AGENDA ITEM NO 7.

ARUN DISTRICT COUNCIL

POLICY DEVELOPMENT SCRUTINY COMMITTEE – 25 October 2007

Decision Paper

Subject : Coastal Defence – Pagham / Church Norton Spit

Report by : Head of Infrastructure, Works & Engineering

Report date : Sept 2007

EXECUTIVE SUMMARY

This report outlines the current situation, including the degree of erosion risk to properties in Pagham, resulting from an extraordinary build up of material on the spits, banks and bars around Pagham Harbour Mouth, which is believed to be accelerating erosion on Pagham Beach. It recommends a course of action including the commissioning of a more detailed study leading to a viable solution to resolve the situation.

RECOMMENDATIONS

The Committee recommends to Cabinet that when it considers the report on 10 December 2007 that:

1. approval is given to pursue the Environment Agency (EA) for funding, (estimated to be in the region of £120,000), to undertake a detailed study to establish a viable solution to address the increased erosion at Pagham Beach provided there is no net cost to the Council.
2. it requires the Head of Infrastructure, Works and Engineering to present a further report when the outcome of the study is known, with recommendations for the way forward.
3. the Head of Infrastructure, Works and Engineering be authorised to draw up and agree a protocol with all parties concerned regarding emergency situations, especially in terms of the Habitat Regulations.

1.0 INTRODUCTION

1.1 The spits, offshore bars and banks around the mouth of Pagham Harbour (hereinafter referred to collectively as 'spits') make for very dynamic conditions. Indeed, they are so dynamic, and the 'input conditions' so varied, that the industry experts who have been consulted agree that it is not worthwhile trying to fully understand all of the process and how they interact. It is better, and more cost effective, to take an overview of the situation and judge and analyse the site by the 'outputs'.

1.2 Monitoring and studies have led to the understanding that conditions at Pagham operate in a 4-5 year cycle, resulting in a relatively stable equilibrium but with a long-term tendency for erosion of Pagham Beach. More details on this cyclic process and the erosion risk to Pagham, are noted below.

1.3 The current situation is one where the perceived cycle has stalled, resulting in conditions outside the normally acceptable but relatively wide ranging 'envelope'; this is leading to an extraordinary build-up of shingle on the Chichester District side of the Harbour channel. This, in turn, is leading to increased scour and erosion on this Council's frontage, with the attendant increased risk of breaching and loss of property; notably, but not limited to, West Front Road.

1.4 This report outlines the work that has been undertaken to date, by way of a 'desktop' study, to look at the options available to the Council. It encompasses:

- A brief history of the Harbour area
- Land ownership and responsibilities
- A background to the current problem; including risks
- Monitoring and mathematical modelling results
- Links to other plans and strategies
- Options and likely outcomes ; including the 'do nothing' scenario
- Methodologies for the 'do something' scenario
- Constraints and limitations (including Habitats Regulations)
- Costings and funding
- Approval routes and programming

2.0 A BRIEF HISTORY OF THE HARBOUR AREA

2.1 Prior to the 1500s the Pagham and Selsey coastline was vastly different to the present day. Maps of 1587 show a recognizable inlet; subsequent mapping shows considerable alterations over time to the location and shape of the channel(s) and spits.

2.2 In 1876 the harbour was sealed by Act of Parliament, with the channel closed and much of the land behind reclaimed; this left part of the channel of the time as what can be seen today as Pagham Lagoon.

2.3 In 1910 a storm breached the shoreline; this led to a *wandering* channel until it was fixed in its present location in 1963. The processes since that time have been studied by a number of researchers; their work was collected and added to by Nick Barcock, a student from Southampton University, who was sponsored by this Council in 1990/01, prior to the construction of the four rock groynes in 1991/92.

2.4 The cyclic process outlined in Barcock's work and supported by subsequent monitoring is shown in Appendix 1 and can be outlined with the following phases:

- The channel discharges s'southeast and a 'normal' west to east littoral drift occurs onto the Pagham Beach frontage, with material (sand/shingle) having come onshore from the Kirk Arrow Spit (near the Bill at Selsey).
- The channel rotates anti-clockwise, leading to the development of a southern spit and near-shore banks – these banks alter tidal and wave currents which start to reduce the littoral drift on the Pagham frontage
- With the build up of the Church Norton spit the channel rotates further, increasing the volume and wave refractional effect of the banks and bars, this starts a local reversal sediment drift on the Pagham side (back towards the Harbour Mouth) which, in turn, increases the scour on Pagham Beach
- Further rotation of the channel, until it is almost parallel with the coast and flowing almost northeasterly; with further build up of banks and bars, increased wave refraction effect and greater scour.
- At some point in the latter stages, storm conditions break up the nearshore banks, returning the channel to its s'southeast orientation and driving the material locked in the banks and bars onto Pagham Beach, thus recharging a depleted shingle beach; the cycle then starts again.

