much as half a mile. In most places the surveyors were working in an area where the last settlement had taken place many years ago, and there was no authority who could offer a solution of the discrepancies brought to light; the district officers had no machinery for dealing with such difficulties, especially when they

concerned boundaries which lay in extensive wastes of sand, tamarisk jungle, or in a river channel. Pillars fixed by the traversers frequently disappeared before the surveyors came to work.

On the other hand the old *musāvis* formed the only existing record of rights and it was essential to make use of them in preparing the new map. An entirely new survey on the ground was impracticable because the riverain areas contained practically no marks to survey; the old *musāvis* had to be used to get a settlement of the boundaries, but to make that settlement of real value they had to be tied to a reliable framework.

The maps as now prepared by the Riverain Survey Section, however, were no authority for the settlement of disputes, for they could have no legal value until each discrepancy was authoritatively settled on the ground.

## SECTION 2. 1904-07

**11. 1904 Committee.** Captain E. A. Tandy, R.E. had taken over charge of No. 18 Party in May 1903, and after his first year, he found that sufficient material and experience had been collected for the matter to be thoroughly discussed between the Settlement and the Survey, and the work to be put on to a more satisfactory basis.

**12. Change of procedure.** In 1904 Captain Tandy and Mr. L. French, I.C.S. drew up a report, which was considered by a committee representing the Punjab Government and the Surveyor General, and the following changes were decided on:

- (a) The 4-inch riverain maps compiled from old *musāvis* were not to be supplemented by plane-table revision in the field.
- (b) They were to be printed and handed over to the Settlement Commissioner, but were not to be published.
- (c) Discrepancies in boundaries under 2 chains were to be adjusted by the draftsmen during compilation.
- (d) More serious discrepancies should be shown as found, except when they could be settled at once by the district officers: they would thus be left for future settlement operations, or till actual disputes were raised.
- (e) The Survey Section should submit indexes on the 1-inch scale showing all important discrepancies, with each case discussed separately in a report.
- (f) Permanent mark-stones or base-lines should be laid down as starting points for any theodolite traverse work that might be necessary for future survey.

**13. Work after 1904.** From season 1904-05 onwards, the work proceeded on these lines in a far more satisfactory manner, the

section working under Mr. Maya Das Puri. The traversers were still very much scattered over the province in small detachments detailed to work with various settlement officers. This work was not however on any regular plan or system but adjusted to the requirements of each particular case, and consisted generally of laying down control lines, and fixing corners of squares and other supplementary points to give the settlement officer a better framework for his compilations.

**14. New 4-inch riverain maps.** The main work of the Section was still the compilation of the 4-inch riverain maps from the old *musāvis*, and the new orders involved the rejection of about 60 sheets which had been completed in the old style.

Compilation in the new style was taken up for the whole area from February 1905, a Drawing Section of about 20 draftsmen being employed throughout the year with a programme of about four years work in front of them. From 1906 mapping was speeded up by omitting all detail that would not be of use in locating boundaries. The last traversing carried out in the field for these 4-inch maps was in season 1910–11, along the Indus between Miānwāli and Dera Ismail Khān, and on the Jumna between Ambāla and Sahāranpur.

**15. Headquarters of Riverain Section.** Headquarters of the Riverain Section was located at Multān during the field season, and at Simla in recess; but during 1906–07 No. 18 Party was transferred from Simla to Dehra Dūn, and came under the administrative control of the Director Northern Circle: this move did not suit the Riverain Section as it was thrown out of touch with the Punjab officials with which it had to deal.

It was not until 1st May 1909 that the headquarters of the riverain section was transferred to Lahore, and thus put into much closer touch with the Settlement Commissioner and his staff; but it continued to work as a section of No. 18 Party until July 1910.

**16. Kapurthala–Amritsar Boundary.** Field work and co-operation with settlement officers continued in a spasmodic manner until 1907.

The only traversing carried out during 1906–07 was a special traverse to facilitate the demarcation of the boundary between Kapūrthala State and Amritsar district; this was the first occasion on which use was made of the 4-inch riverain maps on the ground. The traversers fixed points close to the boundary and these were plotted on 4-inch traces of the riverain maps; offset distances to the boundary were then measured up from the map, and used by the *patwāris* to lay out the boundary on the ground.

**17. Gujranwala Boundary.** Work was carried out on the Chenāb river, during demarcation of the boundary between Gujranwāla district and the districts of Gujrat and Shāhpur. This work had been commenced in 1905–06, when the area was traversed and

mark-stones laid down. The Settlement Officer had first tried with his own staff to enlarge the agreed boundary from the 4-inch riverain maps to the large scale *musāvis*, and then to demarcate on the ground from *pakka* points on both banks. He found he could only do so by laying out squares across the river area, a method that was none too accurate. The Riverain Section prepared new *musāvis* on the 24-inch scale plotted with the traverse points, and drew in on these the boundary lines with all their discrepancies as shown on the 4-inch riverain maps. These were handed over to the Settlement Staff who then decided on the line of the boundary.

During season 1906–07, the Survey Section issued traces to the *kānūngos* who demarcated the boundary on the ground by offset from the traverse points; this was then checked up during season 1907–08 by two traversers of the riverain section, and final plans were then prepared and handed over to the Settlement Officers for record: those for Gujrānwāla and Gujrāt districts on the 24-inch scale, and for Shāhpur district on the 16-inch scale.

**18. Kapurthala–Ferozepore Boundary.** During season 1907–08, the riverain section laid out 24 pointer pillars at the bends of the boundary between Kapurthala State and Ferozepore district, working for the Settlement Officer, Ferozepore.

Three traverse lines were run, two along the high banks of the river, and the third along the boundary line. Iron pipes were embedded in pairs as pointer pillars, their distant apart being 1,000 feet or multiples.

Plots of this work, both on the scale of 200 feet to 1 inch, and 4 inches to 1 mile, were supplied to the Deputy Commissioner, Ferozepore, and these showed all discrepancies of the existing *musāvis*, besides the pointer pillars with their distances in feet from the bends of the boundaries marked on the plots.

