SKELL VALLEY PROJECT

Co-led by National Trust and Nidderdale Area of Outstanding Natural Beauty

iCASP

Integrated Catchment Solutions Programme

Healthy Lands, Healthy Rivers: Narrative report

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Justification of the project/method (Manual chapter 1)

The Payments by Results (PbR) manual has been developed in the River Skell catchment as part of a large-scale conservation project. The Skell catchment rises in the high moorland of Nidderdale National Landscape and flows eastwards, passing the World Heritage Site at Fountains Abbey and Studley Royal, to the city of Ripon. The Skell River catchment is classed as a flashy catchment, i.e., it is characterised by a rapid response in river level to precipitation events. Furthermore, the steep slopes that are a widespread feature in the catchment result in river floods with a high sediment content indicating a large amount of surface run off and erosion. Unusually, there are several water and sediment stores through the catchment (e.g. Eavestone Lake).

PbR frameworks are challenging to develop and implement – they need to be simple enough to be accessible and put into practice on the ground, yet comprehensive enough to account for the complexity of natural systems, the range of interventions, the variability of land use practices, and the restrictions of different funding schemes. These challenges were met during the development of the manual through a highly collaborative approach with many ideas and options discussed. Three PbR workshops with the Yorkshire Natural Flood Management (NFM) Community of Practice, farming community (landholders and farm advisors), and Nature-based Solutions (NBS) and PbR experts were instrumental in shaping the content and structure of the manual. The final development of the manual was through regular constructive meetings between iCASP, the National Trust and the Nidderdale National Landscape staff. Therefore, this report aims to develop a narrative that conveys some of these important discussions and considerations.

The PbR framework developed has an emphasis on reducing river levels and sediment load during flood periods at a catchment scale – through Fountains Abbey and Studley Royal, as well as in the city of Ripon, which reflect the aims of the Skell Valley Project. This informed the relative importance of benefits arising from the PbR scheme, although the framework developed readily permits modification of the relative benefits. An important differentiation in the PbR manual is payments for land management changes where the benefits might be realised over the long-term (decadal) and short-term capital interventions that might have rapid impacts (a few years). This bimodal distinction is a pragmatic approach, but does have limitations.

The manual has been designed for use by an experienced farm advisor or park ranger who would develop PbR plan for a farm or land holding in close consultation with a landowner using a tablet/laptop. The aim is to develop a costed installation plan that will benefit the farm, the land, and the catchment, but this is unlikely to work if the manual is treated as a ‘black box’. An important consideration not included explicitly in the PbR framework is that an essential component to the successful delivery of these schemes are well-trained farm advisors and park rangers. Therefore, the real costs of unlocking NBS investments in a catchment are not completely captured by the numbers generated through using this manual.

Assessing land holdings for NBS opportunities (Manual chapter 2&3)

Overview of NBS

An overview of Nature Based Solutions (NBS) is provided in Chapter 2 of the PbR manual to introduce the concept of NBS, how NBS act to reduce flood and sediment erosion risk (the two primary aims of NBS in the Skell Valley), and the range of NBS relevant to the Skell Valley. It is expected that assessors undertaking opportunity mapping will have a good understanding of the processes underpinning NBS. Therefore, Chapter 2 was designed to provide a broad overview only, with links to general resources

should further reading be required. However, as the manual was also designed to accommodate assessors working through elements of the manual alongside landholders, Chapter 2 may be used as an introduction to NBS if required. To support this, the additional resources listed at the end of Chapter 2 encompass technical and non-technical publications, including scientific, policy and farming-tailored reports.

Pre-assessment of NBS opportunities

Pre-assessment considerations are summarised in Section 3.1 of the PbR manual. Learning was collated from previous iCASP, National Trust and Nidderdale National Landscape projects, and the three PbR workshops with the Yorkshire NFM Community of Practice, farming community (landholders and farm advisors), and NBS/PbR experts. We found that each stakeholder group prioritised and understood different pre-assessment considerations to different extents, although many stakeholders raised similar considerations. By making use of a wide range of experience and sources, we categorised pre-assessment enquiries into four linked topics: reasons behind NBS assessment, stakeholders, funding and permits. It is possible that with government and regional policy changes, the assessment topic questions will change with time. To maintain applicability for as long as possible, the questions are deliberately designed to be overarching, rather than querying specifics (e.g., specific funding schemes).

