HURST SPIT BEACH MANAGEMENT PLAN

1 Introduction

This report supplements the Engineers Report for the Hurst Spit stabilization scheme and sets out the NFDC intentions for the management of Hurst Spit frontage, on completion of the capital beach recharge scheme. The beach management plan will ensure that the standard of service provided by the intitial capital beach recharge is maintained for the 50 year scheme life. It includes details of monitoring, dredging licence requirements, action levels, frequency of recycling, interim recharges and emergency procedures.

The programme is described at two levels of detail: the first identifies a broad 50 year programme in accordance with the benefit cost analysis submitted and approved with the Hurst Spit Stabilisation Scheme application. The second provides a detailed breakdown of activities which are likely to be needed during years 1-5 of the stabilization scheme. The report also discusses methods by which the strategy will be reviewed.

2 Outline 50 year programme

On completion of the capital recharge scheme the beach was able to withstand the design storm conditions without risk of breaching. This has already been demonstrated during the construction phase, when a storm event occurred which exceeded the design wave conditions. The winter period 1996/97 provided a severe test for the capital recharge and the beach has responded in accordance with design expectations. The recharge is however a dynamic structure which will modify rapidly over time due to both cross shore ad long shore transport processes and it will require maintenance throughout its life. As Hurst Spit is a barrier beach it has no secondary protection in the lee of the beach: maintenance of the dynamic barrier is therefore more critical than for a beach recharge fronting a seawall or cliff.

The beach management plan relies on a comprehensive monitoring programme to inform the maintenance programme and this is discussed in detail in section 4. The beach monitoring programme will be used in conjunction with empirical predictive models to provide a decision support system for the maintenance programme.

The scheme has a design life of 50 years, during which there will be a requirement to recycle or top up the renourishment and to maintain the rock beach control structures. Whilst it is difficult to assess the quantities of material that will be lost from the system during the scheme life, estimates have been made to facilitate development of a preliminary programme of recharge maintenance. This programme will be revised in conjunction with the results of the planned monitoring programme at strategic intervals.

No further introduction of additional beach recharge materials are envisaged within the first five years of the beach management plan. Maintenance work will be limited to recycling of material and bypassing of the breakwater in years 1-5. Detailed descriptions of the maintenance during the first 5 year period are provided in section 3. An allowance for major maintenance of the rock structures has been included in year 6: this will follow the initial settlements and movements which might be expected during the first few storm seasons. Further maintenance of the beach control structures is also planned at strategic intervals, during the life of the scheme.

The first planned interim recharge will take place in year 10 when an estimated 100,000m3 of shingle will be required. This will be followed by recharges of 100,000m3 at 15 year intervals until year 40. The volumes are based upon historical rates of loss due to longshore transport. They also assume that the recharge material has a comparable grading with that used in the recharge scheme, which was sourced from Shingles Banks area 406. At the time of construction comparable sediment gradings were not available from other dredging areas at an economic rate. The source of future recharges will be reviewed at a later stage. Appropriately increased volumes of material may be needed if finer more widely graded material has to be used for the recharge at significantly increased cost.

The size and frequency of the anticipated interim recharges reflects an estimate of economies of scale, in combination with anticipated beach losses and exceedence of the alarm beach cross section thresholds. The interim recharges are likely to be carried out by pipeline discharge from a trailing suction hopper dredger, which cannot be carried out economically for volumes smaller than 100,000m3: this is due mainly to mobilization costs which are likely to be of the order of £250,000 at current prices. More frequent lower volume recharges at strategic locations may provide a better technical solution, but these will be much more expensive pro rata. A range of alternative strategies will be considered which may result in smaller volumes of interim recharges at more frequent intervals, using alternative delivery methods.

Provided that the capital recharge is maintained in accordance with the recommendations given in this report, emergency action should not be necessary although a contingency plan is outlined in section 3.

3 Detailed 5 year programme

3.1 Maintenance

A programme of planned maintenance has been developed, to provide a cost effective method of sustaining the integrity of the spit against storm wave action. This programme is based upon the results of both the physical and mathematical model studies and also on the results of field surveys carried out since 1987.