**19. Ludhiana–Hoshiarpur Boundary.** Similar help was given for the settlement and demarcation of the Ludhiāna–Hoshiārpur boundary on the Sutlej river during season 1908–09.

**20. Preliminary investigation of discrepancies on 4-inch Riverain maps.** The 1904 committee had decided that all discrepancies shown up by the 4-inch compilations should be left for decision till the next settlement; but that the survey section should prepare 1-inch *mujmili*, or index maps, illustrating these discrepancies, accompanied by an explanatory report.

The first report drew attention to at least one discrepancy of so grave a nature that the Settlement Commissioner thought it advisable to have it examined straightaway.

It was found that the 4-inch maps were burdened with many errors which were due to the old village *musāvis* not being brought up to date, or to having the latest orders incorrectly entered, or to clerical errors when transferring details from one set of *musāvis* to another; such errors being due to faulty recording and not to

inaccuracy of survey. The Punjab Government was at first unwilling to depute special civilian officers to examine these discrepancies, but in 1908 agreed that such a course was desirable. All districts concerned were asked to depute a revenue assistant or *sadar kānūngo* with local knowledge of the boundaries affected, who should investigate the discrepancies shown up on the compiled maps, compare them against maps and files in the district office, and dispose of all he could. This official was then required to sign a note on each riverain map certifying that the boundaries appeared to be in accordance with latest decisions, and that discrepancies still remaining were not due to clerical error.

### SECTION 3. 1907-10

**21. The Gurdaspur Settlement.** In 1907, Captain Tandy took the opportunity of the settlement of Gurdāspur district to press on the Settlement Commissioner the advantage of making greater use of the Riverain Survey Section to assist settlement operations, and to make practical use of the 4-inch riverain maps for rectifying on the ground the discrepancies recorded.

His proposals were accepted and a start thus given to a programme of methodical co-operation between the survey and settlement departments, by which all the riverain areas of the province were provided with settled boundaries accurately mapped and the means of relaying those boundaries at any time in the future.

**22. Procedure for using riverain maps during settlement.** It took considerable time and much patient labour to work out the best way of co-operation between the survey and settlement staffs.

At first the Settlement Officer, Mr. Dunnett, was firmly opposed to the suggestion to use enlargements of the 4-inch riverain maps in preference to the old 26-inch *musāvis*: he urged that the old *musāvis* were the original authority, and that any errors in the 4-inch maps would be seriously multiplied by enlarging them.

Captain Tandy pointed out the difficulty of joining up the old *musāvis*, as they were based on local systems of squares without any scientific control; it was impossible to get a satisfactory fit between two *musāvis* unless at least two common recognizable points on the boundaries of adjacent villages were found to agree, and this rarely occurred. On the other hand the 4-inch maps were based on a sound traverse framework: and the error solely due to enlargement would not amount to more than 10 *karams*, whereas the discrepancies between the old *musāvis* were generally much greater.

The mean line between discrepancies under 2 chains wide was reasonable; and for the larger discrepancies it was obviously sounder to lay down both lines from the 4-inch map, than to try and lay

them from the old *musāvis* in a manner that would generally be entirely hypothetical. In the case of these major discrepancies Captain Tandy proposed to traverse, mark on the ground, and plot on new 24-inch or 26-inch *musāvis*, a temporary zigzag line covering the ground involved by each discrepancy, and to give the Settlement Officer the 4-inch map showing the approximate discrepant positions of the boundary line, the true position of the zigzag line, and of any points on the boundary picked up by the traversers: he would also give the Settlement Officer separate 4-inch tracing paper reductions of the boundaries as given on the old *musāvis*. The Settlement Officer would then have all the data before him, and be able to shift about the village traces till he got the best solution; the decision could then be drawn on the new *musāvis* and marked out on the ground by the *patwāris* by measurement from the zigzag line.

This procedure was accepted by Mr. F. W. Kennaway who relieved Mr. Dunnett as Settlement Officer in March 1908, with the modification that in the *kachcha*, the main outline only should be laid down from 4-inch maps, but where cultivation occurred the old 26-inch *musāvis* should be used for detail inside the cultivation, controlled along the sides of the 200 *karam* squares by the cutting lines of boundaries as taken from the 4-inch maps.

**23.** This use of the 4-inch compiled maps gave a set of *musāvis* referrible to a single set of squares over the whole area, without any of the labour and uncertainty of square laying; the whole map fitted absolutely to the traverse framework, so that there was no accumulation of errors, and provided data from which all boundaries and disputes might be definitely settled.

The new *musāvis* provided a clear reliable map that could be revised whenever required, and that could be used for relaying any boundary with exactness, which could not possibly be done from the old *musāvis* based on the square system.

The old *musāvis* dated from the last Settlement of Gurdāspur 20 years earlier, and it was noticed that the discrepancies shown up on the 4-inch compiled maps had in every serious case been for years the sources of most acrimonious dispute on the ground. Some of them were the result of simple omission of squares on the old *musāvis*.

**24. Regular Programme.** Work on the Gurdāspur Settlement was started in December 1907 as an experimental measure, and was inspected in the field by the Financial Commissioner in March 1908; it was carried on right through season 1908-09, and a satisfactory procedure was gradually evolved, that was approved by the Settlement Commissioner who agreed that the Survey of India should co-operate in every district settlement throughout the Punjab.

It was estimated that the survey detachment would be able to complete about 100 linear miles of river every year; fitting its programme to that of the district settlements; the riverain work being taken up during the first two years of the settlement.

In 1908 Captain Tandy proposed that the Punjab Government should take over the Riverain Survey Detachment, and appoint a special Riverain Settlement Officer who would work continuously, independent of the district settlements. The Settlement Commissioner agreed to the continuous employment of the detachment, but insisted that it should work under the district settlement officer. He agreed to depute a special E. A. C. for riverain work, who would accompany the survey detachment from one district settlement to another, taking with him a subordinate settlement staff trained in riverain work.