Desk-based assessment of NBS opportunities

Outputs from a previous iCASP, National Trust and Nidderdale National Landscape (then Nidderdale AONB) project in the Skell valley, which mapped the risk of overland flow and sediment erosion for the Laver catchment using open-source software (SCIMAP), were used as the basis for desk-based analysis in this project. The previous project identified sediment erosion as a primary risk in the Skell valley, and overland flow pathways a strong contributing factor to that erosion. This was confirmed by National Trust observation of sediment and water flows into Fountains Abbey and Studley Royal.

To assess opportunities for NBS in this project, we expanded on the SCIMAP analysis to a create desk-based overview of catchment characteristics per farm included within the Skell Valley Project. Maps were created for land cover, slope, and the SCIMAP outputs; with further information gathered on soil type, geology and existing NBS. Instead of including the SCIMAP method in the PbR manual, we included an existing iCASP publication on use of SCIMAP in the Skell Valley in Appendix A.

In the manual, general resources have been referenced to maximise data availability to future NBS assessors. We recognise that University staff have access to scientific literature, which is behind paywalls and may be unavailable to external organisations or the general public. Therefore, all resources listed are open-source and, at the time of publication, contain data specific to the Skell Valley catchment. However, open-source data is often lower resolution than paid-for data sources.

We also recognise that NBS assessors will require a level of understanding to be able to interpret physical catchment and ecosystem services data. We have not provided resources on how to interpret data from the list of sources provided as that was considered beyond the scope of this project. However, general resources on NBS for a range of knowledge levels are listed at the end of Chapter 2, and Chapter 2 itself provides an overview of NBS with descriptions of NBS most likely to be installed in the Skell Valley.

Ground Truthing & Opportunity Mapping

The desk-assessment maps were a useful conversation starter with landholders regarding risk areas within their farms. To foster good relationships, which strongly accounted for landholder viewpoints, we encouraged the landholder to participate in the ground truthing exercise. This involved asking them

questions about current and future land management practices. Simply described, our approach was '*we are here to suggest all opportunities for NBS, we'd like you to tell us what you're interested in, what would work with your current land management scheme, and what you'd be willing to try in the near future'*.

The questions listed in Section 3.3 of the PbR manual were generated using iCASP, National Trust and Nidderdale National Landscape experience from previous NBS projects, and from discussions with landholders during farm walkovers. As local area specialists, the landholders were able to identify errors in the desk-based assessment, generally relating to missing information (e.g., locations of springs and field drains) and high vulnerability zones (e.g., areas with high erosion or common flow pathways which were too small-scale to be identified during desk-based analysis). Field-based discussions were invaluable in determining landholder approved NBS opportunities, and in optimising NBS opportunity locations. As only one or two visits were made per farm during the project, seasonal considerations relied on first-hand landholder knowledge. While farm-scale monitoring may provide further evidence in future, landholders responded positively to their experience, needs and opinions being integral to the assessment process. Landholder-provided information is vital to producing accurate opportunity maps which identify location-appropriate NBS and essential for maximising ecosystem services.

Initially, 'landholder-approved' opportunity maps were created. However, on consultation with National Trust and Nidderdale National Landscape, we expanded the opportunity mapping to create both landholder-approved and 'aspirational' opportunity maps. This two-tier approach should enable a longer-term consideration of landscape management and provide basis for future conversations about NBS installation once funding has been obtained, and when the benefits and impacts of NBS interventions are seen. We found that landholders were very receptive to the approach. They appreciated having a voice early in the PbR scheme, and that we validated their knowledge of the landscape and desire to manage the land for nature & climate resilience. In presentations of our project at conferences (iCASP confluence, Cumbria Rivers Trust), the dual map method has received widespread praise due to its innovative and partnership-centred approach.

In summary, on-the-ground communication and collaboration with landholders before during, and after the development of a PbR scheme and installation of NBS and is crucial.

