

highest level in this flood cycle at the end of ebb attained at the sluice, which discharges the South Holland water into the Nene near Sutton Bridge, was just after mid-day on Monday March 17th., this being indicative of the time lag between the highest level at the upstream and downstream ends of the system, which of course was, to some substantial degree, accentuated by the abnormal conditions of snow and ice. By way of contrast the Internal Boards pumped areas were in general getting into a worse condition mainly for two reasons, firstly the effect of thaw and rainfall on the "quantity run-off" was to put it completely beyond the capacity of the pumping stations with the inevitable result that water levels were steadily rising and continued to do so for some time, secondly, added to the effect created by local conditions the Deeping Fen area was subject to a very considerable inflow through and over the Welland banks at the Deeping villages, and although this had to some degree fallen off by Sunday night there was still a very considerable amount of water actually coming through the banks which of course added to the pumping problem. The 4th District was in very much the same condition and in this particular case although no water had, until early Monday morning, actually flowed over the banks of the Glen they were beginning, after some four or five days, to suffer badly from fatigue, as a result a considerable quantity of water was coming through the banks more particularly in the Counter Drain and Tongue End area, but nevertheless in sufficient quantities along the length protecting the 4th District to create some additional problems. The Pinchbeck Marsh Pumping Station had a rather easier time from a point of view of pumping requirements, but nevertheless had its

longest run in history throughout this particular flood. The upstream end of the Spalding & Pinchbeck district was through most of the flood discharging water into the 4th district as a result of ground levels which ruled the point of discharge rather than bed levels, and the lower lengths of the River Glen banks were of course, not subject to quite the same duty as the upstream lengths with the result that they afforded a greater degree of protection to the Spalding & Pinchbeck area than elsewhere. I think it may be well to add whilst talking about pumping stations, that the pumps at Locks Mill were operated whenever possible to obtain a maximum potential from a point of view of reservoir capacity in the Crowland and Cowbit Washes, but the effect of operating these pumps in the early stages of the flood would be that the water level in the River Welland was inevitably raised with the nett result that a slightly decreased discharge in the main channel meant that the Cradge Bank would be topped at an earlier time. Although it cannot be said that pumping operations would have created no additional reservoir it can in truth be said that the additional reservoir so created would not be equivalent to more than a few minutes discharge in the main river. It had of course been impossible to operate the Locks Mill Station for several days and on Sunday the 16th water was beginning to run round as well as underneath the pumping station and by Monday the station was completely inundated, precautions being taken to guard against any deleterious effect upon the electric power supply of the whole district as an outcome of the electrical gear becoming flooded.

As Monday morning progressed the situation in the Deeping Fen area was becoming considerably worse, the

water level at Podo Hole basin had risen to 3'7 $\frac{1}{2}$ " on the gauge (1.68 O.D.), and it was quite evident that some very serious trouble was going to be experienced with the River Glen which had by 7 o'clock in the morning reached a level of 24'4" O.D.Liverpool at Kates Bridge and was showing every indication of still rising. To add to the general stress at that particular time, it was perfectly obvious that another appreciable rise in the River Welland, with its consequent input into the Washes, could be anticipated within the next 24 hours as water levels in the upper valleys had again risen. Cradging operations were in hand on all the River Glen banks from Bars Bridge upstream to Kates Bridge in anticipation of the ultimate peak of this rapidly rising water level, and by about 10 o'clock in the morning the levels were such that the Glen banks in many cases were beginning to be topped by water to an appreciable degree, with the result that the Fens which were already flooded badly, as a result of the thaw and rainfall in their own district and serious infiltration through the high level banks, were called upon to accommodate still more extraneous water. By noon on the Monday morning the situation had reached such a position on the Glen that everything capable of being diverted from any other source whatsoever was put into the area, which action could be described as dealing with the peak situation on a length of something rather more than 20 miles of extremely precarious flood bank. There were, in a number of places, sheets of water over a hundred yards in length pouring down the river banks and into the Fens which they were supposed to protect, and throughout the rest of the day everything that could be put on to this job was so employed. It was hoped by midnight that the worst of the situation