With this object, a class of 35 *kānūngos* and 4 *nāib tahsildārs* was held in May and June 1909, and taught plane-table traversing, the survey of boundaries by field book and offset, and the plotting and laying off of base-line. In exchange, six traversers of the Survey of India did a 2½ months' course of Settlement training under the Settlement Officer, Gurdāspur.

**25. Final Procedure.** The following may be taken as the final procedure worked out during the Gurdāspur Settlement.

(a) Before settlement operation began, the Riverain Survey Section had available 4-inch riverain maps based on a sound traverse framework, incorporating the boundaries shown on the old *musāvis* with a sufficient area of the *pakka* ground on both banks to provide a junction with district settlement maps.

These riverain maps provided an index or framework for the old *musāvis* and for the lay out of the new *musāvis*. They served as a guide by which the traversers were able to follow out the boundaries, and also as a general index to the settlement officer.

(b) Immediately before settlement operations commenced, or during their first year, the Riverain Survey Section carried out fresh traversing on the ground, which included main traverses run along both banks and a minor traverse net work covering the area under settlement. Wooden pegs or other marks were fixed, from which all boundaries and patches of cultivation might be laid down by the *patwāris*, whose work would thus reduced to simple measurements by offset.

(c) The survey section then prepared new *musāvis*, scale 40 *karams* to an inch, projected with sixteen squares of 200 *karam* sides. The sides of the squares were parallel to the axes of the theodolite traverse computations and the system was continuous from the origin.



Two separate sets of *musāvis* were prepared, (i) for boundaries, (ii) for village detail.

(i) The Boundary *musāvis* were only prepared along the boundaries. When the two districts meeting in a riverain area used different lengths of *karam*, one definite scale was agreed on for this set of *musāvis*. On these were plotted all trijunctions and surveyed lengths of boundary, all traverse lines and stations; and in the *kachcha* areas, main bends and cutting points of boundaries on the sides of 200 *karam* squares were enlarged from the 4-inch maps.

The boundaries from the old original *musāvis* were fitted to this control, showing all discrepancies in different colours.

(ii) The village *musāvis* were on the scale of 40 *karams* to the inch according to the local length of *karam*. They showed no boundaries, but all traverse stations, and on these the *patwāris* carried out detailed survey of the fields. The graticules were marked up in *karam* units, because *patwāris*' work with short chains divided into *karams*. Offsets were laid by means of a wooden right angle cross.

(d) Both sets of *musāvis* were issued to the Settlement Staff in time for the Settlement Officer to make his decisions, and for the *patwāris* to lay the boundaries out on the ground and complete the *musāvis*, before the rise of the river water: this meant that actual traversing had to be completed early in March.

(e) The base-lines to be demarcated on the ground were selected on the traverse chart, one in each *patwāri's* circle, on the high ground, about one or two miles apart. Dressed stones, weighing about 4 *maunds* each, were embedded on three corners of a 200 *karam* square, and corresponding mark-stones were erected on the opposite bank of the river in prolongation of one line. These stones were erected by special traversers and their positions were recorded on the *musāvis*.

(f) After completion of the survey, 4-inch indexes, showing boundaries and demarcated base-lines were issued to the Settlement Officer.

(g) As the riverain survey dealt with the area belonging to only one district at a time, the survey section had to visit each riverain tract twice: the main traverses and mark-stones carried out along the high banks during the first survey held good for the second, but a very large amount of duplication was entailed.

**26. Rules for Settlement Officers.** The procedure described above agrees generally with that embodied in the rules issued by the Settlement Commissioner for the guidance of officers employed on riverain operations. These are reprinted as an appendix to this volume.

**27. Different lengths of Karam.** In preparing new *musāvis*, much extra work was caused by the use of different lengths of *karam* units by adjacent districts in the same riverain area. Each district wanted its *musāvis* on the scale of 40 *karams* to one inch; in some areas the *karam* varied from 57 inches to 57·53 inches; there were also 60-inch and 66-inch *karams*.

With the 60-inch *karam*, *musāvis* were on the scale of 200 feet to an inch, or 26·4 inches to a mile.

With the 5½-foot or 66-inch *karam* which was the most usual length, *musāvis* were on the scale of 220 feet to an inch or 24 inches to a mile; and squares of 200 *karams* gave sides 1,100 feet or 16·67 chains.

The district boundary had to be shown on both scales, and up to 1908 the survey section laboriously effected the change of scale by pantograph: after that, the change of scale was carried out by photography at Dehra Dūn.

**28. The Traverse Framework.** The traverse framework laid down by the Riverain Section covered such a great extent of rough and difficult ground, that the methodical dispersal and adjustment of errors was a matter of importance. Errors were in the first place controlled by frequent connection with Great Trigonometrical stations. Connection was also established with the earlier traverse work of No. 1 Party which had fixed the position of the original village trijunctions about 1870. This traverse work of No. 1 Party had been entirely ignored when the square system was introduced in 1882. After the first few seasons the riverain section abandoned all attempt to make use of these earlier values, as it became evident that they were not sufficiently in accord with the new work, and the labour of adjustment was considerable.

Errors in the riverain traverse were dispersed on the principles described as "Tandy's method" in Chapter IV of the Handbook of Topography, Survey of India.

During 1909 Dr. J. de Graaff Hunter, Mathematical Adviser to the Survey of India, was specially attached to No. 18 Party for a few months to overhaul the Punjab traverse data, and the methods of the Riverain Survey Detachment. He was able to improve these to a considerable extent without increasing cost rates. At the same time he supervised the running of special main traverses along the Sutlej river on the Ludhiāna-Jullundur district boundary, making use of 330 ft. Crinoline chains and 7-inch theodolites.

**29. Ludhiana Settlement.** In season 1909–10 work was taken up in co-operation with the settlement of Ludhiāna District on the Sutlej river, and also of Amritsar District on the Beās and Rāvi rivers. Mr. Dunnett, who had been in charge of the Gurdāspur Settlement up to February 1908, returned from leave in December 1908 to be Settlement Officer, Ludhiāna.