Calculating NBS payment levels (Manual chapter 4)

To develop the PbR manual, we consulted many NBS specialists, end-users including landholders and farm advisors, users of existing similar PbR schemes, and likely managers of the future payment by results scheme in the Skell Valley. We also consulted scientific and non-technical literature to find transferrable examples of the PbR approach. The consultations and literature produced a wide variety of recommendations, needs, expectations and hopes for the manual; because of the range of users and their needs, we found it **challenging to create a flexible scheme** that enabled quantification of a suitable level of evidence for NBS working alongside the need for detail and simplicity.

Following soft-launch workshops with landholders, farm advisors and NBS experts, attendees present were divided between those who wanted a **'black box' approach** and those who wanted to be able to see workings and show them to landholders. Because of this, we added a 'message to the landholder' section into the PbR manual and designed the PbR multiplier (Appendix C) to have easy access but optional tabs showing the workings behind the PbR approach. In this way, the land holder could be walked through the manual with the PbR assessor. It was important to design the scheme to be agile enough to allow landholders to make decisions and use their detailed knowledge of the catchment alongside NBS expertise (i.e., be part of the decision-making process).

We wanted to allow landholders to have flexibility in what interventions they implement, while still encouraging them to choose the most beneficial NBS for the wider aims of the scheme. This is why we implemented a **weighting (multiplier) approach**. Taking this approach provides a framework for, and encourages, aspirational NBS to **go 'above and beyond' business as usual approaches**. This is most clear in the modifier values (Appendix C, Modifier ID tab) for which values are adjusted compared to the catchment average, thus rewarding landholders for going 'above and beyond'.

One way of making the scheme attractive – as suggested by a land holder during one of the PbR workshops – is to apply **PbR as a top-up payment to government incentives** (e.g., ELMS, SFI). This approach allows the PbR scheme to complement, rather than to compete, with other funding sources. A top-up approach would increase payment for land holders while enabling greater funding flexibility, potentially reducing the total financial input per farm from the PbR scheme. Inclusion of installation, loss of income, and maintenance payments may be able to be removed from the PbR scheme if a top-up approach is used. We have provided an alternative PbR multiplier (Appendix C) to enable this approach to calculations.

Flood, sediment and **ecology benefits** can also be **weighted by priority** per farm in recognition of site-specific characteristics and goals. This encourages tailoring of the NBS to catchment characteristics and needs while also reducing the risk of NBS installation in inappropriate locations (opportunity maps should be used to guide placement). For example, Farm A with high flood risk and Farm B with low flood risk may both choose to implement leaky dams; Farm A would have a higher priority multiplier value for flooding, therefore would receive higher payment for that intervention than Farm B. We were concerned that farmers may not appreciate **different payments for the same NBS interventions**, however landholders understood and were receptive to this site-specific approach at the PbR landholders' workshop.

Input key values were determined through consultation with the Yorkshire NFM Community of Practice, the National Trust and the Nidderdale National Landscapes. Source of the values are provided in full in the 'Input key source information' tab in Appendix C. The NBS included are those we identified opportunities for in the opportunity mapping stage of the project. However, following further discussions with National Trust and Nidderdale National Landscape about future NBS schemes within the Skell Valley, we also included 'Blocking drainage grips' and 'Winter cover crops' as further NBS options. The input key values given were determined based on scientific literature. Feedback on the

Input Key values was requested from the Yorkshire NFM Community of Practice, but no feedback was received before project end.

Modifier ID values were determined through consultation with National Trust and Nidderdale National Landscape. These values were approximated based on the Skell catchment average and using the same extent units as projected ELMs payments. Blocking drainage grips and buffer strip interventions required two measurements (e.g., length and width) to enable a flexible but proportionate approach to NBS installation. Exact calculations of the catchment average could not be made within the project timeframe and with available resources, however future calculations could be made with further information (e.g., through extensive GIS analysis and using farm specific data from Natural England with landowner consent). We found that a catchment average approach was the most suitable for comparing different NBS types within the 3-tiered PbR multiplier (i.e., each NBS given a value of 1, 2, or 3). Our initial approach was to compare NBS by ELMS payment, but payments per NBS varied widely and were subject to future change; this approach was not compatible with the PbR calculation.