had been reached as Kates Bridge, which is the upstream point of the length under consideration, peaked from 5.30p.m. to 8p.m. at 26' O.D., (discharging something in the order of 2,400 cu.secs.) and shortly before midnight this level had dropped sufficiently to be recorded and soon after midnight the water level was down by 2". By this time the drop in discharge and the consequent level was just noticeable at Tongue End which was more or less the crucial point of the river. In addition to the normal cradging work undertaken at such high pressure, a number of sheets were placed on the Glen banks during Monday in an effort to seal off some of the worst "runs", in some cases these sheets undoubtedly saving what at the time appeared to be a precarious situation, and in many places downstream of Bars Bridge, where the banks were not topped by the water levels, a number of sheets were placed to good purpose. In spite of all these efforts however, the right bank of the Glen failed on Tuesday the 18th at approximately 6.20 in the morning some half a mile upstream of the railway bridge on the Spalding to Bourne line, and a gap estimated in its early stages to be something rather more than 50ft. wide was formed which discharged a very considerable quantity of the River Glen water into the Counter Drain Washes, with a consequent threat to the already overtaxed Deeping Fen drainage system.

Although the River Welland water level at Market Deeping during the Monday was somewhat lower than on the previous day and Saturday, a great quantity of water was flowing across the Tallington meadows and through the Maxey Meadows into the Crowland and Cowbit Washes, the combined discharge into the Washes being considerably in excess of the capacity of the River Welland through Spalding,

with the inevitable result that the Wash level was steadily increasing. During this period two bridges in the Maxoy Meadows district failed as a result of scour and pressure which they were called upon to withstand but it might be well to add that both these structures were relatively small and not in the best of condition and it is quite obvious from their size that they were never designed to cope with anything but local flood water. I would also mention that these two bridges, together with others of a similar character, were due to be replaced under the River Welland Major Improvement Scheme which was prepared in this Office, a report on the subject being presented to the Board dated July 1944.

As has previously been said, the gale of Sunday night played havoc with telephone communications, but one message that did get through to the office at 9.55 on Monday morning to the effect that "the River Welland was again rapidly rising at Rockingham" gave a pretty sure indication of what was to come in so far as the protective banks between the Fons and the River Welland were concerned, and during the day continuous contact was kept with the Police in various areas who had their patrol cars out to enable us to receive reports on the behaviour of the water levels in various districts. By 11 o'clock in the morning the water level in the Crowland and Cowbit Washes had risen to 16'11" O.D. Liverpool on the Crowland Bridge gauge, which was an increase of approximately 5 inches from the day before. It is worth noting that although the thaw had been in progress for several days there were still some very large ice packs on the Washes which were creating difficulty in so far as flood banks were concerned because the wind had "up ended"

many sheets of ice, in some cases up to 10ft. square, and the wave action coupled with the scouring effect of the ice was beginning to erode the banks badly, and it must be borne in mind that the erosion due to ice, contrary to the normal fretting due to the water surface, extended over some considerable vertical distance. The ice from the Washes was also creating another problem, for where the River Welland flows through Spalding a number of bridges were by this time within an inch or two of the river water level and the ice in some cases was beginning to "pack" against these obstructions and the back breaking job of freeing this ice was undertaken steadily for the next few days, in some cases men working without any form of relief on this job for anything up to 20 hours which gives an indication of the strain that was put on the manpower resources of the district. During the day direct contact was maintained with P.O.W. Camps and prisoners were moved from one camp to another with a view to obtaining a reserve pool at a central point at Spalding to draw upon as circumstances dictated and during the afternoon the position was such that 130 P.O.W's were standing by complete with transport and equipment in addition to those that were being used on various sites. I would here like to mention that in many cases the Camp Authorities co-operated well and during the height of the flood when I think it is safe to say that the situation was appreciated by all, they proved helpful in many ways.

Soon after mid-day trouble developed with the portable unit which had been placed at the 4th District to supplement the permanent pumping plant and the whole ignition system had to be dismantled and checked by men who were already extremely tired, however the pump was very soon in operation

