EXPLANATORY STATEMENT FOR METHOD OF ACCOUNTING FOR REDUCTION IN SEDIMENT RUN-OFF THROUGH GULLY REHABILITATION – VERSION 1.4

The Reef Credits Method of Accounting for Reduction in Sediment Run-off through Gully Rehabilitation v1.4 has been developed to support a market in sediment abatement. The Method is designed to achieve improvements in water quality, i.e. a reduction in fine sediment pollution, through the rehabilitation of gully erosion in catchments draining to the Great Barrier Reef World Heritage Area.

1 METHOD SUMMARY

Our underlying assumption is that for the Reef Credit market to function, buyers will need to have a high degree of confidence in the veracity of sediment savings. Reef Credits are created not by sediment savings, or at least not through this activity alone. Rather, Reef Credits are created when it can be proved beyond reasonable doubt that sediment savings have been accrued. As such this method is focussed principally on setting out the data requirements for proving sediment abatement, rather than specific intervention approaches.

1.1 APPROACH

The two basic steps required to demonstrate abatement are the analysis of the historical trend in erosion, and the monitoring of actual erosion after intervention. The difference between the extrapolation of the historical trend in erosion, and the observed erosion, is the abatement (Figure 1).

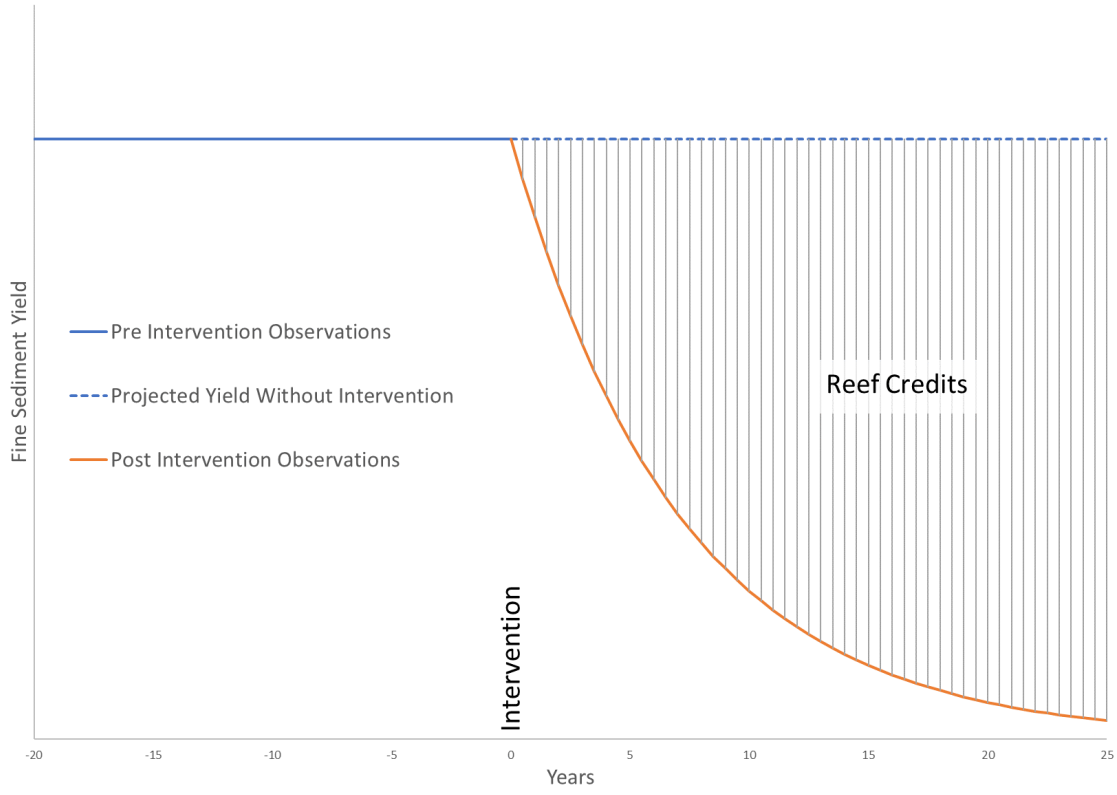

Figure 1 Schematic representing generation of Reef Credits through demonstrated decline in fine sediment yield.