Within the PbR multiplier, NBS with **short-term and long-term benefit returns** were separated in recognition of the widely varying timescales over which NBS is effective. NBS with short-term returns deliver their full potential for flood or sediment erosion mitigation, or ecological benefits, within 1 year of installation, in some cases immediately on installation. Examples include buffer strips, which take a short time to develop vegetation growth, and leaky dams, which are immediately effective on installation. In comparison, NBS long-term benefit returns take time to develop their full potential for ecological services, e.g., woodland which can take 30+ years to mature. It is important to note that the short- and long-term benefit returns identified do not necessarily reflect the lifespan of the NBS. For example, leaky dams are expected to last <10 years without maintenance whereas buffer strips can be continually maintained if the vegetation is not grazed or cut. These categories, although they do not currently affect the PbR calculation, may be used to determine the duration of PbR payments received (e.g., a 5-year initial contract vs >10-year contract).

In **earlier iterations** of the manual, 'short-term' and 'long-term' categories were divided into **'capital' vs 'management' NBS interventions**, where capital incorporated directly paid for installations such as leaky dams and fencing (generally short-term benefit approaches), and management incorporated softer, farming behaviour-based approaches such as reduced grazing and soil health initiatives (generally long-term benefit approaches). We found that 'capital' and 'management' categories did not clearly define/facilitate the difference in prospective payment contract duration.

We contemplated using more traditional PbR payment groupings, such as **opportunity costs** (maintaining current management which is already delivering benefits) and **income foregone** (reduced income or productivity due to interventions, e.g. reduced stocking density). However, on consultation with National Trust and Nidderdale National Landscape we decided this was not fitting with the aims and spirit of the scheme (i.e., to encourage 'above and beyond', not business as usual), so these **sections were omitted**. We recommend that future schemes could consider these as potential options.

Another idea discussed was to add **landowner engagement as an additional multiplier**; this was **omitted** from the multiplier because engagement opportunities do not necessarily influence the success of the NBS. However, there are many opportunities for improved engagement as part of the PbR scheme. For example, citizen science and education days could be used to collect monitoring data on the farms, which may (positively or negatively) influence payment for the NBS depending on monitoring results. There are many benefits to increased engagement, including increased monitoring, knowledge exchange, collaboration for NBS installation/maintenance, and improved community

cohesion. Questions remain regarding whether the landholder should receive payment for time taken to host community events (e.g., citizen science) on their land, and with whom administration (e.g., risk assessments) would lie.

Finally, we discussed **payment by result** – e.g., leaky dam installed - **vs outcome** – e.g., percentage soil retained. **What is the level of monitoring evidence required to release payments**, especially as the baseline continually shifts? Baseline monitoring as part of this project revealed no steady quantification of any variable measured (sediment, water flow/level etc), although monitoring did occur over particularly 'extreme' weather years, incorporating drought and flood events. This means that it may be difficult to associate change in water flow, sediment erosion or ecological uplift to the NBS installed (i.e., outcome), especially at farm scale as opposed to catchment scale. To account for this, we have suggested different levels of monitoring (manual Chapter 5) which enable result- and outcome-based quantification for release of payments. It is important that the outcomes are prioritised to create effective change – and this reiterates the importance of NBS assessment (manual Chapter 3) – however, a results-based approach may be required, especially in the initial years of the scheme while data is collected. In future, the PbR funder may choose to define what level of evidence required for PbR using the monitoring options listed.

Monitoring protocols and responsibilities of NBS interventions (Manual chapter 5)

The choice of monitoring protocol is determined by the output required by the PbR scheme/funder. For some projects it might be sufficient to demonstrate that the intervention is, or is not, functioning as intended, for others there may need to be quantification of the impact. For the Skell Valley PbR Scheme, we utilised a range of farm scale monitoring which could be utilised by landholders, rangers and specialists to obtain these outputs.

Table 1: Farm scale monitoring – pros and cons of equipment and techniques used to monitor interventions in Skell Valley Project.