3. LAND OWNERSHIP AND RESPONSIBILITIES

3.1. Responsibilities

3.1.1. The coastal area is managed by Arun and Chichester DCs (Coast Protection - erosion) and the Environment Agency (Sea Defence - flooding); West Sussex County Council also has an interest, predominantly inside the Harbour, with the Nature Reserve. Further east, at Aldwick, the beach is still privately maintained.

3.1.2. It should be noted that the EA and the Local Authorities management of the coast is through the use of permissive powers (rather than specific duties).

3.1.3. The plan in Appendix 2 shows the extents of these interests.

3.2. Ownership

3.2.1. Arun has a Regulating Lease from the Crown for the Foreshore (i.e. between High & Low Water Mark) from the District boundary going eastwards. Land above High Water is privately owned (Pagham Beach Holdings) and further east by Aldwick Bay Est. Co. and then beyond that by individual frontagers.

3.2.2. The Harbour is owned by EA and managed as a Nature Reserve by WSCC.

3.2.3. Chichester District Councils has a Regulating Lease from the Crown for the land below High water Mark to the west of the Harbour mouth.

4. A BACKGROUND TO THE CURRENT PROBLEM – INCLUDING RISKS

4.1. The 'stalling' of the cyclic process, which has led to the build up of material on the Church Norton Spit, is causing the Pagham Beach defensive bank to become narrower, thus reducing the standard of protection provided to Pagham residents – due to the risk of a breach and flooding through that breach.

4.2. From monitoring data and physical inspections, it can be shown that the beach fronting parts of West Front Road has retreated (through scour and erosion) by up 30 metres since 2003 and as much as 5 metres in the 6 months between September '06 and March '07. These figures are based upon a point at approximately mean sea level, which is considered to be more representative of changes in beach profile. The crest has moved more than the figures mentioned and is giving rise to considerable concern with residents in the immediate and local area.

4.3. It is thought that the reason for this build up of material and the stalling of the cycle is due to a number of placid winters that have not brought storms of sufficient magnitude to break down the spits; there is also anecdotal evidence that there was a period approximately 3 years ago when uncharacteristically large amounts of material came ashore via the Kirk Arrow spit (Selsey Bill) – this drifted eastwards and is now making up the Pagham spit.

4.4. Appendix 3 shows charts derived from Met Office data and how recent years have varied from the norm. The earlier years show a marked Southwest predominant direction with 0.5% of the readings being Force 10 or above; in the more recent years this has reduced to 0.02% - there also being a wider spread of wind directions

4.5. There is a real risk of breaching of the shingle bank in the near future, with the total loss of perhaps six properties; this would lead to water flowing through the breach and inundating most of the Pagham Beach Estate

(flooding some 150 residential properties; cutting off access to 35 properties and severely disrupting access to a further 60).

4.6. The *present day* value of these damages would be in the region of £47m; this figure, set against the likely cost of an initial intervention of £1.37m (study & works), demonstrates a 'robust' cost:benefit ratio in excess of 30. The values are seen as conservative as they do not include a valuation of the risk of loss of life or other "intangibles".

4.7. It must be noted however, that these outline economic calculations have only been undertaken on the costs and benefits of the immediate problem and do not therefore reflect the 100 year timeframe required under Defra guidelines. More work would need to be carried out as part of the proposed study, to look at the long term economic sustainability of the frontage, before approval and grant aid could be given for any proposed works.

4.8. There is also a wider and longer term problem, in that the material that would normally have been deposited on Pagham's beaches would be transported through littoral drift onto Aldwick, Bognor Regis and successively to Ferring and ultimately eastwards to Worthing. With a considerable amount 'locked up' at Pagham, the downdrift beaches would become denuded to some degree – this effect would decrease further eastwards, but there will be a need to monitor the beaches east of Pagham closely and consider extra reactive maintenance over the next 2 – 5 years if no spit management is undertaken.

5. MONITORING AND MATHEMATICAL MODELLING RESULTS

5.1. The Pagham frontage has been, like the whole of the Arun coastline, subject to regular monitoring since 1973. This was originally operated by the Environment Agency (and its predecessors), with Arun's own detailed coastal monitoring project providing supplementary data between 1995 and 2001 and latterly the monitoring now falls under the scope of the Strategic Regional Coastal Monitoring Project.

5.2. All of the data has been gathered to a common base and along predefined survey lines; accordingly, the outputs can be relied upon to provide robust evidence.

5.3. Whilst the bulk of the topographical surveying no longer utilises aerial surveying techniques, an air survey is still undertaken once per annum giving a pictorial view of how the beach is changing.

5.4. From this information it can be seen and demonstrated, through the development of initial 3-dimensional mathematical models, that the spit has grown by approximately 120,000m^3 (above the normal deltaic plateau) and in the sixth months between the last two surveys (Sep '06 – Mar '07) has lengthened by approximately 125m (see Appendix 4).