again, but shortly after 7 o'clock in the evening two head joints went on the 4th District main engine and again frantic efforts were made to get the engine going and by eight minutes past eleven in the evening the engine was again running satisfactorily, and from that time onwards no further serious trouble was experienced with any of this plant although water levels continued to rise in the district for some time. At 3.40 in the afternoon the slightly comforting information came through to the office that Market Harborough, which is at the head of the catchment area, had been under anything between two and three feet of water at various times but that this now showed some distinct signs of subsiding, and although this point was some considerable distance from the critical point of the river it did indicate that the high discharges in the river were at some points beginning to abate. At 4 o'clock in the afternoon the rate of rise of water level in the Fens showed that the Podo Hole engines were losing at the rate of one inch per hour and that the 4th district was losing at the rate of $\frac{3}{4}$ " per hour, and both of these steadily rising water levels could by this time be largely attributed to the fact of infiltration and overflow of main river water into the Fens. By 5 o'clock in the afternoon reports were coming in from the upper reaches of the Glen to the effect that substantial falls in water levels were taking place progressively down the river, one message was to the effect that the water level at Essendine had dropped by approximately 2ft., giving rise to some somewhat unfounded optimism so far as the embankments on that particular river were concerned. It was anticipated in view of the sudden fall in the upland water levels that the fall in the embanked

channels would be equally sudden, but the amount of residual water in the Wilsthorpe, Greatford and King Street area were such that they continued to feed the lower reaches of the Glen for some considerable time.

By 6 o'clock in the evening some new difficulties were being experienced in the Marsh area in the district of Hurdletree Bank. The people on the South Holland side of the Hurdletree Bank were alleging that the water coming from the South Wolland district into the South Holland system was so great in quantity that it was flooding their land and very careful regulation of the sluices was put in hand with periodical closures to check on water levels, to the evident dis-satisfaction of the people on the South Wolland side of the bank, but all things considered the system with its present limitations has worked reasonably well in this area. By mid-day on the 17th. the water level on the River Wolland at Spalding had risen to approximately 15 O.D., and it was fortunate that for the following few days the effect of tide on this water level was not appreciable as we were, at that time, enjoying a period of neaps, and it was not anticipated that tidal influence would be felt until the Friday or Saturday to any appreciable degree.

During the evening one fresh water slacker on the left bank of the River Glen near Bordens Bridge was giving a certain amount of trouble but was successfully sealed as a result of sheeting and bag work, and a number of runs in the bank were successfully dealt with in a similar manner.

During Monday evening the N.F.S. put certain pumping operations in hand at Towngate Near Market Deeping in an effort to control the flood waters seriously affecting houses and roads, but their efforts did not do much to improve the situation although it may have been worse without their

pumps on the site. By 9 o'clock at night the water in the Crowland and Cowbit Washes had risen to 17'7" O.D. Liverpool and arrangements were being made for extensive work on the Wash banks to be put in hand immediately to supplement the action that was at the present time being taken, and arrangements were also made to evacuate the cottages at Locks Mill which were by this time completely flooded.

On Tuesday morning the 18th the situation with regard to the main rivers in general through the Fen was still deteriorating although there had been a very slight drop in water level on the Glen, but as I have previously mentioned one of the Glen banks failed at approximately 6.20 in the morning and it was now very evident that some extensive trouble would be experienced with the high level banks impounding the Crowland and Cowbit Wash flood waters. It was quite evident by this time that the gravitational systems in the Marsh had reached and in some cases passed their worst conditions and also that in the extreme upper reaches of the highland river systems the run-off was quite definitely becoming less. The areas under the protection of the high level river banks however were still subject to the inflow of water both through and over these flood protection works and in this connection Deeping Fen, Bourne Fen and South Holland were suffering particularly badly, the pumped areas as opposed to the gravitational area of the South Holland system being in a very precarious position.

During the morning immediately following the Glen breach, arrangements were put in hand to effect a closure as soon as possible. The result of the breach was, of course, to lower the water level to some degree in the River

Glen and calculations showed that by about 9 o'clock in the morning something between 720 and 1,000 cu.secs. was being discharged through this breach and one would imagine that with this extra discharge, coupled with the fact that the run-off in the upper reaches was lessening, the water level in the Glen near the breach would have dropped very rapidly, but the flooded areas above Katos Bridge were of such an extent that they fed this channel at a high level for some considerable time to come. The water level in the river adjacent to the breach on the Tuesday morning when the failure occurred was approximately 19 O.D. and this water level fell by about 4ft., until such time as the breach was finally sealed and it continued to drop at much the same rate for the next day.