Monitoring type	Pros	Cons	Did it work well?
Weather Station	• Install and set up does not require specialist knowledge or skills • Low maintenance • Real time data uploaded to server • Data is easy to share via link to online portal	• Produces large data sets so long-term trends can be difficult to visualise without specialist skills/training • Needs to be placed in suitable location otherwise data is unreliable (e.g. under tree canopy will impact accuracy of wind and rain measurements) • Is needed on a catchment scale not individual farm scale • Requires on going payment for data services	Yes – would have been impossible to tie water level to rain events without weather station. Useful for catchment- and farm-scale impacts (e.g. how well an intervention worked during a storm event) Very reliable
In water level monitoring	• High frequency time series data allows for in depth analysis of trends • In water probes allow for monitoring of high flow events without endangering staff • Minimal maintenance if cellular enabled logger used	• Produces large data sets so long-term trends can be difficult to visualise without specialist skills/training • Specialist knowledge/skills are required for installation to ensure correct location chosen and installation done safely • If in-probe logging chosen, then maintenance burden is higher – e.g. every 3 months probe needs to be removed and data downloaded	Yes – as specialists the high frequency data allows for links to rainfall event data from weather station. Not essential if monitoring undertaken by rangers and landholders as trail cameras/manual level record keeping can be done

Level boards	• Cheap and easy to install • Very reliable provided they are securely installed • Does not require any specialist skills or knowledge to install	• Can be used without a camera but this provides no record or quantification • Requires trail cameras or repeat depth logging to provide useful data	Essential for any NBS that transiently retains water – ensure each board has an identifying mark/number so trail camera images can be distinguished during data processing.
Trail Cameras	• Cheap and easy to install • Very reliable provided they are securely installed • Does not require any specialist skills or knowledge to install	• Produces large data sets that are be difficult to visualise without specialist skills/training or large time commitment to transcribe level by hand • Can be obscured by high vegetation/moved by livestock, which would cause holes in data set if not regularly checked and reset • Medium maintenance burden – batteries and memory cards need to be swapped every 5 months	Yes – however one site the cameras became obscured by vegetation during summer growth. Data processing is either very laborious (manually watching video and noting the date, time and level on board) or required specialist skills and knowledge to code up a picture processing tool.
iPhone (for 3D LIDAR models e.g. scanniverse)	• Does not require any specialist skills or knowledge to use • Relatively quick to collect model data • Produces visual output	• Better for small scale models as otherwise model is too large to easily export/send/view • Creation of point clouds to quantify differences between scans requires specialist knowledge and software • Vegetation and water surfaces can produce less accurate models • Requires more expensive iPhone 12 Pro or better	Yes – good to easily produce 3D models however large files size for large models can make exporting model difficult.
Uncrewed aerial vehicle (i.e., drone)	• Produces visual output and can quantify change	• Requires in depth training, paperwork and landowner permission	Yes – great for producing high resolution model of interventions that can be interrogated to

	• Relatively quick and easy to use • Once baseline model produced flights can be minimal, e.g. every 6 months or after a large storm event	• Prohibited to fly in populated areas, flight paths, etc. • Not a standalone piece of equipment – requires GPS, ground control points, NTRIP subscription for scaled models to be created • Creation of model from images requires specialist knowledge and software • Creation of point clouds to quantify differences between models requires specialist knowledge and software • Weather dependant – can't be flown if raining or high winds which can impact ability to monitor soon after large storm events • Survey grade UAV provides the best most consistent results but at extra cost	extract changes in roughness or elevation. However it is skill and equipment intensive and isn't required if scheme doesn't require quantification of impact.

Monitoring Recommendations/Learnings

- Ensure level boards are labelled so you can easily distinguish between sites when processing data.
- We found level board and trail cameras to be very reliable and the video outputs engaging for a wide range of viewers – the only issues to note are livestock knocking the camera or vegetation obscuring the field of view.
- Most monitoring equipment can be installed by a ranger, although some guidance or training needed to ensure the best monitoring location is selected.
- The biggest issue is data processing and handling. Most of the data collection techniques are simple but require good IT skills and/or training to turn into useful outputs.
- Long monitoring projects require a significant amount of staff time and accumulate huge data volumes. Data storage and data management can become a major overhead.