3.1.1 Threshold levels

A damage threshold or alarm condition has been defined, at which maintenance is necessary to avoid failure. A simple geometric definition of damage threshold is not appropriate, as the damage threshold condition, defined by conditions giving rise to overtopping and resulting in roll back of the crest, varies along the length of the Spit. The wave climate is more severe at the western end of the spit, and consequently the alarm or threshold damage level of the crest is higher than at the eastern end where the spit is more sheltered. The alarm cross section for the renourished beach has been defined in terms of minimum crest elevation and minimum crest width, and also by reference to predictive models of cross shore transport. This alarm value is reached when the design storm followed in quick succession by a 1:5 year and a 1:1 year storm would result in failure of the bank by crest lowering. The method of determination of this condition is achieved by combined use of the predictive cross shore empirical models SHINGLE and BREACH.

The maximum run-up levels and alarm levels have been defined from the extensive series of physical model tests. The maximum run-up levels recorded, by measurement of the level of the run-up berm, vary considerably along the length. Values of +6.3m OD between profile lines HU6-HU18 (Figure1), with a crest width of 6m, and +4.8m ODN with the same crest width between HU18-HU20 provide the effective upper limits of wave run-up for the conditions tested. Sections constructed with crest levels excess of 6.1m ODN were not overtopped at all during testing and this should therefore provide a safe crest level. The vulnerability of the beach to narrow crest widths was demonstrated in the model. Whilst a crest width of 8m at a level of 6.1m ODN provides a very safe situation against breaching in the design storm at the western end of the spit, the crest width should be maintained at this level, to allow for a sequence of storms occurring over a short period of time. The performance of Hurst Spit in 1989, when subject to two severe events in a short space of time, demonstrates the requirement for some considerable reserve in the design of the nourishment.

3.1.2 Settlement and Shingle Loss

The beach recharge was constructed at a higher level than was required to resist overtopping during the design storms. This was necessary to allow for loss of cross sectional area of the beach recharge by subsidence of the shingle into the very soft substrate. It is not possible to estimate the volume of shingle lost by subsidence during the life of the scheme, since ground conditions vary considerably along the length of the spit. Initial losses are higher than expected at certain locations but are generally lower than initial predictions. Recent experiences with emergency renourishment following breaching have shown that considerable loss of material may occur initially following reinstatement: this is due to subsidence into and shearing of the underlying saltmarsh. This is less likely to pose a problem on the section of the spit which lies above partially compacted saltmarsh. The renourishment landwards of the beach may pose more of a problem in this sense. Evidence of rates of settlement by leveling of datum poles, suggests that in excess of 0.5m settlement may be expected during the first year following construction, in addition to the initial settlement caused by the initial loading of the saltmarsh. Careful monitoring of the crest levels following construction should identify those areas that will require maintenance due to settlement. Allowances have been made for topping up the crest to the design level during the first two years following construction, by recycling of excess materials within the system. Similarly, excess material remaining above the design levels will be trimmed when appropriate, to provide additional volume at more useful locations.

3.1.3 Routine Maintenance Requirements

Routine maintenance requirements include the following elements

1 Clearance of material from the plugged breakwater gap will be required annually. The gap between the breakwater and the shingle bank/revetment is only fifteen metres at the toe. In view of the longshore transport from the west, the breakwater gap will plug with sand and shingle after a fairly short period of time. It will, on occasion, be cleared naturally by wave action, either by overtopping or by waves driving through the gap at high water levels. However, it is expected that the breakwater will slow the transport rate considerably, consequently requiring some artificial force to drive the material through the gap and on to the

main body of the spit. Some bypassing of the toe of the breakwater will occur, but this will be a small fraction of the total quantity of material in transport. Material from this zone will be used to patch the beach approximately 100 metres downdrift of the breakwater, at the location where erosion is expected to be greatest and which will provide the supply of material to the downdrift area of the beach. An equilibrium rate of transport is unlikely to be reached in less than 2-3 years following construction. Better estimates of long term maintenance commitments will be made with the aid of the monitoring programme