As the Jullundur *karam* was 57·5 inches, against the Ludhiāna *karam* of 57·157 inches, the suggestion was made to have one set of *musāvis* on the common scale of 24 inches to a mile for both districts and to provide the *patwāris* with special scales of their district *karams*; but this was not accepted.

**30. Riverain Survey Section separated from 18 Party.** Captain E. A. Tandy went on long leave in August 1909. He had been in charge of No. 18 Party since May 1903, except for period of 14 months, 1905–06, when his brother Captain M.O'C. Tandy had acted for him.

He had found the Riverain Survey Section struggling with a vast area with no definite plan of operations, using methods that could lead to no final solution. After much patient experiment and demonstration, he left it working on sound lines, with a settled programme, firmly established in the confidence of the Settlement Department.

The Riverain Survey Detachment became an independent unit in 1910, and worked on steadily until it completed its full programme.

## CHAPTER III

### Riverain Survey Detachment & No. 22 Party, 1910 to 1929

**31.** On 1st July 1910 the riverain section of No. 18 Party was formed into an independent detachment under the administrative control of the Superintendent Northern Circle.

The detachment was placed under the charge of Mr. Maya Das Puri, who had been associated with this riverain work since he had joined No. 18 Party in 1901. It continued to do a great deal of other work required by the Punjab Government, but in 1910 it employed about 40 draftsmen and traversers on riverain surveys alone.

**32. Programme completed.** The riverain work of the detachment was now standardized and followed a regular programme, so it is not necessary to describe each season's progress in detail.

Table A, and the index map attached, show the districts in which work was carried out each year, from the Gurdāspur settlement onwards, and the annual cost.

**33. Cost Rate.** The full cost of riverain survey, from season 1916-17 to season 1928-29, totalled Rs. 13,77,720, which covered 1,177 linear miles of river, of which 490 miles involved detailed settlement on one bank only.

Up till about 1916 all temporary *khalāsis* were paid direct by the Settlement Officers: from 1916 to 1920 the cost of labour and transport was particularly high owing to war difficulties.

Assuming the cost of survey along one bank only to be .6 of the cost of surveying both banks, we get a rough cost rate of Rs. 1,400 per linear mile of river, both banks surveyed.

This cost rate covers main traverse, minor traverse net-work for detailed boundary and settlement surveys, the fixing and supply of mark-stones, all on both sides of the river. It also covers the supply of plotted *musāvis*, and the preparation of final maps and indexes. It does not cover the preliminary work of reducing the old *musāvis* and compiling them on to 4-inch riverain maps, nor of running the necessary traverse framework for that purpose.

This rate would be higher in areas where jungle clearing was a heavy charge.

**34.** From 1919 the status of the detachment was raised to that of a party, with the title Punjab Riverain Party, which was again changed to No. 22 (Riverain) Party from 1st January 1920. With this change, Rai Sahib Maya Das Puri severed his connection with

riverain surveys, and in 1921 charge of the party fell to Rai Sahib Dhani Ram Verma who held charge until the end of 1928. In 1929 the party completed the last of its riverain maps and charts and was transferred to other work.

**35. Records.** The values of all permanent points fixed during these riverain surveys have been compiled into manuscript record volumes, arranged by degree sheets and illustrated by charts. These volumes are stored with the Director Frontier Circle, Survey of India, Simla.

*Musāvis* and index maps will be found at the headquarters of the districts to which they belong.

**36.** Table B gives a statement of the more important of the special surveys other than riverain, carried out for the Punjab Government and others by the Riverain Survey Detachment or No. 22 (Riverain) Party.

No detailed account of these surveys is given here, for though the methods of traversing boundaries, and breaking the country up into squares, were in some cases similar to those followed in riverain operations, yet they have nothing to do with the general plan and purpose of Riverain Surveys.

**37.** The account that has been here given of the labour and cost of these riverain surveys, and of the difficulties that were encountered in working out the details of procedure, may be taken as a warning of the troubles that will follow any attempt to base riverain maps on an inadequate framework. The results of these surveys should be carefully preserved, and the demarcated base-lines should be relaid by Survey of India agency whenever serious gaps occur.

TABLE A.

Progress of Punjab Riverain Surveys

**Notes.** (i) This table shows the surveys carried out in co-operation with district settlements, as described in paragraphs 24, 25 and 32.

(ii) In each district, field work fell into three definite stages, and occupied two to three years.

Stage (a). Main traverse circuits on both banks of river.

Stage (b). Minor traverse to fix points and boundaries for detailed survey of the district under settlement.

Stage (c). Laying down permanent mark-stones, as base-lines, on both banks of river.

Where the river formed the boundary between two districts, stages (a) and (c) of the survey fell into both districts, and did not have to be repeated except where mark-stones had disappeared.

(iii) The season of survey covers period 1st October of one year to 30th September of following year.

(iv) Mileages are entered against the work of the first season only.

(v) Until 1916-17, the costs given in the table do not include the pay of *khalāsīs* on the temporary establishment, who were paid by the Settlement Officer.

(vi) The costs cover all the work of the drawing office, viz., plotting and completing *musāvis*, and preparing index maps.

(vii) The *musāvis* were on the scale of 24 inches to a mile or 220 ft. to an inch, except in those districts where other scales are given in the table.

Season	River	Length of river in miles	District under settlement	District on opposite bank	REMARKS	Cost
1907-08	Rāvi ...	35	Gurdāspur (a) (b)	Gurdāspur (a) (b)	Experimental	Rupees 21,626
	Beās ...	32	Gurdāspur (a) (b)	Hoshiārpur (a)		
1908-09	Rāvi ...	...	Gurdāspur (b) (c)	Gurdāspur (b) (c)	District Boundary demarcated 2½ miles.	15,072
	Rāvi ...	20	Gurdāspur (a) (b) (c)	Jammu		
	Beās ...	...	Gurdāspur (b) (c)	Hoshiārpur (c)		
	Sutlej ...	...	Ludhiāna (b) (c)	Hoshiārpur (c)		
	Sutlej ...	55	Ludhiāna (a)	Jullundur (a)		
1909-10	Chenāb ...	40	Gujrānwāla (a)	Gujrāt (a)		45,056
	Rāvi ...	40	Amritsar (a) (b) (c)	Siālkot (a) (c)		
	Beās ...	40	Amritsar (a) (b) (c)	Kapūrthala (a) (c)		
	Sutlej ...	...	Ludhiāna (a) (b) (c)	Jullundur (a) (c)		
	Sutlej ...	65	Ferozepore (a)	Lahore (a)		

TABLE A. (contd.)

