Final Project Report (to be submitted by 20th September 2018)

Instructions:

- Document length: maximum 10 pages, excluding this cover page and the last page on project tags.
- We welcome the submission of Annexes (i.e. bachelor or master thesis, references, species lists, maps, drawings, pictures) to further HeidelbergCement's understanding and future use of your findings, however they will not be reviewed by the Jury, and we kindly ask for these to be sent separately to the National Coordinators.
- Please use the attached template for species data collected during the project and submit with the project report.
- Word/PDF Final Report files must be less than 10 MB.
- If you choose to submit your final report in your local language, you are required to also upload your final report in English if you wish to take part in the international competition.
- To be validated, your file must be uploaded to the Quarry Life Award website before **20th September** 2018 (midnight, Central European Time). To do so, please log in, click on 'My account'/ 'My Final report'.
- In case of questions, please liaise with your national coordinator.
- You should not publish additional private information in your final report (e.g.: address, day of birth, email-address, phone number), just complete the categories we ask for below under "Contestant profile".

The final reports should comprise the following elements:

For research stream projects:

- Abstract (0,5 page)
- Introduction :
    - For projects that are building upon a previous project, write a summary of actions that were already completed in the previous project.
    - Project objectives
- Methods: a detailed description of the methods used during the project is required.
- Results: the results of the project should be outlined and distinguished from the discussion.
- Discussion:
    - Results should be analysed and discussed with reference to region/country taking into account other publications.
    - Outline the added value of the project for science and for the quarry / company.
    - Recommendations and guidance for future project implementation and development on site is requested. Where possible, please mention the ideal timing and estimated costs of implementation.
- Final conclusions: a short summary of results and discussion.

For community stream projects:

- Abstract (0,5 page)

- Introduction
    - For projects that are building upon a previous project, write a summary of actions that were already completed in the previous project.
    - Project objectives
    - A short description of the site and the team members and the targeted audience of the project.
- Actions and activities: a detailed description of planned or implemented actions and outreach activities done to elaborate the project, list of stakeholders involved.
- Discussion:
    - Project teams should discuss the pros and contra and illustrate experiences.
    - Outline the added value of the project for biodiversity, the society and the quarry / company.
- Deliverables: practical implementation and development recommendations of the project are required. Where possible, please mention the ideal timing and estimated costs of implementation.
- Final conclusions: a short summary of the project findings and discussion.

1. Contestant profile

▪ Contestant name:	**Dr Tim Mackrill**
▪ Contestant occupation:	Nature Conservation
▪ University / Organisation	Roy Dennis Wildlife Foundation
▪ Number of people in your team:	Two

2. Project overview

Title:	Safe Homes for Sand Martins
Contest: (Research/Community)	Community
Quarry name:	Grange Top Quarry, Ketton

Abstract (max 0.5 page)

Each spring Sand Martins return to nest in colonies in quarries and along rivers where they excavate their nests in sandy substrate. The ephemeral nature of nesting sites combined with the presence of predators mean that many nests fail to produce young each summer. The presence of nesting Sand Martins also has the potential to disrupt extraction work in active quarries. The Safe Homes for Sand Martins project involved the construction of an artificial Sand Martin nesting bank at Grange Top Quarry in Ketton, Rutland. The bank, consisting of 252 individual nesting chambers, now provides a permanent, safe breeding site for the birds and will allow quarrying activity to continue as normal.

Sand Martins were seen investigating the bank in mid-June, and some individuals began nest building soon afterwards. This encouraging sign suggests the first birds are likely to breed in 2019. The design of the bank enables each nest chamber to be accessed from the rear to enable ongoing nest recording and ringing of chicks. Solar panels have been installed to provide power for internal lighting and a high definition camera system to provide images from active nests once the first birds begin breeding.

The bank will provide a valuable educational resource and year 4 children from Ketton primary school were invited to participate in the project from the outset. They produced outstanding project work based on a visit to the bank during the construction phase, and a subsequent nest recording and ringing session at an established colony in an artificial bank at nearby Rutland Water Nature Reserve. The project was also showcased at the Hanson Open Day that attracted over 4000 people. The project demonstrates the great value in establishing partnerships between Hanson and local NGOs, schools and other community groups.

This project provides a long-term sustainable working model that could be replicated at other Hanson/Heidelberg Cement sites. This would be of considerable benefit to the company by reducing future disruption to planned quarrying activities, while proving considerable conservation, research, educational and community benefits.

Final report (max 9 pages)

1. Introduction

1.1. Background

The Sand Martin is a small, migratory, insectivorous bird that winters in sub-Saharan Africa before returning to the UK in late March and early April to breed. Sand Martins nest in colonies in quarries and along river banks where they excavate their nests by burrowing into sandy substrate. The ephemeral nature of nesting sites combined with the presence of predators mean that many nests fail to produce young each summer.