5.5. The predefined survey lines (5.2 above) were established at the outset of the survey for monitoring the erosion/accretion of shingle beaches along the whole coast. It would be desirable at this stage and essential in the longer term to undertake more detailed surveys.

5.6. The area has the protection of the Birds Directive (see 9.1.2 below) which, unfortunately, precludes personnel entering onto the land to undertake these more detailed surveys during the nesting season. This year the nesting season has extended beyond the normal March to mid July period and it has not been possible for such surveys to be carried out - it would not be cost effective to survey this relatively small area using air survey techniques.

5.7. It is planned to carry out a detailed survey as soon as practicable – this could be incorporated into the further study outlined in 8.7. This would not only benefit the process analysis but would also be essential for the preparation of contract documents should some form of 'intervention' be approved.

6. LINKS TO OTHER PLANS AND STRATEGIES

6.1. The SMP (1997) indicated a 'Hold the Line' policy for the areas both east and west of the harbour. The recently completed review took on board work done as part of the CDS (below) and set out a policy of 'Hold the Line' for the Pagham Beach side but one of 'Managed Realignment' for the Church Norton side. This work was undertaken prior to the realisation that the spits were growing outside of the normal 'envelope'

6.2. Neither the River Arun to Pagham CDS nor the Pagham to East Head CDS have been formally concluded and further work is being undertaken on both to enable Defra approval to be obtained and their Implementation Plans to be rolled out. The Arun-Pagham Strategy set out a preferred option to 'maintain' the current standard of service through recycling from Aldwick (providing agreement can be secured with the private frontagers at Aldwick). The Pagham to East Head Strategy promotes managed realignment; seeking to gradually realign the spit to a more natural orientation. Again, both of these proposals have been arrived at without the full realisation of the extraordinary conditions on the spit.

6.3. CHaMPs (Coastal Habitat Management Action Plans): these set out broad terms under which habitats can be managed. In the case of the CHaMP for this area, Pagham has been identified as being a candidate to provide compensatory habitat where habitat is being lost in neighbouring harbours to the west. If Pagham Harbour were to change in character (due to partial blocking of the channel or a breach in the seaward berms) there could be problems of the UK not meeting BAP habitat targets.

6.4. Chichester flood relief: the works undertaken following the major flooding in Chichester in the early 1990s rely upon acceptance of a peak flow of approximately $4m^3$/sec of extra freshwater flow into the harbour. Partial

blocking of the channel or extra seawater flow into the harbour through a breach could seriously jeopardise these arrangements.

6.5. Land drainage: Pagham Harbour is a route for land drainage for much of the Manhood Peninsula. Partial blocking or extra saline inflow could affect this natural drainage and have consequences for the agricultural production of the area.

6.6. Further to 6.2 above, it is believed that the strategies currently being formulated will lead to some form of move away from the *status quo* for the harbour and it surroundings. It is therefore proposed to promote within the community a mechanism of 'change management'; whereby information is widely distributed through newsletters and open fora etc. It is proposed that this should extend to the work proposed in this report

7. OPTIONS AND OUTCOMES (INCLUDING A "DO NOTHING" SCENARIO)

7.1. If current conditions prevail (and there is little to indicate that they will not) there is a significant risk of breach within the next 2 - 5 years, with the serious consequences outlined in 4.5 (above).

7.2. There is also a risk, albeit a lesser one, of the harbour mouth blocking, thus introducing problems to the free draining of land drainage discharges to the Harbour including the flows coming from the Chichester Flood Relief Channel and the pumped discharges from the Ferry Pumping Station, which helps to drain large areas of the Manhood Peninsula.

7.3. There are few options open if the risk of breach is to be avoided. The "Do Nothing" option amounts to a "wait and see if a storm does the work" option. Unfortunately, as time goes by, the magnitude of storm necessary to reform the channel and drive the spits onto the Pagham side increases. We end up hoping for a magnitude of storm that is likely to cause massive damage along the remainder of the coastline!

7.4. In the event that a breach in the shingle bank fronting the properties occurs, or properties are seriously threatened, before an approved scheme is put in place, there needs to be an approved Council policy on the extent (if any) of emergency interim action that would be taken. It is proposed to carry out works, probably beach reprofiling and recycling, if an emergency situation arose - subject to 7.5 below.

7.5. There also needs to have an agreed protocol with Natural England in respect of any emergency works relating to the implications of the Habitat Regulations (see 9.1.4 below)

8. METHODOLOGIES FOR THE "DO SOMETHING" SCENARIO

8.1. It is essential that any action on the coast is considered in a holistic manner to ensure that there will be no detrimental effects elsewhere. This is the

purpose of developing the Plans and Strategies mentioned in 6 (above); however, methodologies for developing such Plans and Strategies cannot consider every eventuality such as the extraordinary development of this spit.