Season	River	Length of river in miles	District under settlement	District on opposite bank	REMARKS	Cost
1910-11	Indus ...	...	Miānwāli	Dera Ismail Khān	Traversing for province boundary, Miānwāli <i>tahsil</i> .	<i>Rupees</i>
	Jhelum ...	38	Shāhpur (a)	Jhelum (a)		
	Jhelum ...	30	Shāhpur (a)	Shāhpur (a)		
	Chenāb ...	...	Gujrānwāla (b) (c)	Gujrāt (c)		26,328
	Beās ...	...	Hoshiārpur (b)	Gurdāspur	Scale 200 ft. to 1 inch	
	Sutlej ...	28	Hoshiārpur (a)	Ambāla (a)	do.	
	Sutlej ...	...	Ferozepore (b) (c)	Lahore (c)	do.	
	Sutlej ...	20	Ferozepore (a)	Jullundur (a)		
	Jumna ...	24	Ambāla (a)	Sahāranpur (a)		
1911-12	Jhelum ...	35	Shāhpur (a)	Shāhpur (a)		
	Jhelum ...	...	Shāhpur (b) (c)	Jhelum (c)		
	Chenāb ...	40	Siālkot (a)	Gujrāt (a)		
	Chenāb ...	10	Gujrānwāla (a)	Gujrāt (a)		
	Rāvi ...	...	Siālkot (b)	Amritsar	Scale 200 ft. to 1 inch	
	Sutlej ...	...	Ferozepore (b) (c)	Lahore (a) (c)	do.	24,969
	Sutlej ...	25	Ferozepore (a)	Montgomery (a)	do.	
	Sutlej ...	...	Ferozepore (b) (c)	Jullundur (c)	do.	
	Sutlej ...	...	Hoshiārpur (b) (c)	Ambāla (c)	Scales 190 feet } to 1 inch 191½ " }	
	Sutlej ...	...	Hoshiārpur (b)	Ludhiāna		
1912-13	Jhelum ...	...	Shāhpur (b) (c)	Shāhpur (b) (c)		
	Jhelum ...	...	Shāhpur (b) (c)	Jhelum (c)		
	Jhelum ...	46	Gujrāt (a)	Jhelum (a)		
	Chenāb ...	...	Siālkot (b) (c)	Gujrāt (c)		
	Chenāb ...	...	Gujrāt (b)	Siālkot		
	Chenāb ...	...	Gujrāt	Gujrānwāla		
	Rāvi ...	65	Lahore (a)	Lahore (a)*	* Before the formation of Shekhūpura District; after 1923 Lahore District included the right bank of the Rāvi.	21,906
	Sutlej ...	...	Ferozepore (b) (c)	Montgomery (c)		
	Sutlej ...	...	Lahore (b)	Ferozepore	200 ft. to 1 inch.	
1913-14	Jhelum ...	...	Gujrāt (b) (c)	Jhelum (c)		
	Chenāb ...	...	Siālkot (b)	Gujrāt		
	Rāvi ...	...	Lahore (b) (c)	Lahore (b) (c)		32,375
	Sutlej ...	...	Jullundur (b)	Ferozepore	Scale 200 ft. to 1 inch	
	Sutlej ...	...	Jullundur (b)	Ludhiāna	Scale 330 ft. to 1 inch	
1914-15	Chenāb ...	6	Shāhpur (a) (b)	Gujrānwāla (a)	Extended as part of Gujrāt Survey	
	Chenāb ...	...	Gujrāt (b) (c)	Gujrānwāla (c)		22,865
	Rāvi ...	...	Siālkot (c)	Amritsar	Relaid 9 mark-stones only.	
	Sutlej ...	...	Jullundur (b)	Ludhiāna	Scale 330 ft. to 1 inch	
1915-16	Indus ...	60	Dera Ghāzi Khān (a)	Bahāwalpur (a)		
	Sutlej ...	...	Ambāla (b)	Hoshiārpur	Scale 190 ft. to 1 inch	
	Beās ...	20	Kāngra (b) (c)	Hoshiārpur (c)	Scale 191½ ft. to 1 in. Main traverse from Kāngra Settlement Survey.	28,706
	Chakki ...	10	Kāngra (c)	Gurdāspur (c)		

TABLE A. (contd.)