The presence of nesting Sand Martins also has the potential to disrupt extraction work in active quarries. The opportunistic nature of the species means that Sand Martins are often drawn to newly excavated areas, particularly where shear faces have been created. In such a situation quarrying work must cease for the duration of the breeding season.

Grange Top Quarry at Ketton in Rutland supports a colony of approximately 25-50 pairs of Sand Martins, with numbers fluctuating year-by-year. A mist netting session undertaken under licence during June 2017 revealed that at least two of the breeding birds originated from nearby Rutland Water: one was ringed as a chick in 2015 and the other in 2016. Evidence suggests that the productivity of the Ketton colony is limited by predation. Monitoring during the 2017 breeding season revealed that several nests failed due to predation by Badgers, Stoats and Carrion Crows. This was predominantly due to topography of the nesting area, which allowed easy access to nests by both ground and airborne predators. Remote trail cameras captured images of Stoats entering burrows and Carrion Crows waiting to snatch fledglings. In addition field signs indicated that several nests were dug out by Badgers.

The installation of artificial Sand Martin banks at several sites around the UK has provided ideal nesting habitat at locations where natural nest sites are prone to predation or at risk due to the ephemeral nature of nesting substrates. One such example is Rutland Water Nature Reserve, situated less than 10 miles to the west of Ketton, where two artificial banks support a breeding population of over 200 pairs of Sand Martins. These banks provide a safe breeding site for the birds but also facilitate scientific recording and monitoring. The design of the banks permits access to the rear of each individual nesting chamber to allow the status of nests to be recorded and any chicks ringed. In 2017 more than 1600 Sand Martin chicks were ringed in this way. In addition a high definition camera provides live footage from active nests.

1.2. Objectives

The evidence from Rutland Water indicates that the installation of artificial nesting banks in quarries has the potential to provide a safe breeding location for Sand Martins while allowing quarrying activity to proceed as usual. Through the Safe Homes for Sand Martins project we aimed to provide a sustainable working model for other quarries to follow through the installation of an artificial bank at Grange Top Quarry, based on the design

used at Rutland Water. We believe this has the potential to be of significant conservation and quarrying value, while having additional community outreach and educational benefits.

The key objective of the project was therefore to install a 252 hole, predator proof Sand Martin bank and to monitor the subsequent use by Sand Martins. In addition Ketton Primary School were invited to participate in the project from the outset, to help demonstrate the associated ongoing educational benefits.

1.3. Site description

Grange Top Quarry has been an active limestone quarry since 1928, with areas at various stages of working and restoration. The limestone and clay extracted provides raw materials for the adjacent Ketton cement works for the production of cement. The unworked land is mainly in agricultural use, with extensive areas of woodland and scrub. The quarry is home to 26 different species of butterfly and a large number of birds. It includes a woodland SSSI and nearly 13,000 trees and shrubs have been planted. The company has also built a 63-metre long bat cave in the quarry. In recent years local volunteers have helped clear some of the scrub in the SSSI and grazed the grassland with donkeys. The intention is to link up all of the remaining pockets of grassland, but to leave some scrub. An artificial Osprey nest was erected in the quarry in 2017 and a pair of Ospreys took up residence during summer 2018. It is hoped that the pair will return to breed in 2019.

1.4. Team members

The project has been overseen by Dr Tim Mackrill of the Roy Dennis Wildlife Foundation and Lloyd Park of the Leicestershire and Rutland Wildlife Trust. Tim managed the Rutland Osprey Project, as well as other initiatives at Rutland Water Nature Reserve including a successful water vole reintroduction, for more than ten years. He has recently completed his PhD on Osprey migration at the University of Leicester. Tim now works on a range of species recovery projects with the Roy Dennis Wildlife Foundation, and continues to be heavily involved in work at Rutland Water, including with Rutland Water Ringing Group. Lloyd Park is Reserve Officer for the Leicestershire and Rutland Wildlife Trust at Rutland Water. He is a fully qualified bird ringer and trainer and is secretary of Rutland Water Ringing Group. Both Tim and Lloyd have extensive expertise and experience of Sand Martin bank construction and monitoring, including ringing of chicks. Additional support for the project was provided by volunteers from both Leicestershire and Rutland Wildlife Trust and Rutland Water Ringing Group, with technical advice regarding the installation of solar panels and camera equipment from Jason Fathers of Wildlife Windows.

The team was greatly supported throughout by Hanson staff at the quarry, led by Quarry Manager, Clifford Daly who have an impressive commitment to conservation and biodiversity work. Construction work was carried out to a high level by Hanson contractors R and R Mills who kindly contributed 30 days to the project on a voluntary basis.