2 An accumulation of the coarser fraction of material is likely to occur at the rock revetment west of Hurst Castle. Excess material has also been located in the main body of the spit to form a reserve stockpile approximately 400 metres from Hurst Castle. This will provide a supply of shingle for recycling to the area between profiles HU7-HU9 (see figure 1), which is the area most likely to be vulnerable to erosion. An additional at risk zone has been noted between profiles HU19-HU20, where focusing of wave attack results from the re-combination of the bi-directional wave climate at the shoreline: this occurs in a discreete zone approximately 50 metres wide

It is likely that annual maintenance of these areas will be needed by recycling of material from the stockpiles and accumulation points. Allowance has been made to recycle approximately 5000m3 per year.

3 Following construction of the rock revetment at Hurst Castle, the rate of shingle transport is likely to reduce slowly. The accumulation of shingle at the North Point is also likely to be reduced eventually as the supply of material diminishes. This area will effectively be isolated from the main system: lies within the adjacent process cell as defined in the shoreline management plan. Wave action from the north east will however continue to drive material along the shingle recurve. As less material will be entering the system from Christchurch Bay there is a risk that beaches on the northern side of Hurst Castle will be outflanked over a period of years. There is unlikely to be a significant reduction in sediment supply to North Point for at least 10 years, if current longshore transport rates are maintained. The longer term problem can be overcome by recycling material between the accumulating North Point and the area immediately to the north of Hurst Castle. Any surplus material can be transported further around onto the main body of the Spit. It is expected that there will be an annual commitment to maintain the river entrance channel, and to protect the northern flank of the Castle defences. Recycling from the North Point would still continue when the new rock revetment around the castle was finally constructed.

The operations outlined above will be carried out with mechanical plant. Operations will generally only last a few days each year. Recycling activities from north point will be executed outside of the bird nesting season and in liaison with Nautral England and the Hampshire and Isle of Wight Wildlife Trust, which manage the conservation interests of the site. Local liaison will also take place with English Heritage's managing agents for Hurst Castle. Maintenance works will be scheduled to avoid the main holiday season where possible.

Provided that the spit is maintained in accordance with the recommended programme outlined above, emergency works should not be necessary. In the event that the alarm thresholds are reached the following course of action should be followed:

1 Identify the extent of damage and calculate the volume necessary to reinstate the beach to the maintained cross section profiles

2 Examine the possibilities of recycling from existing stockpiles or sections where accumulation has taken place. Make up the shortfall using material from these reserves where possible, using mechanical plant to recycle the material within the site.

3 Import the minimum quantity of material to make up any shortfall by road. This option is unlikely to be required, but provides a fall back position.

4 Monitoring Programme

The design criteria for recharge of the Hurst Spit barrier beach are somewhat unusual: no green water overtopping is permissible, if the beach is not to be breached. It is therefore essential that the beach is monitored frequently after construction. The beach will reduce in cross sectional area and crest level during its life and it will eventually reach an alarm condition when it will be necessary to renourish. It is essential to make frequent comparison between the beach profiles, design conditions and the geometric/hydraulic framework of results developed during model testing. A monitoring programme has been planned, to follow completion of the works programme. The programme is outlined in the following sections. Some elements have been implemented prior to the commencement of the works, to provide baseline data. This will allow changes resulting from the works, or from the dredging of the Shingles Banks to be identified.

4.1 Hurst Spit

4.1.1 Plan Shape Changes

Detailed land surveys of the area 200 metres to the east of the proposed breakwater, and 200 metres to the west have been established (Figure 1) to evaluate the performance of the breakwater. Initial surveys were established prior to construction of the breakwater in 1995 and these have been continued in conjunction with the routine coastal monitoring programme. These surveys provide a spot height coverage on a grid of approximately 5m. The data, which is 3 dimensional is stored on a PC based database and analysed using DGM3 software. The analysis comprises comparison of plan shape and volumetric changes, production of contour plots, and establishment of the local longshore transport rates. Data will be used to fine tune the programme for sediment bypassing of the breakwater.