Season	River	Length of river in miles	District under settlement	District on opposite bank	REMARKS	Cost
						<i>Rupees</i>
1916-17	Indus ...	143	Dera Ghāzi Khān (a) (b) (c)	Muzaffargarh (a) (c)		
	Chenāb ...	44	Multān (a)	Muzaffargarh (a)		77,947
	Rāvi ...	34	Multān (a)	Jhang (a) Multān (a)		
	Jumna ...	...	Ambāla (b) (c)	Sahāranpur (c)	Scale 190 ft. to 1 inch	
1917-18	Indus ...	22	Dera Ghāzi Khān (a) (b) (c)	Muzaffargarh (a) (c)		
	Indus ...	...	Dera Ghāzi Khān (b) (c)	Bahāwalpur (c)		1,09,132
	Rāvi ...	...	Multān (b)	Multān, Jhang		
	Sutlej ...	55	Multān (a)	Bahāwalpur (a)		
1918-19	Indus ...	...	Dera Ghāzi Khān (b) (c)	Bahāwalpur (c)		
	Indus ...	...	Dera Ghāzi Khān (c)	Muzaffargarh (c)		
	Chenāb ...	64	Multān (a) (b) (c)	Muzaffargarh (a) (c)		1,14,938
	Rāvi ...	...	Multān (b) (c)	Multān (b) (c), Jhang (c)		
	Sutlej ...	68	Multān (a) (b) (c)	Bahāwalpur (a) (c)		
1919-20	Chenāb ...	...	Multān (b) (c)	Muzaffargarh (c)		
	Sutlej ...	...	Multān (b) (c)	Bahāwalpur (c)		99,165
	Sutlej ...	68	Montgomery (a)	Bahāwalpur (a)		
1920-21	Panjnād ...	44	Muzaffargarh (a)	Bahāwalpur (a)		
	Chenāb ...	...	Muzaffargarh (b)	Multān		
	Sutlej ...	...	Montgomery (b) (c)	Bahāwalpur (c)		1,12,268
		...	Montgomery (b)	Ferozepore		
1921-22	Indus ...	...	Muzaffargarh (b) (c)	Dera Ghāzi Khān (c)	Relaid 27 mark-stones only.	
	Panjnād ...	...	Muzaffargarh (b) (c)	Bahāwalpur (c)		1,02,661
	Chenāb ...	...	Muzaffargarh (b) (c)	Multān (c)	Relaid 21 mark-stones only.	
1922-23	Indus ...	...	Muzaffargarh (b)	Dera Ghāzi Khān		
	Indus ...	8	Muzaffargarh (a) (b) (c)	Dera Ismail Khān (a) (c)		91,869
	Chenāb ...	122	Jhang (a)	Jhang (a)		
	Jhelum ...	40	Jhang (a)	Jhang (a)		
1923-24	Indus ...	74	Miānwāli (a)	Dera Ismail Khān (a)		
	Chenāb ...	...	Jhang (b) (c)	Jhang (b) (c)		1,08,092
1924-25	Indus ...	20	Attock (a) (b) (c)	Peshāwar (a)	Scale 165 ft. to 1 inch	
	Indus ...	10	Miānwāli (a) (b) (c)	Dera Ismail Khān (a) (c)		
	Indus ...	42	Miānwāli (a)	Miānwāli (a)		1,47,844
	Jhelum ...	...	Jhelum (a)	Shāhpur	Mileage } 1910-11 given } 1912-13	
	Jhelum ...	15	Jhelum (a)	Gujrāt		
	Jhelum ...	...	Jhelum	Kashmir (a)		
	Chenāb ...	...	Jhang (b) (c)	Jhang (b) (c)		



TABLE A. (concl'd.)

Season	River	Length of river in miles	District under settlement	District on opposite bank	REMARKS	Cost
1925-26	Indus ...	...	Miānwāli (b) (c)	Dera Ismail Khān (c)		<i>Rupees</i>
	Indus ...	...	Miānwāli (b) (c)	Miānwāli (b) (c)		
	Jhelum ...	...	Jhelum (b) (c)	Shāhpur		
	Jhelum ...	...	Jhelum (b)	Gujrāt		
	Jhelum ...	...	Jhelum (b) (c)	Kashmīr (c)		1,62,253
	Rāvi ...	20	Montgomery (a)	Montgomery (a)		
	Rāvi ...	42	Montgomery (a)	Lyallpur (a)		
	Rāvi ...	12	Montgomery (a)	Shekhūpura (a)		
1926-27	Rāvi ...	...	Montgomery (b) (c)	Lyallpur (b) (c)		1,08,076
	Rāvi ...	...	Montgomery (b) (c)	Shekhūpura (c)		
1927-28	Chenāb ...	...	Gujrānwāla (c)	Shāhpur (c)		85,657
	Rāvi ...	...	Montgomery (b) (c)	Lyallpur (c)		
1928-29	Jumna ...	120	Karnāl (b) (c)	Sahāranpur (c)	Work was tied to the main traverses laid down for the Punjab-U.P. boundary survey.	
	Jumna ...	...	Rohtak (b) (c)	Muzaffarnagar (c)		
	Jumna ...	...	Gurgaon (b) (c)	Meerut (c)		
		...	Gurgaon (b) (c)	Bulandshahr (c)		
		...	Gurgaon (b) (c)	Aligarh (c)		

### ABSTRACT

Indus ...	379	miles of which	210	entailed settlement surveys on one side of the river only
Panjnad ...	44	"	44	"
Jhelum ...	204	"	16	"
Chenāb ...	326	"	"	"
Rāvi ...	268	"	35	"
Sutlej ...	384	"	191	"
Beās ...	92	"	40	"
Chakki ...	10	"	10	"
Jumna ...	164	"	164	"
<b>TOTAL ...</b>	<b>1,871</b>	<b>linear miles of river</b>	<b>710</b>	

TABLE B.

Special Surveys

CARRIED OUT BY THE RIVERAIN SURVEY DETACHMENT AND  
No. 22 ( RIVERAIN ) PARTY.

Ambāla–Sirmūr Boundary Survey	1925–26
Beās Reservoir Survey, Kāngra District	1925–26
Changa–Manga 4-inch Forest Survey, Lahore District	1928–29
Dera Ismail Khān 4-inch Survey of Indus for C.R.E.	1910–11
Gujrāt–Shāhpur Rectangulation	1913–14
Gujrānwāla Town Survey	1919–20
Hatti 3-inch Survey of Military Practice Camp	1916–17
Jhelum Town Survey	1918–20
Kāngra Settlement Survey	1912–1917
Kāngra Trunk Road Survey	1914–1917
Kāngra Valley Development Survey	1927–28
Khaur Special Survey for Attock Oil Co.	{ 1915–16 1920–22
Khushab Thal Survey, Shāhpur	1912–15
Lahore Cantonment Boundary Survey	1914–16
Lahore and Environs 4-inch Survey	1924–25
Lahore Nazul Land Survey	1921–22
Lahore Town Survey (330 and 100 ft. to 1-inch)	{ 1920–21 1924–26
Lower Bāri Doāb Rectangulation	1906–1913
Montgomery, <i>kilabandi</i>	1927–28
Montgomery, <i>murabbabandi</i> of crown waste land	1927–28
Multān Rectangulation	1918–19
Multān Suburbs Survey	1919–20
Muttra Nazul Land Survey	1926–27
Punjab–Bahāwalpur Boundary Demarcation	1926–27
Punjab–United Provinces 4-inch Boundary Survey	1925–29
Shekhūpura <i>Tahsīl</i> 1-inch Boundary Survey	1924–25
Siālkot <i>Tahsīl</i> Boundary Survey	1922–23
Simla Settlement Survey	1914–16
Sutlej Valley Extension of Rectangulation	1928–29
Upper Bāri Doāb 8-inch Canal Survey	1926–27