The target audiences of the project reflect the range of potential positive outcomes. We hope to encourage managers of other Hanson sites (and the wider quarrying industry) to follow the model developed at Ketton, and

also to demonstrate the potential for the Sand Martin work to provide a valuable educational resource for schools and other educational establishments and to promote long-term sustainable relationships with community groups and conservation NGOs.

2. Actions and Activities

2.1. Design and Construction

The key element of the project was the construction of the Sand Martin bank. The first site meetings were held in January in order to finalise the design, location and construction of the bank. After extensive discussions in which a range of different options were reviewed, we proceeded with the design developed and successfully implemented at Rutland Water Nature Reserve. This, we felt, would create a basic model that could be easily replicated at other Hanson sites in the future.

A site close to existing Sand Martin nests in the quarry was chosen. This is adjacent to two areas of water which provide ideal foraging conditions for the birds, which feed on airborne insects caught on the wing. Once the site had been agreed, a concrete pad was laid to ensure that the bank could be orientated with the majority of holes facing north-west (thereby replicating the orientation of existing nests) or south-east. The concrete pad provided a firm footing for a breeze block construction, with the completed bank measuring 16 m x 4 m x 2 m with nesting chambers created on three sides.

Construction began in February. Five double-skin layers of breeze blocks were laid before a metal skirt was incorporated in order to exclude predators from climbing up the outside of the bank to reach the nests. Three rows of nest chambers were created above the skirt by laying hollow blocks on their side (again, double-skinned), with a final layer of blocks above in order to support the roof. Clay drainage pipes with a diameter of 75 mm were then cemented into position inside the outer layer of blocks in order to create entrances to each individual nest chamber, which was located in the inner row of hollow blocks. Once the walls were complete a steel roof was installed on wooden beams and a full height door fitted to provide access to the interior of the bank. The outer walls of the bank were then rendered. A textured sandy appearance was achieved by flick rendering a sharp sand mixture (10 sharp sand, 2 lime, 0.5 cement) onto a base butter coat (5 soft sand, 5 sharp sand, 2 lime, 0.5 cement). Small wooden hatches were fixed to the rear of each nest and a layer of sand added to every nest chamber and entrance pipe. A small piece of carpet was fixed to the inside of each door to exclude drafts.

The build was frequently interrupted by cold and inclement weather during March and early April, but the main construction work was eventually completed by the end of April. The bank is situated a considerable distance from mains electricity, and so solar panels were installed in order to provide the necessary power supply. A 280W system was considered most appropriate in order to ensure a reliable power source for interior strip lighting and high definition camera system.

The high definition camera system consists of a Vivotek 8152 network camera and associated transmission equipment. This is housed inside a specially designed box that can be fixed to the rear of each nesting chamber. This will allow the camera to be moved between active nests in the bank once the first birds begin breeding, with images relayed to the quarry site office wirelessly using an EL-Enstation5. This highly flexible system was considered the best to use because it requires minimal cabling, and replicates the existing set-up at Rutland Water Nature Reserve which has been in use for several years. There is potential for these images to be streamed online once the first birds begin breeding.

2.2. Monitoring

Evidence from Rutland Water, where there was little or no uptake of the artificial banks in the first summer after construction, suggested it was unlikely that Sand Martins would breed in the Ketton bank this year. Delays in construction, caused primarily by adverse weather in March and April meant that the chances were further reduced. Nevertheless fortnightly visits was undertaken by Tim Mackrill and Lloyd Park from May onwards to check for signs of occupancy.

These visits indicated that numbers of returning Sand Martins were considerably lower than normal. Monitoring at Rutland Water revealed a similar pattern, with numbers of both adults and fledged juveniles down by almost 50% compared to the previous year. Furthermore, this situation was replicated across the country, with lower than average numbers of Sand Martins as well as House Martins and Swallows reported throughout the UK. It is thought that poor weather in North Africa and southern Europe was responsible, with birds either lost on migration or very late returning.

Despite the lower than average numbers, Sand Martins were seen investigating the Ketton bank for the first time on 15th June. Subsequent checks revealed that grass and feathers – typical lining material - had been added to at least 15 nest chambers. Although none of the birds went on to lay eggs or rear chicks, it was an extremely encouraging sign and raises hope that the first pairs will breed in 2019. A similar pattern of behavior was observed at Rutland Water the first summer after construction of the two artificial banks there.