Establishing an historical trend is to be achieved through analysis of historical air photos extending back 20 to 50 years, combined with modern day topographic surveys and soil analysis (see Stout et al., 2019 as an example). In most cases the historical trend will be represented simply as the average of the last 20 years. In exceptional circumstances it may be appropriate to extrapolate from a non-linear trend, established over at least 40 years. Monitoring erosion after intervention is to be achieved by intermittent water quality monitoring (at the gully outlet) and repeat topographic survey throughout the 25 years following intervention. Neither water quality monitoring nor topographic survey are free from difficulty or uncertainty, hence these two separate approaches are used to provide two independent lines of evidence for post-intervention sediment yield, which, when combined, will provide the best available measure of actual erosion (see Brooks et al., 2020 for an example of the multiple lines of evidence approach).

1.2 CONSTRAINTS

Whilst there are many interventions available to reduce gully erosion, relatively few approaches lend themselves to cost effective measurement of impact. The likely corollary of needing to have confidence in the reported sediment yield abatement numbers (in order to have a saleable product) is that considerable expenditure will be required for gathering evidence of sediment savings. Collecting and analysing the necessary historical data and establishing and maintaining monitoring equipment over 25-year crediting period will require significant monetary investment. This will likely limit the approach outlined here to ventures large enough to substantiate this expense. However, it is worthwhile noting that the costs of data collection are expected to decline as monitoring technologies evolve.

The need to establish an historical trend with some degree of confidence further constrains the use of this approach to well-established gullies. This is not to imply that efforts to address incipient gullying are not valuable in themselves as a means to address the overall sediment load to the Great Barrier Reef, just that such efforts may be difficult to implement under a results driven market-based mechanism. Clearly the impact of an intervention can only be appreciated if the pre-intervention trajectory is well-defined. Presently, year on year changes in gully sediment yield, even accounting for differences in rainfall, are simply too great to allow confident prediction based on a limited observation time. In this Method a minimum 20-year observation period has been selected. This time period is somewhat of a compromise. It is intended to be long enough to support the calculation of an average, but not so long that it includes data from a time when the gully was expanding at a rate very different from the present. If proponents wish to calculate a projected yield based on a non-linear trend rather than simply using an average (for example, if the rate of growth is increasing such that a simple average would under-estimate that like to occur going forward) than more stringent data requirements must to be met (Figure 2).

1.3 COMMENTS ON LIDAR USEAGE IN MONITORING

At sites where rock-capping and mulching is applied to the gully surfaces, it is recognised that the LiDAR-based topographic survey does not represent the bare ground condition, and over the first few years after treatment will not provide an accurate picture of erosion rates on its own. Indeed, settling and decomposition of applied mulch may provide a false indication of erosion at the site. These surveys are more valuable for longer term monitoring, to provide additional evidence that the site remains stable over timeframes of > 5 years. It is also acknowledged that as grass cover increases there will also be difficulties in using these data to determine fine resolution changes. *In situ* water quality monitoring data from the gully outlet will be required over timeframes of < 5 years.