## APPENDIX

### Punjab Government Rules for Riverain Surveys

FINANCIAL COMMISSIONERS' STANDING ORDER No. 17

RELATIONS OF REVENUE OFFICERS TO WORK OF  
SURVEY DEPARTMENT

*Original Issue, dated 15th June 1909.*

1. (1) Deputy Commissioners will maintain in their offices a list of the Great Trigonometrical Survey stations in their districts, and should see that the instructions given below are carried out.

Maintenance of Trigonometrical  
Survey stations.

(2) In his field inspections the *Patwāri* in whose circle any such pillar is situated should note whether the mark is in good repair in the manner already prescribed for *pakka* survey marks in the instructions given in Standing Order No. 22 on Harvest Inspections.

(3) On the completion of the *kharif* harvest inspection such *Patwāri* shall send a report in the subjoined form to the *Tahsildār* for submission to the Deputy Commissioner:

1	2	3	4
No. of pillar	Name of village in which pillar is built	Name of police station and <i>tahsīl</i>	Remarks on the condition of pillars

(4) Should any pillar not be situated within the boundaries of any revenue village the *Tahsildār* shall make special arrangements for the inspection of such pillar and for the preparation of the prescribed report by a *Patwāri* or *Kānāngo* as soon as possible after the *kharif* harvest inspection.

(5) The Deputy Commissioner shall submit an annual return in the above form to the Superintendent, Trigonometrical Survey, Dehra Dūn, on the 1st December in each year, and shall carry out any repairs to those pillars that the Superintendent may desire him to make and for which he may provide funds.

2. It is the duty of the Collector to furnish to any party of the Survey of India employed in his district, on the requisition of the officer in charge of the party, a list of all the estates, forests and municipalities included in the district, and a skeleton map thereof.

List of estates and *mujmili* be furnished.

The Collector is responsible for the correct spelling according to the authorized system of all names entered in the list referred to. Each name should be plainly written both in Urdu and English. And the list should further show the *Patwāri* circle, *thāna* and *tahsil* in which the estate or forest is included.

The skeleton map, commonly called a *mujmili* map, may be prepared very roughly and need not be drawn to scale, but it should roughly indicate the limits of all estates and forests. It is required by a Survey party as a rough guide to the position of each estate or forest, and as a safeguard against omissions and oversights in the earlier stages of their work.

3. When the operations of the Survey of India in progress in any district include the survey of village or forest boundaries of trijunction pillars, it is the duty of the Collector to arrange that the boundaries and pillars under survey are indicated to the Surveyors in the one case by the *Patwāris*, and in the other case jointly by the *Patwāris* and by the Forest officials in charge of the village or forest.

Indication of boundaries.

It is not intended by this rule that either *Patwāris* or Forest Guards should continuously attend on the Surveyors during the progress of the survey. When the survey has reached the stage at which the boundaries or pillars will be surveyed, the Officer in charge of the Survey party or his authorized assistant will intimate to the Collector or (if so previously arranged with the Collector) to the Forest officer or to the *Tahsildār*, the dates on which the attendance of each local official will be required, and any temporary inconvenience to current work involved in these attendances, which will seldom exceed three or four days, must be accepted.

The Government will hold Collectors and Executive Forest officers responsible for any errors of survey which may arise from inattention to this order.

If in any case for which the above directions provide, the boundaries are found to be uncertain, or not to be adequately indicated by existing pillars, the Collector should avail himself of the powers provided in Chapter VIII of the Land Revenue Act, in order to supply such deficiencies in the demarcation as he may consider material.

## APPENDIX TO STANDING ORDER No. 17

*Correction slip No. 662 S. O. (New Series), dated 18th January 1924.*

*Rules for Riverain Measurements carried out in conjunction with the Survey Department.*

It is the duty of the Settlement Officer to supply the Riverain Survey Officer, by the first of May each year, with a statement showing the villages to be traversed in the ensuing season distinguishing those which are to be wholly and those which are to be partially remeasured, and affording information as to the scale to be used and the distance desired between traverse points. With this statement should be sent a small scale map of the district showing the names of the different villages as well as their boundaries. The Riverain Officer will then prepare a programme for the ensuing season and submit it by the 1st of June to the Superintendent, Northern Circle, who will forward it to the Financial Commissioner for approval. Before actually commencing the work of the season the Riverain Survey Officer should consult the Settlement Officer as to the order in which villages should be traversed. The Settlement Officer must be careful to arrange in ample time (at present the press requires about two months' notice) with the Director of Land Records for the supply of ruled and backed *musāvis* to the Riverain Drawing Office. There will be two kinds of *musāvis*, namely: 16 square and 8 square ones. The latter will be used for such outer portions of villages as can be included within them.

2. It is the duty of the Settlement Officer to see that all existing boundary pillars are put in a proper state of repair.

3. It is the duty of the Settlement Officer to make arrangements with a contractor for the supply of stones to mark the corners of base-lines according to the list supplied by the Officer in charge of Riverain Survey.

4. Early in the cold weather it will be the duty of the Officer in charge of Riverain Survey to arrange that traversers begin work in the riverain tract. At the commencement of work, each party should be accompanied by the village *Patwāri* and the *Lambardār* to point out boundaries and to show where points should be thrown, as well as to arrange for the supply of information, etc., and to act generally between villagers and the traversers.