2.3. Education outreach

A key element of the project was to demonstrate how Sand Martin banks can provide a valuable educational resource. An initial meeting was held with Maggie Kelly from Ketton Primary School on 16th January with a view to organizing a programme of work for her class of 29 year 4 children at the school. A project of this type and scope includes elements of several different subjects included in the national curriculum, including geography (Sand Martin migration), science and mathematics (recording and monitoring, plus use of solar panels and cameras etc.) and English (report writing).

We were keen for the children to see the project from the outset, and so a visit was made to the quarry on 28th March while construction work was taking place. The children arrived on site at 10am. Tim Mackrill and Lloyd Park provided an introductory talk and were immediately impressed by the background research that the children

had undertaken. The group was then transported through the quarry to the construction site. By this stage the walls were full height but the roof was yet to be installed. This enabled Tim and Lloyd to talk through the design of the bank and to answer more of the children's questions. The group also spent time drawing diagrams and making notes to enable them to compile a report on their return to school. In subsequent weeks, the children worked on their reports which they presented, filmed and edited in a TV news style. A selection can be viewed here.

Later in the summer, on July 4th the same group of year 4s from Ketton school joined Tim Mackrill and Lloyd Park on one of the Sand Martin nest recording visits at Rutland Water Nature Reserve. The bank chosen was constructed by Lloyd and a team of volunteers in 2014 and now supports a thriving colony of up to 85 pairs, although numbers were down considerably this summer. The group was taken inside the bank to observe active nests, and then several broods of chicks were ringed. This provided a unique opportunity for the children to see the chicks at very close quarters and at different stages of development, and to learn about this vial aspect of scientific recording and monitoring that is based on standardized British Trust for Ornithology methodology.

It is hoped that the first birds will breed in 2019 and, if this is the case, children from Ketton school will be invited to a nest recording and ringing session at the quarry at the earliest opportunity. This demonstrates the ongoing commitment of Hanson, the Sand Martin project team and also Ketton school to continue this important education work in future years. Furthermore the installation of the HD camera system will allow Ketton and other local schools to view footage from active nests. An example of the footage captured by the same camera system at Rutland Water can be viewed here. There is potential to involve a range of other educational establishments from primary school to post-graduate level in ongoing nest recording and ringing which will be undertaken by Lloyd Park, Tim Mackrill and colleagues from Rutland Water Ringing Group. In the past MSc projects have been undertaken at Rutland Water based on data collected at the Sand Martin banks.

2.4. Community Outreach

Hanson's Open Day at the Ketton site on 30th June provided a valuable opportunity to showcase the project to over 4000 visitors. Tim Mackrill and Lloyd Park manned a display which featured images of the construction of the Sand Martin bank, as well as footage from active nests at Rutland Water. This generated considerable interest from a constant stream of visitors throughout the day. In addition Tim Mackrill was interviewed by Rutland Radio and this interview was broadcast the following day.

The project was also featured in the June edition of Hanson's Open Door publication which is circulated to residents in Ketton, Stamford and nearby villages, thereby further raising the profile of the project locally.

2.5. Stakeholders

The complete list of stakeholders involved in the project is as follows:

Roy Dennis Wildlife Foundation, Leicestershire and Rutland Wildlife Trust, Ketton C of E Primary School, Rutland Water Ringing Group, Wildlife Windows (technical support for installation of solar panels and camera), British Trust for Ornithology, R and R Mills Contractors (construction work).

3. Discussion

The key objective of this project was to construct an artificial Sand Martin bank in the working part of the quarry at Ketton and we are delighted that this has been achieved to a very high standard. We believe that this now provides a sustainable working model for other quarries to follow, both in terms of design and construction, but also with regard to community and educational participation. Evidence from Rutland Water and other sites indicates that once a colony of Sand Martins is established in the bank, the population will increase annually as survival of juveniles increases (due to reduced predation) and as other birds are attracted to join the colony. In the long term we believe that this will lead to greatly reduced disruption to extraction work elsewhere in the quarry, while delivering clear conservation, community and educational benefits.

The fact that lower than expected numbers of Sand Martins returned in the spring, and that construction work was delayed by sustained periods of cold and inclement weather, meant that it was not unexpected that there was no breeding in the bank this summer. Nevertheless, we were encouraged to see Sand Martins investigating the bank and adding lining to nests for the first time in June. A single pair bred in the most recently constructed bank at Rutland Water in its first summer, before increasing to 22 pairs in year two and 60 pairs in year three. This suggests that Sand Martins are very likely to breed at the Ketton bank for the first time next year. All of the stakeholders involved this year are committed to the project in the long term and this will guarantee its sustainability.