The active shingle recurve north of Hurst Castle is at present monitored on a quarterly basis. An area immediately to the south of this, linking the North Point to the castle, has not been monitored as regularly. Quarterly surveys are proposed to fill in the gaps in existing information. Knowledge of the performance of this area will provide valuable information to evaluate the performance of the proposed rock revetment around Hurst Castle and to quantify long shore transport rates. It is proposed that the whole of the

beach north of the Castle from reference line HU20 (see figure 1) be monitored routinely on a quarterly basis for the duration of the monitoring programme. This will be surveyed to the same format as previous surveys in this area. Data will be analysed using PC based DGM3 software. The data will be used to fine tune the beach recycling programme.

The varied wave conditions and location of the offshore banks results in a varied response along the length of the spit. An annual spot height survey will be carried out to determine volumetric changes of the whole spit. This will be carried out in parallel with the annual hydrographic survey. Data will be used to determine annual rates of change of volume within the system.

4.1.2 Profile Response

The existing monitoring programme provides adequate information along most of the length of the spit. Additional survey lines should be established between survey lines HU16 to HU20 (see figure 1). This will provide the same density of coverage along the full length of the spit.

Additional post storm surveys will be required to allow validation of the predictive numerical model, which is being developed from the physical model. These surveys will be carried out in parallel with wave measurements and tidal measurements. This data will provide confirmation of the validity of alarm threshold values provided by the physical model studies and the numeric model, and will also identify action points for recycling and maintenance of the beach recharge.

4.1.3 Sediment Grading

The renourishment material has a similar grading to the indigenous material, but the process of construction has resulted in artificial sorting of the materials. This will result in a modified profile response, until such time that the beach has been fully resorted by wave action. The sediment transport rates and the profile response of the spit to storms are not expected to be significantly different to the present.

The loss of shingle and the finer fraction of material under storm attack will be greater than prior to the recharge, until the resorting process has been completed.

Sediment sampling and size grading analysis will be carried out in order to identify changes in the grade of material and the rate of loss of the smaller fraction, thereby providing further valuable information for the purposes of maintenance. Results of post nourishment surveys will be compared with the database results for both the physical model and full scale monitoring results. The beach response models may then be calibrated, allowing adjustment of the database predictions to accommodate the effects of different beach grading.

4.1.4 Offshore Surveys

The offshore bathymetry is subject to frequent change and as a result the design wave conditions may also change from time to time. Frequent monitoring of the offshore bathymetry will be undertaken to identify any significant changes which may affect the incident wave conditions and which show localized redistribution of sediment (Figure 2).

An annual hydrographic survey is appropriate for identification of nearshore changes. Offshore surveys will extend across the whole of the North Channel adjacent to the spit, extending approximately 500 metres offshore. These have been established in conjunction with the land surveys and will be carried out to coincide with the summer land survey.

4.1.5 Hydrodynamic Measurements

A Datawell omni directional wave rider buoy was installed in the North Channel, on the leeward side of the Shingles Bank, and has been used in conjunction with a wind recorder located in the Western Solent to monitor wave conditions and validate numerical modeling of nearshore wave climate conditions.

The buoy has been moved to the location off Milford on Sea, at which a buoy was previously deployed, to determine extreme wave climate conditions (Figure 2). A telemetry link to Lymington Town Hall has been established, together with a logging station. Contingency has been made for maintenance of this equipment during the course of the programme. This would normally entail monthly or bi monthly checks of the equipment and inspection of the moorings, together with changes of batteries whenever required. The buoy itself will need to be replaced at some stage during the monitoring programme.

The data collected will be used toupdate the extreme wave conditions analysis and to determine actual conditions impacting on the beach recharge. This in turn will be used to provide input to the predictive maintenance model, using monitored cross section data and empirical models of profile response. The buoy has already provided extremely valuable information about severe storms which occurred during and soon after completion of construction: it has confirmed that the scheme is capable of withstanding the current design conditions.

The data suggests that design conditions have already been exceeded on several occasions. This implies that the original extreme wave climate predictions, carried out by HR Wallingford, is based upon a dataset which may not be statistically representative and which may under predict the extreme events: these may need to be updated. The revised extremes analysis will be used to determine existing factors of safety of the scheme. This in turn will inform the predictive model and be used to revise alarm conditions if appropriate.