As the result of the slight easing of the situation in the Marsh area most of the resources of the Authorities were now switched to dealing with work in Deeping Fen and on the high level banks of the Welland and the Glen. There were now three main factors to consider which obviously took priority over all other matters connected with the flood, and although other districts could not be and were not entirely neglected it was quite obvious that they were beginning to get over the worst of their troubles. The chief concerns were, of course, the River Glen, Deeping Fen, and the River Welland.

During the day heavy baulk timbers were brought in from Holbeach and other preliminary preparations were made as the first stage towards sealing the breach in the Glen. The water escaping from the breach (incidentally this quantity of water was far in excess of the pumping capacity of Deeping Fen Pumping Stations) obviously would do untold damage if it were not controlled in some way before a

closure could be obtained and the whole of the Counter Drain bank was heightened in an effort to prevent anything from coming from the Glen into the Deeping Fen area, and a temporary bank was made from the upstream end of the Counter Drain bank in the Baston Common district in an effort to prevent water getting round the Counter Drain bank and so ultimately into Deeping Fen. In spite of these efforts however a considerable quantity of water (how much it is impossible to estimate with any degree of accuracy) did find its way into Deeping Fen but it is quite obvious that this protective work did in fact save a vast area from further inundation. It might be well to add that the land between the River Glen and the Counter Drain is known as a "wash" and, although it has been flooded seriously, ploughing has been possible on the whole of the area for sometime as a result of the rapid evacuation of the flood waters since this course became possible.

The next major consideration through the day was the whole of the River Welland flood banks, and the organization that at the present moment was in hand being strengthened and built up progressively throughout the day and for that matter throughout the remainder of the week.

I would here like to mention that considerable assistance was given by the police in the control of traffic, the emergency closure of roads to all except our own transport and in the organization and maintaining of all one way traffic wherever practicable, and in addition to the police, one or two local people gave some very material assistance in this connection.

By mid-day on the Tuesday Deeping High Bank was beginning to "fret" very badly immediately downstream of Crowland Bridge and some quite considerable quantity of

water was getting through the bank and causing some concern, whilst further downstream, in the neighbourhood of Four Mile Bar and Locks Mill, there were some hundreds of runs through the bank although as yet there was still a free board of about a foot at this point. Immediately above Crowland Bridge the bank supporting the roadway was beginning to wash out during the morning owing to infiltration, and by mid-day the water level had risen to such a degree that vast quantities were going over the road thus adding to the difficulties at present being experienced with this particular length of bank. At the top end of Deeping High Bank, near the old staunch, water was beginning to go over during the morning, again adding to the quantity of water getting into Deeping Fen already by means of infiltration, and from this time onwards the three particular points mentioned gave some considerable concern from the point of view of their stability.

The length of the Welland through the Deepings was still creating some very considerable trouble and water was getting out on both sides of the Deeping district, respectively into Deeping Fen and Maxey.

On the east side of the Washes, the Cowbit Bank protecting the South Holland district was being overtopped in a number of places and here again extensive cradging work was in hand. Downstream of the Washes, through the town of Spalding, water levels by this time were well above the road level in many places, and the Locks Mill Bridge over the River Welland was beginning to hold up water due to the fact that the whole of the waterway underneath the bridge was "drowned". This particular bridge gave rise to one of the most persistent rumours of the flood namely that "the bridge was going to be blown up" and it took some very

considerable time before this pet theory of many people was exploded.

During the afternoon the culvert under the Counter Drain which in the normal course of events drains the Counter Drain Washes began to give trouble. It will be remembered that the Counter Drain Washes were now in effect a reservoir protecting Deeping Fen from the water getting through the breach in the River Glen, and if this culvert failed it would inevitably mean the complete inundation of the Fen and for the next three days work was more or less continuous to prevent this culvert from finally blowing. Due to some particularly good work carried out under very risky conditions this culvert was prevented from failing although some considerable quantity of water did in fact get through from the flooded Washes into Deeping Fen. As a result of the continuous introduction of extraneous water into Deeping Fen, the gauge at Pote Hole Pumping Station on the basin side had risen to 5'3" by 11 o'clock at night on the Tuesday, and although this water level still continued to rise very steadily for some further two or three days the rate of rise was now very much less than had previously been the case because water was beginning to spread very extensively across the land. Early on the morning of Wednesday the 19th of March the Kates Bridge gauge had fallen to 25'4 $\frac{1}{2}$ ", this gauge level was indicative that the upland water was definitely easing and it could be expected that within the next four or five days most of the residual water in the King Street area would be clear, with the welcome result that the Glen water level would then fall relatively quickly.