5. Such ~~points as~~ the Settlement Officer may require should be traversed and ~~where necessary~~ marked on the ground by the Officer in charge of Riverain Survey. These should include:

- (a) All existing trijunction pillars.
- (b) Recognizable physical features of a permanent nature.

- (c) The survey party's traverse points. These should not be more than 200 *karams* apart and should invariably be close to the district or *tahsīl* boundary.
- (d) A number of points in the *kachcha* area to facilitate internal measurements by the *patwāris*. These points will usually be in cultivation.

6. The Riverain Drawing Office should also obtain the last settlement maps of all coterminous villages on either side of the boundary and combine them into a single 4-inch map in order to see how far they agree with each other.

7. Inside each village a suitable square should be selected by the Officer in charge of Riverain Survey to form the special baseline of that village. This should be on ground not exposed to river action. Stone pillars should be erected at three corners of this square. A corresponding square on *pakka* ground should in each case be selected and similarly marked on the opposite side of the river. This will materially facilitate the relaying of boundaries on future occasions when such may be necessary.

8. As a result of the traversers' work the Riverain Drawing Office will supply the Settlement Officer with:

- (a) *Musāvis* showing paper boundaries in those cases where it is discovered in the course of the examination prescribed in rule 6 that the boundaries of the settlement maps do not coincide.
- (b) Separate *musāvis* for each village showing the points traversed under rule 5.

This (b) series will be complete and continuous for the whole tract and will be numbered serially. Where it is found necessary because of discrepancies to prepare an (a) *musāvi*, the (a) *musāvi* will correspond exactly to a (b) *musāvi* and bear the number not of a separate (a) series but of the (b) series. It will be easy to transfer the points shown in (b) to (a) with the help of the squares shown in both. The *Patwāris* will work on (b) and (a) will remain in the Revenue Record Room until they are required for reference under Rule II. It is advisable to have paper boundaries marked only on (a). If they are worked on (b) the *Patwāris* are apt to sow dissension even when there is no actual dispute on the spot. It is for this reason that the traverser should show "*Chāndās*" only along the boundary and not attempt to mark out the actual boundary itself.

9. *Musāvis* are supplied gradually by the Survey Department from the 15th December to 15th March. As the latest *musāvis* are not issued till 15th March it is necessary for the *Patwāris* to whom these *musāvis* are issued to have everything in readiness to start work immediately. If the work is not completed in April the traverse marks will be washed away by the rivers rising when the snows in the hills begin to melt. The

Settlement Officer should give separate *musāvis* alluded to in rule 8 to *Patwāris* upon which it is easy for them to carry out a rapid and accurate survey. In the *kachcha* area of course entire remeasurement is required, but where the system of measurement in use is that of *tarmim*, the *Patwāris* need not remeasure the whole of the *pakka* area of each village. The *pakka* area may be *tarmimed* separately, and the work so done can for the sake of completeness be transferred to the Survey *musāvis* in continuation of the remeasurement of the *kachcha*, either by scale or by pantograph. The scale is the best instrument for this work, since any slight discrepancy can then be distributed; with the pantograph this is not feasible.

10. The *Kānūngos* who were employed with the traversers may now be appointed by the Settlement Officer to supervise the detailed measurements. It is advisable to have a special *Nāib-Tahsildār* in charge of the whole cadastral survey of riverain areas.

11. It is in connection with the remeasurement of the *kachcha* area that boundary disputes arise and discrepancies have to be reconciled, and this requires careful treatment. The *Nāib-Tahsildār* will first of all mark the external boundaries of the village as shown in the settlement *shajra*. The *Patwāri* will then easily be able to fix the field boundaries which he should show to the owners concerned. In case the settlement *shajras* are in such a dilapidated state that they do not clearly show the village boundaries or in case the boundaries of two villages overlap or an area has been omitted from measurement in both maps, the *Nāib-Tahsildār* should prepare a statement of the case, illustrated by tracings from the *musāvis*, and submit it to the Settlement Officer for his decision which will be marked on both sets of *musāvis*. His report should include the statements of *Lambardārs* and owners interested in the matter. To enable him to deal properly with disputes, the *Nāib-Tahsildār* will require:

(a) the settlement *shajras* of villages on both sides of the river,

(b) all records of previous disputes and decisions. If any of the villages involved are situated in another district, it is necessary to obtain the co-operation of those authorities. The most convenient course is to obtain jurisdiction for the Settlement Officer over the whole of the riverain area of the adjoining district.

12. It may happen that the scales employed on each side of a river differ. It is of course essential that the whole area be plotted on one scale and the more convenient one may be selected and the internal measurements conducted accordingly; if considered necessary, reduction or enlargement of the completed map can be carried out subsequently for villages using a different scale from that adopted.

13. An important part of the traverser's duties is the embedding of the base-line stones, this work must be carried out by the Survey Department who will supply the Settlement Officer with an index map showing the corners of squares so demarcated.

14. It is the duty of the Director of Land Records to maintain a list of selected *Kānūngos* so that one may be deputed without delay as soon as the traverser arrives in the district.

15. A supply of wooden pegs, 2 feet long and 6 inches in circumference should be provided by the *zamīndārs* under orders of the Settlement Officer for marking points.

16. *Lambardārs* and *Zaīldārs* should be made responsible that the pegs and survey marks are not removed or destroyed. A list should be maintained by the village *Patwāri* in the following form:

1. No. of *chāndā*.
2. Field No. in which the *chāndā* is situated.
3. Owner's name.
4. Name of the tenant.
5. Signature or the thumb mark of the owner of the field.
6. Seal of *Lambardār* concerned.

The position of the pegs and *chāndās* should be marked by the *Kānūngo* on one of the *Patwāris'* maps: it will then be easy to fix responsibility.

17. The *Nāib-Tahsildār* on special duty should be provided with a miniature Swiss cottage tent and a *shouldari*. One or two *Muharrirs* should also be given him and a small contingent advance. He will need a good deal of tracing cloth for his reports on disputed boundaries.



# INDEX MAP TO RIVERAIN SURVEYS OF THE PUNJAB

1907-1929.

Scale 1 inch = 32 miles.