8.2. All works should also be sustainable; SMP guidance defines sustainable long term management policies as avoiding "tying future generations into inflexible and expensive options for defence" (Defra, 2001).

8.3. From the outline work done on this project to date it is clear that there is a 'comfortable' benefit:cost ratio for the works to re-establish the normal cycle.

8.4. The SMP has examined the broad brush economics of the frontage and arrived at the preferred option of Hold the Line (indicating long-term positive benefit:cost ratio) It is less clear whether the defence of Pagham will attract Defra funding in the longer term, if and when the normal cycle is restored.

8.5. A separate report is also being presented to this Committee to consider the wider implications of this long-term funding shortfall for Arun's coastline.

8.6. It is recommended that some form of short term remedial works be investigated further and put in hand, is possible, without delay. If it transpires that the long-term defence of Pagham cannot be funded then these works can be taken as part of a 'change management' regime.

8.7. It is recommended that a study be commissioned without delay and that this looks at:

8.7.1. Revisiting and refining the outline economic analysis undertaken to date, to confirm the robustness of the business case,

8.7.2. Undertaking mathematical modelling as deemed necessary, including determining the optimum shape (3D) of the channel, so as not to disrupt the outflow from the Harbour; and to establish the amount of material to be moved

a) back onto the Church Norton bank and
b) onto the Pagham Beach side of the channel.

8.7.3. Demonstrating that the suggested solution (whatever that may be) is the correct one – especially but not confined to the Habitat Regulations

8.7.4. Planning permission would be required and, as the site is within SSSI, an Environmental Impact Assessment will need to accompany the application.

8.7.5. As the site has EU environmental designations, an Appropriate Assessment will also be required as part of the study.

8.7.6. Setting out a framework for agreeing any further works with all appropriate parties and undertaking a public consultation exercise.

8.7.7. Obtaining all necessary approvals (including application for a licence under the Food and Environment Protection Act).

8.7.8. Formulating an application to the Environment Agency, to include the work in the medium term plan in line with current Defra guidance.

8.8. Options for the "works element" are noted below:

8.8.1. Training the channel with temporary works (rock or concrete blocks) to use the force of the flow of water into and out of the Harbour to recut the channel – this would do little to move the spits onshore to replenish Pagham Beach and may increase the risk of blocking the channel altogether;

8.8.2. Dredging the spit by sea based plant (suction dredger) – this is not seen as viable as the water is very shallow in the nearshore zone and the risks of damage to the dredger would be too great.

8.8.3. Plant could be set up on the spit to mix seawater with the sand and shingle of the spit, to enable the mixture to be pumped ashore. The mobilisation costs of this are understood to be prohibitive for this size of project.

8.8.4. Small split bottom barges could be loaded by land based plant on the spit and move the material across the channel – barges of such a (small) size to get inshore would make the operation too time consuming and a deeper water loading/berthing channel would need to be maintained, making this a non-viable option due to cost.

8.8.5. **The preferred option** at this stage would be to use land based plant (excavators, dump trucks and dozers) to cut a dry channel, taking the material westwards to help remedy Chichester DC's erosion whilst, at the same time, similar plant would collect and stockpile the spit material ready to form a causeway back to Pagham Beach. On a single tide, the ends of the dry channel would be opened to the sea and the causeway formed back to land. After this operation, the plant would continue to dig and transport the spit 'overland', both westwards to supplement the Chichester DC berm and eastward to recharge Pagham Beach until the spit was reduced in height to the required level (approximately mid-tide – as per the normal 'ebb delta' level usually existing in the area.

8.8.6. The existing channel be abandoned and a new cut be formed further to the west – this would enable natural long-term spit process to re-establish but as the current spit would still exist it would have little short term benefit against the scour affecting Pagham Beach, which would probably require beach nourishment from external sources; it may however be seen as affecting the Natura 2000 site less (see 9.1.4 below).

8.8.7. A further option, which would affect the Natura 2000 site less, would be to address the Pagham Beach erosion solely by bringing beach nourishment from external sources. This may however exacerbate the risk of the channel blocking, as the reverse littoral drift (back to the harbour) would still exist due to the spit's existence.

8.8.8. NB There have been suggestions that explosives could be used to move the material; this has been discounted because a) there would be too much disruption to the environmentally designated area and b) it is highly

unlikely that such a process would be successful; the force of the explosives would project the material into the air only for it to return to earth in roughly the same position as it started!

9. CONSTRAINTS & LIMITATIONS

9.1. Pagham Harbour is designated in a number of international, national and local ways:

9.1.1. It is a Ramsar site – coming from a convention, signed in Ramsar, Iran, in 1971, an intergovernmental treaty on wetlands – the Pagham 'Ramsar area' extends over 637ha.

9.1.2. It is a Special Protection Area [SPA] - SPAs are highy protected sites, classified in accordance with Article 4 of the EC Directive on the conservation of wild birds (79/409/EEC), also known as the Birds Directive, which came into force in April 1979.