It is clear that a project of this kind can greatly encourage community participation at Hanson sites, and Rutland Water Ringing Group, Leicestershire and Rutland Wildlife Trust and Roy Dennis Wildlife Foundation are delighted to be involved and fully committed in the long term. This will ensure that monitoring of the bank is undertaken on an annual basis in the most rigorous, scientific manner, based on standardized British Trust for Ornithology methodology. Similar partnerships could be established with the local ornithological community if Sand Martin banks are built at other Hanson sites. It is important to clarify, however, that the establishment of other banks is not dependent on securing this level of local support. The minimum requirement is that a new bank is sited in a suitable location, preferably close to areas where Sand Martins have bred in the past, and where disruption from ongoing quarrying activity can be minimized. Once the bank is in place it only requires checking once per year in order to clean out old nest sites and to add new sand to each nesting chamber. If sufficient local expertise can be found, additional nest recording and ringing of chicks can be undertaken, thus adding further conservation, research, educational and community value.

A further example of the long-term commitment to the project at Ketton is the relationship that has been developed with Ketton school. The project work undertaken by the year 4 children was outstanding, and helped to demonstrate the educational benefits of the project. The lack of any breeding birds this summer meant that it

was not possible to provide footage of active nests for the children to view, but the fact that all the necessary equipment for the HD camera system is in place means that this will be possible in 2019 if, as hoped, the first Sand Martins begin breeding. As discussed this footage will be made available for other schools and additional educational establishments to use, and there is potential for it to be streamed live on Hanson's website on the Ketton community page. The high level of interest in the project demonstrated by visitors to Hanson's Open Day on 30 June shows that this would be a popular move, and it would further demonstrate Hanson's environmental credentials and provide a valuable PR opportunity.

The visit by Ketton school to the Rutland Water Sand Martin bank demonstrated the educational value of the nest recording and ringing sessions. This provided the children with a unique experience that can be replicated at Ketton in future years. The Ketton bank was designed specifically with visiting groups in mind, with the central area between the two main rows of nests twice as wide as the corresponding areas in the Rutland Water banks. The lighting installed is also considerably better than at Rutland Water, which greatly enhances the overall experience. The ringing and nest recording sessions could be offered to a range of other educational establishments, from primary schools to universities. There would also be potential post-graduate research opportunities as the Sand Martin colony grows in size, and this could include comparisons with data collected at Rutland Water.

4. Deliverables

The Sand Martin bank was specifically designed so that it can be easily replicated at other Hanson sites. The breeze block structure is strong and easy to construct. Furthermore this design has been used with great success at Rutland Water Nature Reserve. Photographs of the build and technical drawings are included in Appendix 1 and Appendix 2. Many of the materials for construction were sourced on site and this reduced the overall cost to £2993 plus associated labour. The artificial bank required a total of 50 days of labour to complete. Hanson contractors R and R Mills generously contributed 30 of these days on a voluntary capacity. Appendix 3 includes a breakdown of material costs at Ketton along with a prediction of costs based on this design, should all building materials need to be purchased new.

Although this specific bank was built with 252 holes, the size can be adapted according local needs. It is important, however, that the central corridor between the two rows of nests is as wide as possible if the bank is to be used by visiting groups. Adequate lighting is also essential. The 280W solar system installed at Ketton provides sufficient power to run four 1.5m 60W LED Strip Lights as well as the HD camera and associated equipment as follows:

- Camera - Vivotek 8152 plus IR lighting ring and external microphone
- Wireless bridge - EnGenius Enstation 5 long range N300 wireless outdoor CPE
- POE switch - NETGEAR GS105UK 5-Port Gigabit Unmanaged Ethernet Switch

The total equipment cost of the solar system, interior lighting and HD camera system was £2346.50 and the details are included in Appendix 3.

It is preferable for construction work to start as early as possible so that new banks are completed before any birds return in mid-late March in order to maximize chances of occupancy in year one. However experience from Rutland Water, and now Ketton, demonstrates that it is more realistic to expect birds to breed for the first time in the second year. Chances of occupancy are also greatly enhanced by siting the bank close to suitable foraging areas over water, where there is a greater density of airborne insects, and near former breeding sites or existing colonies. It is also essential to minimize disturbance around new banks, and so careful consideration needs to be given to this in light of any future quarrying plans. In working quarries Sand Martins are most likely to be attracted to newly worked faces, particularly if extraction leaves shear faces with exposed sandy substrate. In this scenario re-profiling the face to a 45% slope should dissuade Sand Martins from excavating burrows and instead encourage colonization of a newly-erected artificial bank.

Our work shows that the installation of Sand Martin banks creates clear community and educational benefits. Developing relationships with local NGOs and ornithologists can therefore add considerable value to Sand Martin bank projects and increase long-term sustainability. If possible finding local ornithologists who are prepared to monitor the bank from the outset enables colonization to be monitored closely and for the educational potential of the bank to be explored. It is clear from interest in the project at Ketton that taking this approach from the outset helps to build momentum and adds greatly to the reputation of Hanson within the local community.