Re-analysis of the wave records will be necessary from time to time to ensure that the design conditions have not altered significantly, due either to bathymetric changes or to increased storminess. This will provide a much better and more reliable method of establishing the near shore wave climate on a long term basis. The results from wave records will also be used to provide full scale calibration/validation of the model results at the site under real conditions. This will provide validity to the empirical framework developed by model testing and a high degree of confidence in the performance and maintenance requirements.

The recent installation of a tide gauge by NFDC in the new Hurst Spit breakwater will, in the long term, provide valuable data from which more reliable surge predictions can be calculated for the site. The profile response database may also be used in conjunction with results of revised surge level predictions, to give an improved prediction of the

required beach cross sections required to withstand the most extreme water levels. The design water level may change in conjunction with medium term sea level changes. Clearly this is a very important factor in determining the design conditions at the site, as the wave conditions reaching the spit are determined largely by the depth of water across the shallow offshore banks. Data from the tide recorder will also provide details of water level profiles during storm events.

Current metering surveys, carried out at several stations over full tidal cycles prior to construction of the breakwater, will be repeated post construction to identify any changes in current paths and magnitudes caused by the breakwater. These will be carried out within the first two years of completion of the scheme, to establish any local changes in the current regime.

4.2 Data Storage

Data is currently stored in a series of spreadsheet databases which provide easy access to the data, enabling beach profile performance to be compared for a wide range of beach geometry and wave and water level conditions. The performance of the beach can therefore be assessed by comparison of any beach profile with a given crest level, and cross section area above any given level, and with a range of wave and water level conditions. Analysis of this data in conjunction with the time series data is cumbersome however. The SANDS Shoreline and nearshore data system will be installed to manage the profile and time series data sets.

This system will enable the performance of the proposed beach nourishment to be assessed throughout its life, by comparison with the design conditions. The complex wave climate, resulting in varied wave conditions along the length of the spit, can be assessed by substituting different wave conditions into the database for comparison with given profiles. As the geometry of the beach changes with time, either as a result of subsidence or to wave action, the possibility of wave overtopping can be assessed. The wide range of beach profiles in the database allows any combination of beach geometry and wave conditions to be assessed within the range tested. By testing over a wide range of water levels a water level response function can be established. The effects of changing sea level, or of revisions in the surge water level, can therefore be taken into account by substitution of other water levels into the database.

Initially the predicted response of the renourished beach can be established by using the database as a look up table, by reference to the desired wave water level, wave condition and geometry. This method is however cumbersome to use and requires considerable background knowledge of the database structure. The extensive database will therefore be developed into a more sophisticated and simple to use parametric model of the beach profile response. This will allow the beach geometry to be assessed by substitution of geometric and hydraulic variables into a numeric model of a series of equations. The mathematical model will be developed in conjunction with field monitoring programmes.

4.3 Dredging Licence Requirements

An environmental assessment and review of proposals to dredge from Shingles Banks Area 406 (Figure 3) was carried out, prior to approval of the Hurst Spit stabilization scheme. The licence was given conditionally on implementation of an extensive

monitoring programme, to examine the impacts of the dredging programme on the area. This 5 year programme was included within the original benefit cost analysis for the shingles banks option for the Hurst Spit Stabilisation Scheme. A statement of the agreed programme of monitoring of dredging area 406 Shingles Banks, in accordance with the schedule of conditions annexed to the government view, is given below. It also includes the programme of monitoring outlined for Hurst Spit above.

4.3.1 Bathymetric surveys – Shingles Banks

A pre-dredging hydrographic survey will be carried out of the dredging area and out to 300metres from each of the boundaries of the area (Figure 3). Parallel tracks at approximately 50 metre intervals will be run across the area. This density of coverage will be repeated on subsequent surveys, spanning the 5 year monitoring programme. A post dredging survey will be carried out of the area following completion of the dredging programme.