9.1.3. The site is a nesting site for a species of European importance (Little Tern) and as such the Habitats Directive (Council Directive 92/43/EEC) is also applicable; there are very strict rules that apply to these sites and the control of what and when any intervention might be allowed

9.1.4. The SPA designation makes this a "Natura 2000 site". Intervention works affecting these sites have to have an Appropriate Assessment and undergo an extremely rigorous testing procedure laid down in the Regulations. This may result in the preferred option outline in 8.8.5 (above) not being permitted but the progression of some other suitable alternative which would have a lesser impact on the habitats concerned. It may also be the case that other mitigations works and the provision of 'compensatory habitat' may be necessary. However, it should be noted that, as a worst case scenario, no interventions may be allowed.

9.1.5. It is also a Site of Special Scientific Interest, necessitating effective management which is essential to conserve the special wildlife and geological features of the site. The primary reason for the open coast part of the SSSI is the geomorphological interest. The spit has built to its current configuration through natural processes; to undertake intervention works may be seen as contrary to the geomorphological interests of the site.

9.1.6. It is also a Local Nature Reserve operated by West Sussex County Council.

9.2. Notwithstanding all of the above, Natural England has indicated that there is allowance within the Habitat Regulations for "an over-riding public interest" for intervention works. However, this cannot be considered until all other measures have been exhausted through an Appropriate Assessment. It is unlikely that the preferred option (8.8.5 above), as it stands, would withstand the rigorous testing of an Appropriate Assessment. A good deal of the resources to be allocated in the proposed study would be directed towards

the Appropriate Assessment, in an effort to find a mutually agreeable way forward.

9.3. It is also suggested that a protocol be drawn up and agreed in relation to any emergency works to avoid the possibility of an offence being committed (under the Habitat Regulations). Understandably, Natural England would probably only support a 'minimal intervention' approach regarding emergency works.

10. COSTING, FUNDING AND PROCUREMENT ISSUES

10.1. This report follows an 'officer level' meeting of those authorities concerned; it is only natural that it has been prepared by Arun District Council, as Pagham Beach would be most likely to suffer the effects of erosion first. However, both Chichester District Council and the Environment Agency have interests in the area, and as such, it is imperative that these works are undertaken in partnership with our neighbours.

10.2. The likely cost of a study would be in the region of £100,000 plus the cost of specialist geomorphological advice, which could be a further £20,000.

10.3. The likely cost of the preferred 'works' option is in the region of £1.25m (note that this may not be feasible due to the need to work within the Habitat Regulations)

10.4. Subject to sufficient funds being available and a sufficiently high 'priority score', works of this nature are now funded by 100% grant in aid no matter which authority undertakes the work.

10.5. This Council would be in a position to offer its services to act as "lead" for the study element of the project.

10.6. The most suitable method of procuring the works element would probably be to make use of the EA's Framework Contractor arrangement. This would obviously be subject to further discussion with the partners.

11. APPROVAL ROUTES AND PROGRAMMING

11.1. Defra has now devolved much of its previous operational work to the Environment Agency, through the making Space for Water initiative, outlined in previous Annual Coastal Protection Reports.

11.2. EA has therefore a greater strategic overview of coastal defence works and will be responsible for approving any applications for studies, works and funding thereof.

11.3. It is for this reason that it is recommended that an application be made to EA for a study, to establish a viable solution to the problem of increased erosion on Pagham Beach (this may involve works to remove the spit and deposit it on Pagham Beach and in doing so re-establish the cyclic process experienced in the area until recently).

11.4. As noted above, the cost of such a study would be approximately £100,000 plus the cost of specialist geomorphological advice, which could be a further £20,000.

11.5. To ensure that this project is included in EA's forward financial programming, both the recommended study and the suggested mitigation works have been included in the recent (annual) Medium Term Plan submission. This inclusion in the submission does not commit the Council or any of the other affected parties/partners to proceeding with the project but it does remove the risk of financial programming delays that could be experienced in securing funding (100% grant in aid) should the Council/partners be minded to proceed.

11.6. The requirement of the Birds Directives dictates that no work can be carried out on the site between March and July. Best efforts would need to be made to ensure that preparations were such that subject to all necessary approvals a contractor was appointed and ready to start work in late Summer early Autumn of 2008.