Just before 1 o'clock in the morning of the 19th the first "top blow" had taken place on the Deeping High Bank near

Four Mile Bar, but this was immediately sheeted and bag breasted on the river side, and in common with a number of blows which occurred later it was sealed to such a degree that serious consequences did not arise. The water level in the upstream end of the Wash had risen 8" in the last 12 hours by 2 o'clock on the Wednesday morning, which in effect meant that cradge work extending over a distance of some 9 miles had to be raised steadily throughout the day, and every inch rise in water level meant an increase of length of cradging involving something in the order of two or three miles. Soon after 4 o'clock in the morning contact was made with the Clerk to the Spalding Urban District Council advising him of the present situation and pointing out that it would in all probability worsen, and asking him to put in hand certain works in the town of Spalding and to deal with the local population in so far as their own personal interests were concerned. As an outcome of this conversation and conversations with other officials in the town a number of useful things were done including the taking over of certain lengths of cradging through the town of Spalding, the provision of almost 100% street lighting for the assistance of such work and the control of traffic.

About this time the Bell Tunnel through the South Holland bank at Cowbit was showing distinct signs of weakness, the culvert itself was subject to a head of something in the order of 15 or 16 feet of water and it was impossible to say exactly what was happening on the Washes side, but a considerable quantity of water was coming through the culvert and out of the bank on the South Holland side. At about 5 o'clock in the morning the road which runs along the top of the bank and over the culvert began to subside, but the bank was prevented from blowing by

following the subsistence by cradging and by blocking the upstream end of the culvert.

By about 6 o'clock in the morning the Counter Drain bank was being overtopped at its upstream end in spite of work that had been done up to that time and still further labour, transport and material were drafted in to cope with this particular situation. It was of course, impossible at this stage of the flood to give any relief to the Counter Drain by means of the culverts to the Pumping Stations at Podge Hole and the 4th District because the water levels in the areas controlled by these two stations was far in excess of safety limits, and in fact very considerable areas were by this time under water. However the Vernatt's Drain had behaved remarkably well throughout the whole of this flood and the Counter Drain was able to discharge at a relatively high level direct into the Vernatt's Drain by gravity for very long periods of time, and in fact the doors were only shut for intervals of an hour or less in each tidal period and there is no doubt that the Vernatt's Drain Improvement which was carried out during the war had paid a very handsome dividend in this respect alone.

Later during the morning the Bell Tunnel at Cowbit was again giving further trouble and by about 8 o'clock the whole of the verge was lost and a considerable amount of the road had subsided. A closure was again effected by means of sheeting, straw trusses and bag work, but not without some very great difficulty, and from this time onwards the culvert was nearly lost on a number of separate occasions and constant work was in progress at this particular site for the next four days.

During the whole of the period since the breach occurred on the Glen material was constantly being brought in in readiness for an attempt to make a closure and the great difficulty with the particular job was access. It must be remembered that the whole of the land adjacent to and under the command of the Glen banks was flooded and the only point of access which could be used in any satisfactory way was by means of Bourne and down to the Tongue End Bridge, and from that point down to the breach all material had of necessity to be floated or man handled. One thing that was good news up to date was that the culvert under the Counter Drain, which it will be remembered had given some considerable trouble, was in a fairly satisfactory state by about 6.30 in the morning of the 19th and this did to some degree ease the situation as the labour that had been more or less permanently employed on this job could now be switched to the Counter Drain bank job thus assisting to prevent a further spreading of flood water.

On five separate occasions during this night the cradging work on the upstream end of the Deeping High Bank near the old staunch had failed but in every case a satisfactory closure had been made within a relatively short period of time in addition to the normal work that was constantly in hand of raising and extending all the cradging as the water level in the Washes increased. At 9 o'clock in the morning the level at Market Deeping on the Welland was 23'6", at Kates Bridge on the Glen it was 24'7", and information from further upstream indicated that the upper ends of the rivers were now subsiding very rapidly from a point of view of discharge. During the whole of the day the gauge at Market Deeping on the Welland remained steady with very little fluctuation, but Kates Bridge on the Glen continued to drop very slowly.