A single hydrographic survey will take place during dredging, as the operation is expected to be completed within approximately 2 months. An additional survey two weeks after commencement of dredging will take place, within the boundary of the licensed dredging area, to confirm that there are no excessive changes. This will be confined to the zone within the dredging area above 10mCD and will be surveyed and plotted at a coarser resolution (100m spacing). In the event that excessive unforeseen changes are identified, further consultation will be made with the DEFRA laboratory at Burnham on Crouch.

Profiles taken across the Shingles Banks (outside the dredging area) will be at an interval of 200m whilst those taken within the dredging area shall be at an interval of 50m.

The following programme of works will be carried out:

Post Contract	Dredging Area	Shingles Banks (outside area)
Year 1	2 monthly	6 monthly
Year 2-5	Quarterly	6 monthly

The timing of surveys and the interval between surveys may be subject to variation if weather conditions and tidal conditions restrict working periods.

A bathymetric survey of the Needles channel will be carried out in accordance with the specification provided by ABP Southampton in advance of the dredging. This will provide coverage of the nearby deep water channel at track spacings of 50m. The survey will be repeated on completion of the dredging and copies of the survey will be provided to ABP Southampton.

Results of hydrographic surveys will be plotted in accordance with the government view schedule of conditions.

General Methodology

Position fixing will be by DGPS with a real time position fixing accuracy of better than + - 2m in the horizontal plane. Surveys will be carried out to predetermined grids, using navigation and hydrographic surveying software to plan and execute the surveys. Soundings will be logged from an echo sounder via a digitizer to a portable PC computer. Tidal corrections will be provided from a local tide gauge. Measured tidal curves will be provided for the duration of each of the hydrographic surveys.

4.3.2 Sidescan Sonar Surveys

A sidescan sonar survey providing complete coverage of the same area will be carried out. This will be repeated following completion of the dredging. An intermediate sidescan survey will be made within the dredging area during the dredging programme.

A trawl survey will be carried out of the dredging area to identify obstructions on the sea bed. This will also be repeated on completion of the dredging programme. No further sidescan surveys will be carried out during the five year programme of monitoring.

Interpretation of the surveys will be provided to DEFRA and access to raw data will be provided if required.

4.3.3 Western Isle of Wight Shoreline

Monitoring of the performance of beaches on the west coast of the Isle of Wight and changes to the bathymetry of the offshore Shingles Banks dredging area will be carried out. The surveys will include quarterly topographic line and level surveys of beaches, spot height surveys and hydrographic surveys. Additional surveys will also be carried out after severe storms. A base line survey will be carried out prior to the commencement of dredging operations. Data will be recorded by NFDC in a database and analysed as part of a beach management programme. The coastal survey area will extend along the foreshore of the Isle of Wight between Alum Bay and Fort Victoria at agreed locations and the offshore surveys will be carried out across the dredging area and adjacent parts of the Shingles Banks.

Results of the surveys will be compared and will be analysed be reference to measured and predicted wave conditions. If and when appropriate, a revised mathematical model refraction grid of the Shingles Banks area will be produced for use with the refraction models OUTRAY AND INRAY (previously used in determination of the nearshore wave climate) and these models re-run by an idependent contractor to identify changes to the wave climate resulting from modified offshore bathymetry.

4.3.3.1 Method of Working

The method of working to be adopted for the surveys will be in accordance with the New Forest District Council coastal monitoring programme standards. The following sections provide a method statement and programme of working, including details of survey equipment, survey methods and data analysis.

Surveys will be carried out to designated control positions. These positions will be maintained with a scaffold pole, painted marks or similar appropriate marker. The control positions of all stations will be located by traverse or with kinematic DGPS and copies of coordinate positions will be provided for IOW Council use.

4.3.3.2 Timing and frequency of surveys

Topographic surveys will be carried out quarterly. Topographic surveys will be carried out over low water periods whenever possible. A hydrographic survey will be carried out annually in the nearshore zone, to coincide with the summer survey.

New Forest District Council will advise the IOW Council appointed representative of the survey date not less than 24 hours in advance of each survey. NFDC should be advised in advance of engineering works on the foreshore which may affect either beach control stations or beach levels within the survey areas. In either of these instances the IOW Council will be responsible for the costs of carrying out revised baseline surveys and re-establishment of survey controls.