11.7. Given the risk of not concluding all of the necessary studies, consultation and all of the necessary approvals set out above it is clear that this date may well not be met, hence further enhancing the requirement to agree an emergency situation protocol with all interested parties, especially Natural England; it is intended that this would be included in the proposed 'next stage' study

11.8. Works of this nature also carry significant risk (extra cost) if undertaken in the winter months. Accordingly, it would be prudent to establish an alternative strategy whereby the works are delayed until the 2009 season but have a emergency procedure in place to safeguard the Pagham Beach crest and to ensure the channel is not blocked. Again, a protocol needs to be established in advance

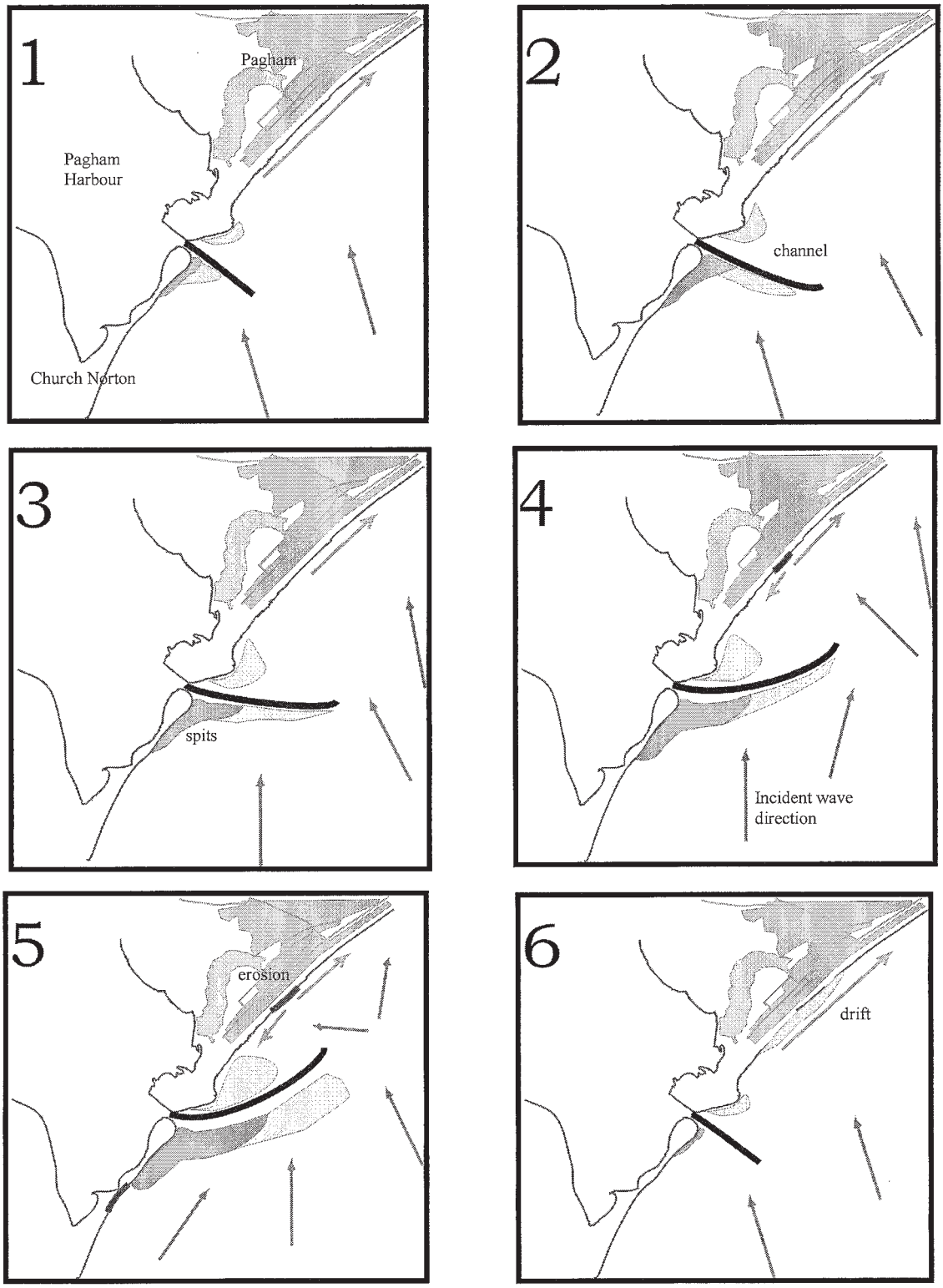
11.9. It should be noted that there exists within the Council's Constitution (Part 6 Rules of Procedure and Standing Orders) the mechanism by which emergency works, such as remedying breaches in the defences, can be authorised without the need to undertake the lengthy procedures involved with an Individual Cabinet Member decision [ICM]. Such action would of course be reported to the relevant Committee Cabinet as soon as practicable and any works would need to be undertaken within the terms of the protocol noted above.

Background Papers: Coastal Erosion Associated with a Tidal Inlet: Pagham, West Sussex – Barcock & Collins (University of Southampton) 1991.