5. Final Conclusions

The project has delivered a high quality artificial Sand Martin bank that will be of considerable conservation, quarrying, education and community benefit for many years to come. This demonstrates the great value in establishing partnerships between Hanson and local NGOs, schools and other community groups. We believe that the project has created a sustainable model that could be replicated at other Hanson sites, which in time will be of considerable benefit to the company by reducing disruption to future quarrying activities. Evidence from Rutland Water shows that once a colony become established in an artificial bank, numbers will grow and this will likely prevent Sand Martins attempting to breed in other parts of working quarries, with new birds compelled to join others in the artificial bank. Furthermore the colony is likely to be far more successful because predation can be almost completely eliminated. This in itself delivers quarrying and conservation benefits which fully justify the initial costs of construction. The clear educational and community benefits that come from the additional activities that can be undertaken add considerable value to any such project, as demonstrated by our work at Ketton.

To be kept and filled in at the end of your report

Project tags (select all appropriate):

This will be use to classify your project in the project archive (that is also available online)

Project focus:

- ☐Beyond quarry borders
- ☒Biodiversity management
- ☐Cooperation programmes
- ☒Connecting with local communities
- ☒Education and Raising awareness
- ☐Invasive species
- ☐Landscape management
- ☐Pollination
- ☐Rehabilitation & habitat research
- ☐Scientific research
- ☐Soil management
- ☒Species research
- ☐Student class project
- ☐Urban ecology
- ☐Water management

Flora:

- ☐Trees & shrubs
- ☐Ferns
- ☐Flowering plants
- ☐Fungi
- ☐Mosses and liverworts

Fauna:

- ☐Amphibians
- ☒Birds
- ☐Insects
- ☐Fish
- ☐Mammals
- ☐Reptiles
- ☐Other invertebrates
- ☐Other insects
- ☐Other species

Habitat:

- ☐Artificial / cultivated land
- ☐Cave
- ☐Coastal
- ☐Grassland
- ☐Human settlement
- ☐Open areas of rocky grounds
- ☐Recreational areas
- ☒Sandy and rocky habitat
- ☐Screes
- ☐Shrub & groves
- ☐Soil
- ☐Wander biotopes
- ☐Water bodies (flowing, standing)
- ☐Wetland
- ☐Woodland

Stakeholders:

- ☐Authorities
- ☒Local community
- ☒NGOs
- ☒Schools
- ☐Universities

Appendix 1

1. Photos of construction

Figure 1. A concrete pad provided a firm base.

Figure 2. Block work construction.

Figure 3. The metal skirt prevents predators such as Stoats climbing up to nest holes.

Figure 4. A full height door provides easy access to the interior of the bank.

Figure 5. The bank awaiting rendering, with blockwork and roof complete.

Figure 6. Doors were fitted to the rear of each nest chamber.

Figure 7. Carpet was fixed to the inside of each door to exclude draughts.

Figure 8. LED strip lights provide lighting inside the bank.

Figure 9. Flick rendering gave the bank a natural appearance.

Figure 10. The completed bank with solar panel for power.

Figure 11. The completed bank is sited close to two areas of water where the birds can forage.

2. Ketton school visit during the construction phase

Figure 12. Lloyd Park discussing bank design with the children.

Figure 13. Lloyd Park explaining where Sand Martins have previously nested in the quarry.

Figure 14 (above) and 15 (below). Showing the children the interior of the bank.