4.3.3.3 Topographic Spot Height and Line and Level Profile Surveys

All surveys will be leveled to Ordnance Datum Newlyn and zero coordinates of survey lines will be given to Ordnance Survey National Grid (OSGB36).

Levels will be recorded at each visible beach slope change or at 5m (horizontal) intervals whichever is less. All storm ridges and troughs will be recorded. The upper beach (above 0m ODN) will typically be leveled at 2-3m horizontal intervals to allow adequate description of the upper beach profile.

All topographic surveys will extend at least as low on the foreshore as -0.5m ODN. Levels will be recorded to an accuracy of +/-0.1m.

Topographic surveys will be carried out by using an EDM theodolite with data logger or by kinematic DGPS land survey. Vehicular access will be required to the beach areas along the seawall sections at Colwell Bay and Totland Bay.

4.3.3.4 Baseline Surveys

A baseline topographic survey will be carried out prior to the commencement of dredging operations. The first survey will be in Summer 1996 prior to commencement of dredging operations. This survey will be used as control for the remainder of the monitoring programme. Spot heights will be recorded within the survey areas. The surveys will include locations of the beach crest and main change points and will provide spot height converage along predefined and agreed profiles, to give even coverage of the survey area. Coordinated levels of control positions will be set up at agreed locations. Control will be established at each of the locations to be used for routine monitoring.

Profiles across open beach will be surveyed at the locations agreed by IOW Council and NFDC. Areas of groyned beach will be surveyed with three profiles per compartment; one in the centre and one on either side of the groyne, approximately 2m from the groyne boards. The profiles and profile groups are located at intervals of approximately 200m.

4.3.3.5 Quarterly Topographic Surveys

Quarterly beach surveys will be carried out along agreed survey lines. Sections of open beach will be surveyed at intervals of approximately 200m. Groyne compartments will be monitored at similar intervals, but with three profiles per compartment (as on the baseline surveys). In the event that significant changes are measured on the quarterly surveys, these profiles will be supplemented with additional survey lines as appropriate.

4.3.3.6 Excluded Areas

Certain stretches of coast within the area of interest cannot be surveyed for practical reasons, although none of these areas include a beach at the shoreline. These areas include; the armoured wall at Fort Albert, the rock reefs between Colwell and Totland Bays and the seawall at the North Eastern end of Totland Bay, where waves break at the toe of the wall and no beach is exposed at low water.

The beach area between Fort Albert and Fort Victoria will be surveyed only on the occasion of the baseline survey. Much of this area is devoid of beach material and comprises a clay platform with boulders and occasional pockets of sand. Wave conditions at this site are largely unaffected by conditions in Christchurch Bay, due to the effects of the narrow channel between Hurst Spit and Fort Albert.

4.3.3.7 Post Storm Surveys

Post storm surveys will be carried out at an agreed threshold storm event. This will be triggered by reference to the NFDC wave rider buoy, located in Christchurch Bay.

4.3.3.8 Hydrographic Surveys

Hydrographic surveys of the nearshore zone will be carried out in parallel with the summer topographic survey. They will be carried out over high water spring tide periods and will overlap the topographic survey, extending inshore of the Mean Sea Level contour. Hydrographic surveys will be carried out over the high tide period following or prior to the topographic survey, conditions permitting.

Coverage of the nearshore zone will be provided between the Needles and Fort Victoria offshore beach areas. Survey tracks will be spaced at intervals of approximately 200m spacing and will run approximately perpendicular to the shoreline, to the 5mCD contour or to a distance of 500m from the CD contour (whichever is less). The base line survey will be carried out to the same standards as the routine surveys and the first survey will be carried out in August 1996.