Beach Monitoring Data & Air Photos – Arun DC and Environment Agency (& predecessors) 1973 to date

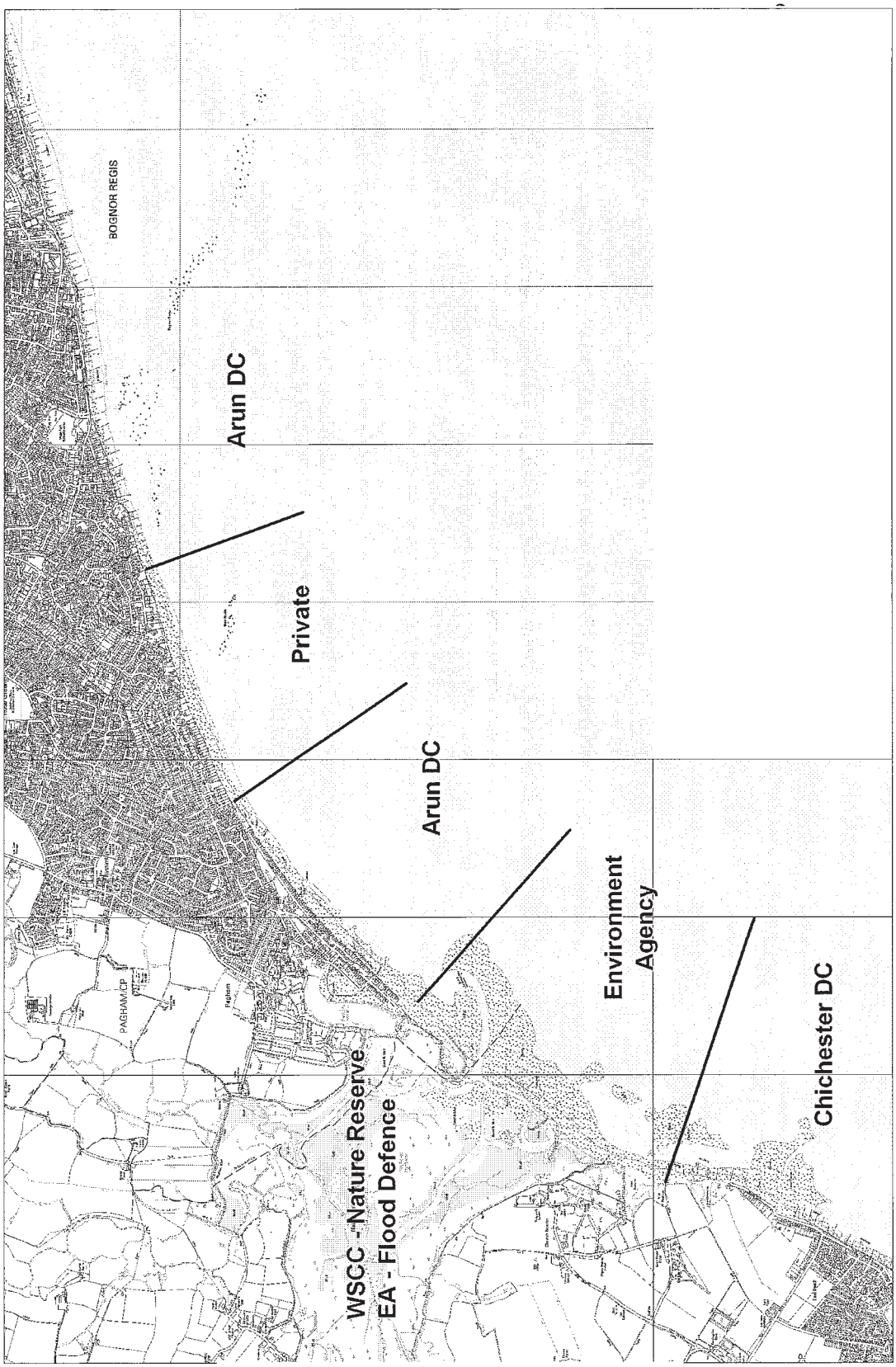
Contact: Roger Spencer – Principal Engineer : ext 37812