3. Ketton school visit to Rutland Water

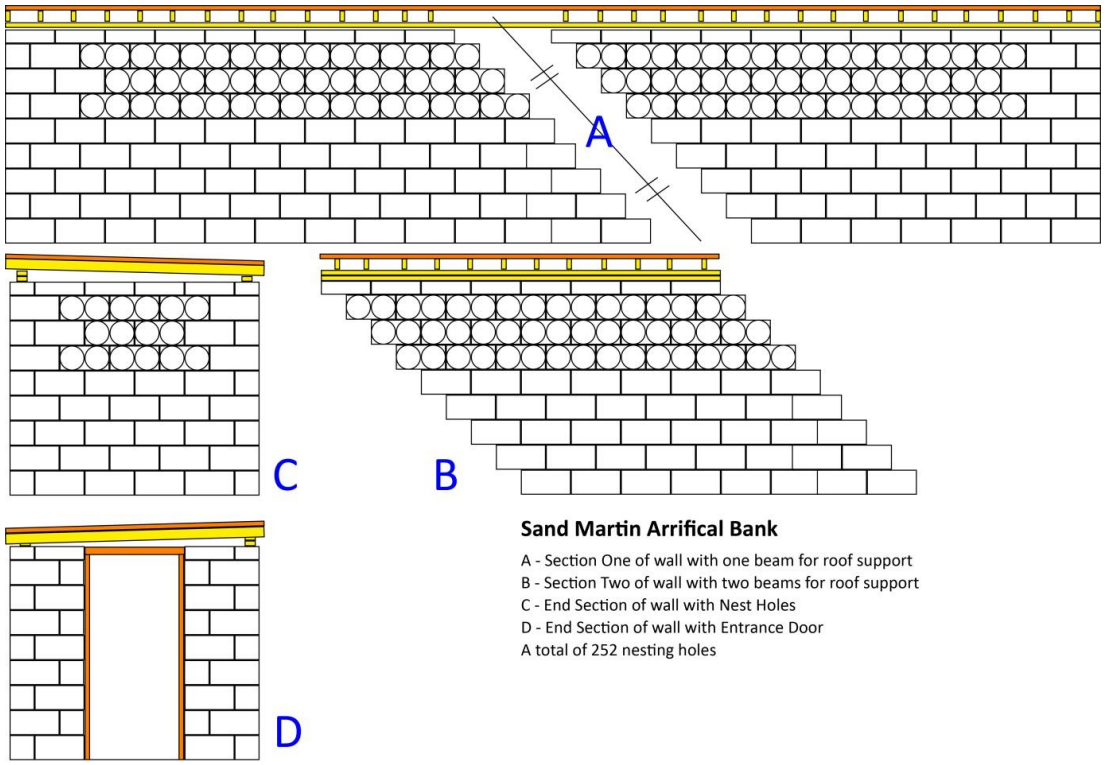
Figure 16. Lloyd Park ringing Sand Martin chicks with the children.

Figure 17. The ringing gave the children a unique chance to see Sand Martin chicks at close quarters.

4. Hanson Open Day

Figure 18 (above) and 19 (below) Lloyd Park talking to visitors to the Hanson Open Day about the Sand Martin project and other biodiversity in the quarry.

Appendix 2 - Artificial Sand Martin Bank Design

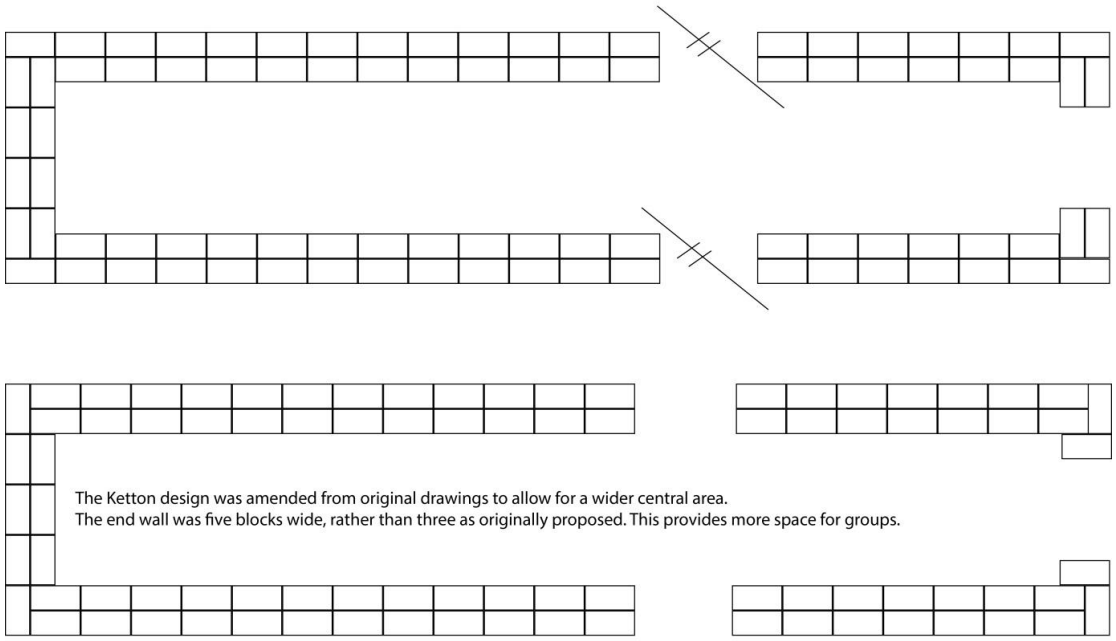


Sand Martin Arrifical Bank

A - Section One of wall with one beam for roof support
B - Section Two of wall with two beams for roof support
C - End Section of wall with Nest Holes
D - End Section of wall with Entrance Door
A total of 252 nesting holes

Artificial Sand Martin Bank

Floor plan showing alternate level of block layers



The Ketton design was amended from original drawings to allow for a wider central area.
The end wall was five blocks wide, rather than three as originally proposed. This provides more space for groups.