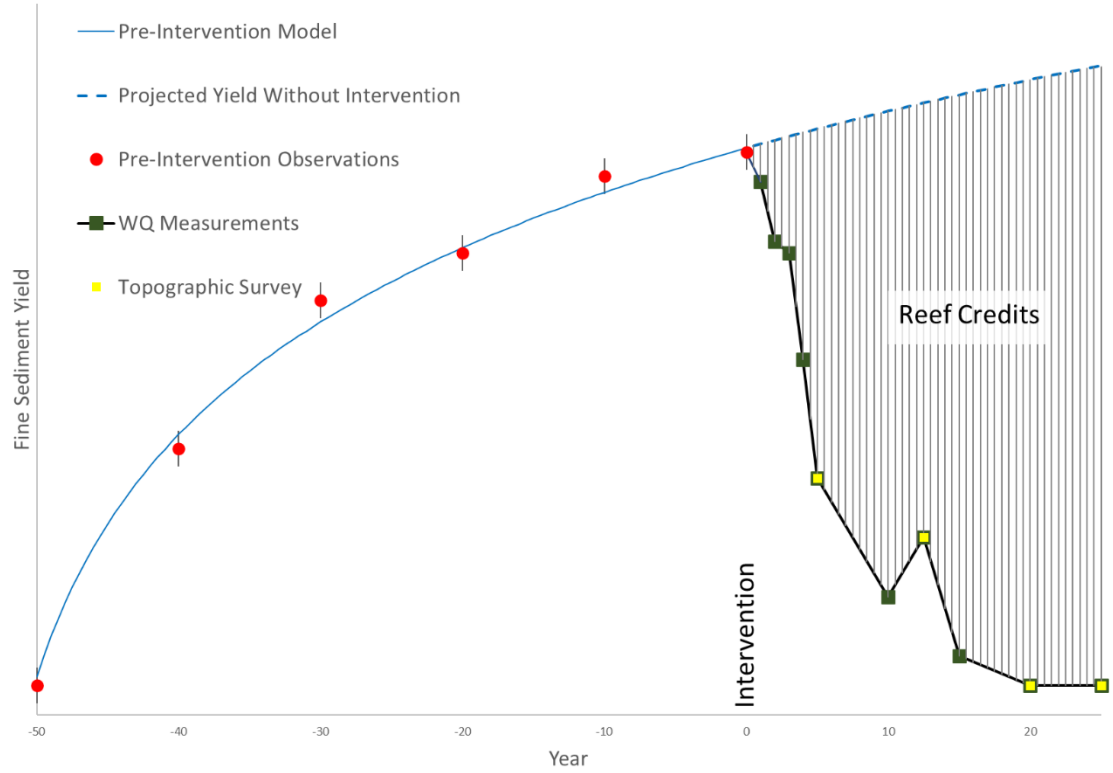

Figure 2 Quasi-realistic model representing generation of Reef Credits. Note non-linear pre-intervention model requires data extending back more than the standard 20 years. Furthermore the collected data (red circles) should be able to be described by a fitted curve (solid blue line) having a high correlation coefficient. With these two pre-conditions met, proponents are able to use a non-stationary projected yield (dashed blue line), which results in an increase in the calculated reef credits above that which would result from just using the average of the last 20 years prior to intervention. Post intervention observations are of two types, namely water quality measurements (green squares) and topographic survey based measurements (yellow squares) which occur at different intervals. Water quality measurements will be more frequent early on, as topographic survey based approaches will be in error over the shorter term due to post engineering settling, mulch decay and grass growth. Over the longer term the uncertainty introduced by these effects is considered to be small, relative to measurement uncertainties inherent to water quality monitoring approaches, hence topographic survey will yield the better results over the latter part of the crediting period. The frequency of water quality monitoring can therefore be substantially reduced as the project progresses, such that occasional collection serves simply to provide supporting evidence for the topographic survey based estimates of fine sediment yield.

2 FUTURE DEVELOPMENTS: BIOAVAILABLE PARTICULATE NUTRIENTS

Gully erosion also contributes significant bioavailable particulate nutrient (BPN) loads to the GBRWHA, but at present the nutrient contributions from gully erosion are not included in this Method. This is because the science underpinning the relationships between fine sediment production and transport and the associated nutrient transformations as they are delivered to the GBRWHA is not yet sufficiently established. It is anticipated that this will be included in subsequent versions of the Method. Once the science explaining the relationship between specific soil types and BPNs is more established it may be possible to retrospectively apply for BPN-related Reef Credits for projects initiated within the Reef Credit beta phase (as defined in the Reef Credits Standard), albeit that we are unable to anticipate at this stage the analytical burden required to quantify BPN distribution between stores, gullies and streams.

3 REFERENCES

Brooks A. P., Spencer J., Doriean N. J. C., Thwaites R., Garzon-Garcia, A., Hasan., S., Daley, J., Burton J. (2020) *Effectiveness of Alluvial Gully Remediation in Great Barrier Reef Catchments.* Report to the National Environmental Science Program. Reef and Rainforest Research Centre Limited, Cairns. (211 pp).

Stout, J.C., Curwen, G., and Brooks, A. (2019). Preliminary Assessment of gully systems on Glen Bowen Station. Report to the Land Holders Driving Change Project, *Precision Erosion & Sediment Management Research Group*, Griffith University, Gold Coast. 36 pp.