Appendix 1



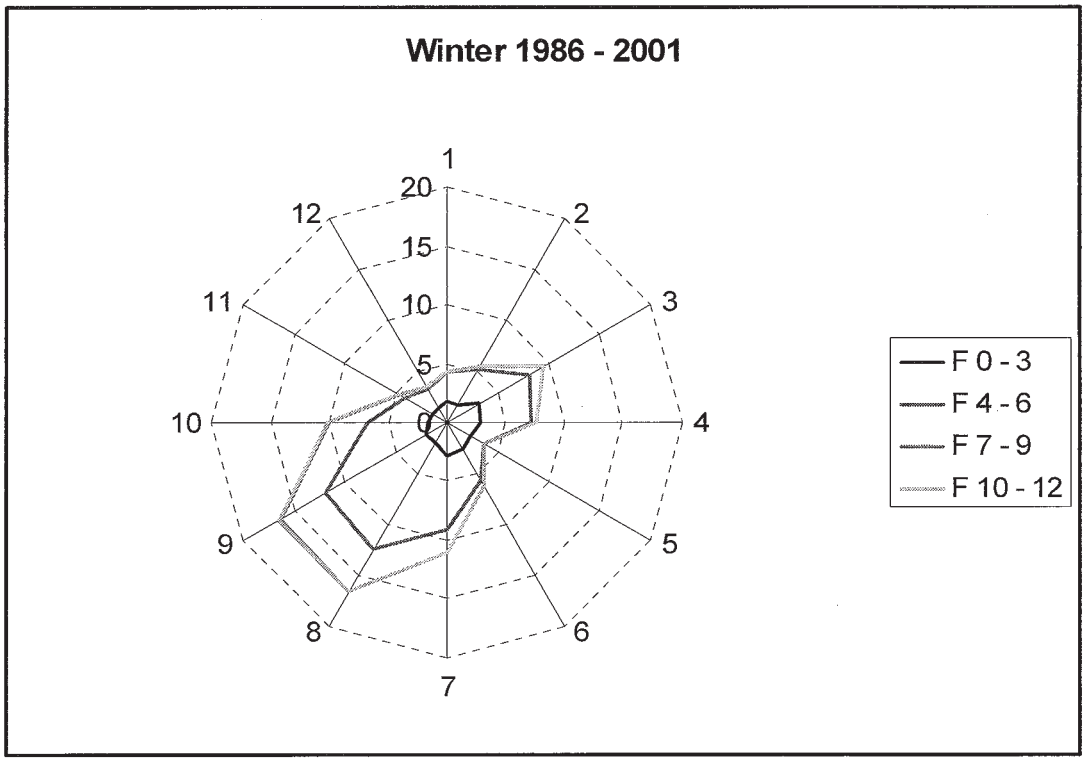
Sequence of the 4 – 5year migrational cycle of Pagham Harbour Channel

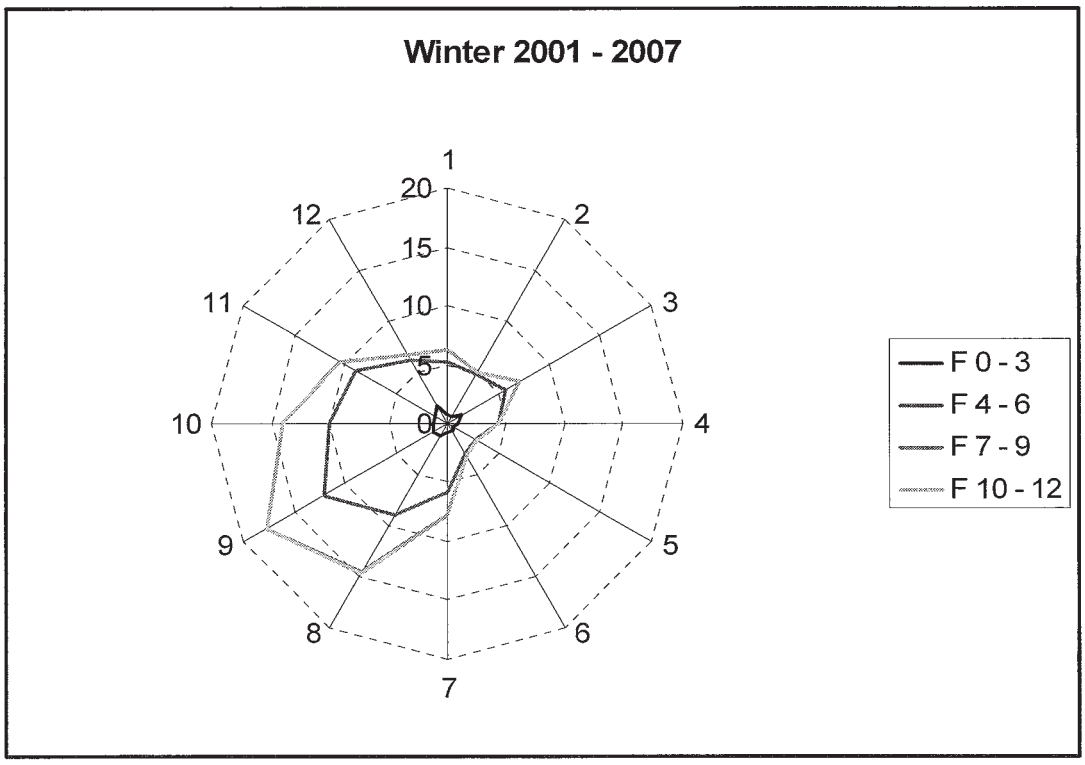
Appendix 2



Coastal defence Responsibilities

Appendix 3





Wind Roses Derived from Met Office "Fine Grid Model" Data

Appendix 4

Changes in Spit and Channel Positions Summer 2006 to Spring 2007