Appendix 3 – Costs of Sand Martin bank construction

1. **Material costs of artificial Sand Martin bank based on the design used at Ketton**

Note: Approximately 50 days of labour are required.

	Quantity	Cost each	Total
Concrete	9	102.00	918.00
Concrete blocks	800	1.85	1480.00
Clay pipes	300	2.95	885.00
Timber for roof	1	550.00	550.00
Plyboard	11	28.00	308.00
Roofing sheets	1	495.00	495.00
Sand	6	45.00	270.00
Cement	120	4.50	540.00
Door	1	165.00	165.00
Hinges for nest chamber doors	300	1.95	585.00
Rendering materials	1	325.00	325.00
Metal skirting	1	220.00	220.00
Misc materials	1	450.00	450.00
			£7191.00

2. **Actual costs of construction materials for Ketton**

	Quantity	Cost each	Total	Details
Concrete	0	0.00	0.00	Broken bags provided by Hanson, mixed on site
Concrete blocks	200	1.85	370.00	200 blocks purchased, remainder left over from various projects
Clay pipes	300	2.95	885.00	300 purchased
Timber for roof	1	200.00	200.00	Quantity left over from cladding quarry workshop
Plyboard	6	28.00	168.00	5 left over from boarding preheater tower during shutdown
Roofing sheets	0	0.00	0.00	Surplus materials from new bag filter
Sand	6	45.00	270.00	All purchased
Cement	120	0.00	0.00	Broken bags provided by Hanson, mixed on site
Door	0	0.00	0.00	Reclaimed from redundant building recently demolished at Hanson
Hinges for nest chamber doors	300	1.95	585.00	All purchased
Rendering materials	1	65.00	65.00	Remainder of materials required provided from Hanson (damaged goods)
Metal skirting	0	0.00	0.00	Surplus materials from new bag filter
Misc materials	1	450.00	450.00	Screws, fixings, spray foam, paint etc
			£2993.00	

3. Camera, solar and lighting equipment

	Make/model	Quantity	Price per unit	Total
Camera	Vivotek 8152	1	370	370
Wireless bridge	EnGenius Enstation 5 long range N300 wireless outdoor CPE	2	125	250
PoE switch	NETGEAR GS105UK 5-Port Gigabit Unmanaged Ethernet Switch	2	49.5	99
IR lighting ring for camera	Sourcingmap Array 36 Low Power Infrared IR LED Light Board Module For CCTV Camera	1	17.5	17.5
DC power supply adapter	12V 1A Mains AC-DC 1A	1	19.5	19.5
DC power extension cable	Liwinting 5m DC Power Extension Cable 2.1*5.5mm Male to Female Connector	1	14.5	14.5
External microphone for camera	Audio Mic Microphone for CCTV Security Camera Spy	1	10.25	10.25
280 W solar panel	280W REC Twin Peak 2 module, black frame, white backsheet; product code: REC-280-TP2/BLK	1	145	145
Solar charge controller	MPPT 50A charge controller 100 volt input 12/24 v output; product code: VBS-MPPT 100/50	1	248	248
				0
Solar panel inverter	Victron Energy Inverter Phoenix Connector VE Direct SCHUKO 12-250v; product code: VP-12/250 UK	1	375	375
12 v leisure battery	Varta Sealed Battery 12 v 90Ah (c20); product code: LFD90	1	145	145
Made-up cables (for solar panels)	MC extension cable assembly 10 metre male/female (MC4); product code: C1-4/MCMF 10 (2)	1	38.9	38.9
Solar panel mount	Wall/ground mount for 720-1050mm wide panels; product code: PVM-A101	1	98.5	98.5
Cat 6 cable	External Cat6 Solid Core UTP Cable	100 metres	115	115
Earthing rod	Earthing 3/8" 4' Rod	1	5.25	5.25
Earthing rod clamp	Earthing 3/8" Earth Clamp	1	4.35	4.35
LED strip lights	60W 5ft LED Strip Lights IP65 Non Corrosive Weatherproof Garage Workshop	4	79	316
Cable for lighting	NEXANS HEAT-RESISTANT FLEX 3093Y 3-CORE 2.5MM² 50M WHITE	50 metres	27.5	27.5
Light switch	1-GANG 2-WAY SWITCH METAL-CLAD	1	8.25	8.25
Sockets	13A 2-GANG SINGLE POLE SWITCH SOCKET METAL-CLAD	2	19.5	39
			TOTAL	**£2,346.50**