4.3.3.9 Data Format

The data will be presented in a format that complies with the requirements of the NFDC coastal database or to an alternative format agreed with IOW Council. Data will be presented as XYZ data files, and DXF (1m intervals) files. Cross section files will be derived by ground modeling, along seaward extensions of topographic survey profiles. These cross sections will be presented in the same file format as the line and level topographic surveys. Line and level data will be recorded in data files which may be read by IBM PC compatible computer equipment. All survey lines for a single beach area will be recorded in the same data file, on the occasion of each survey – see details below. Data will be provided on 31/2 " high density floppy disks. Hard copies of surveys

will also be provided. These will show plan location of profiles and spot heights at a scale of 1:1250; cross section profiles at a scale of 1:500; contour plans of survey areas at 1m intervals derived by ground modeling at a scale of 1:1250.

4.3.3.10 Data Analysis

Reports will be provided with each survey. These will include a numerical analysis of changes in the beach cross section area at each profile. Comparisons will be made with the past 3 surveys and also with the baseline survey.

4.3.3.11 Independent data review

In the event that beach levels fall on the Isle of Wight shoreline following the dredging contract, the following independent review procedure will be adopted. HR Wallingford on an independent contractor will review changes and if appropriate shall carry out wave refraction modeling and wind wave analysis. The refraction grids will be modified by substitution of the revised bathymetry of the Shingles Banks into the model. Wind and wave data will be analysed to determine if weather conditions have been typical for the period prior to beach changes.

4.3.4 Benthic Ecology

Grab samples will be taken at 16 locations on a pre-determined grid 200m x 400m within the dredging area. Eight additional control samples will be taken out side of the dredging area. Two Shipek grab samples will be taken at each location and these shall be combined for analysis purposes. Samples will be taken with a marine biologist present and samples preserved for laboratory analysis. A description of benthos will be made during sampling and a detailed description of the samples will be made to identify the frequency and names of species within the samples. The survey will be repeated on completion of the dredging and will also be repeated 1 year later.

4.3.5 Fisheries liaison

A committee was established to provide a code of working practice during dredging to ensure that inconvenience to the fishing industry was minimized during operations. A working programme was agreed with the local fishermens' associations and with DEFRA fisheries office at Poole.

5 Review of Strategy

The beach management plan will be reviewed annually and minor revisons made to the maintenance and monitoring programmes to reflect any unexpected changes to beach performance. The expenditure profile plan will also be reviewed and modified to reflect the changes required. The results of the monitoring programme will be tested against new developments in best practice for design and management methods. Any changes will be tested by sensitivity analysis against a range of scenarios. If the monitoring data suggests significant changes in either beach response or conditions at the site, the probabilistic risk assessment procedures adopted at the design stage will be reassessed.

An in depth review will take place five years after completion of the capital recharge. This will be used to determine strategy for the next five years and to develop the next

interim recharge programme. This review will coincide with the completion of the Shingles Banks monitoring programme and a review of this will take place at this time. The potential source of beach recharge materials will be assessed at this stage and a new application made to extend the dredging licence for Shingles Banks if appropriate.

6 Costs

Costs of the works are as outlined in the Hurst Spit Stabilisation Scheme Engineers Report. The costs reflect those given in the previously accepted benefit cost study for the Hurst Spit Stabilisation Scheme. The application for scheme approval (FCP3) submitted with this application categorises investigations connected with fulfillment of the licence conditions as preliminary studies.

6.1 Compliance with Government view dredging licence conditions years 0-6

The licence for Shingle Banks Area 406 was awarded conditionally on the basis of an extensive monitoring programme which commenced prior to the works contract and extends for 5 years beyond the scheme completion. The monitoring requirements are extremely onerous and are outlined in sections 4.1-4.3 above. The following schedule identifies an estimated breakdown of costs for the programme. The costs of carrying out this work are based on tender prices for surveys carried out in connection with the Hurst Spit stabilization scheme. Analytical work will be carried out by an in house specialist group.

Allowances are made within the monitoring programme costs for the review of the beach management plan. In view of the data analysis requirements for this segment of the programme, a database package and associated hardware will be purchased to handle the data. Purchase of the Halcrow SANDS system is proposed at a cost of approximately £10,000. These costs have been allowed for in the first year of the programme. Costs of the hydrodynamic measurements include maintenance of the wave rider buoy and tide gauge and analysis of the context of the monitoring programme, which will be contracted out under a term tender.