Protecting nature on private land using revolving funds: Assessing property suitability

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Hardy, M., Bekessy, S., Fitzsimons, J., Mata, L., Cook, C., Nankivell, A., Smillie, K., & Gordon, A. (2018).
Protecting nature on private land using revolving funds: Assessing property suitability. *Biological
Conservation*, 220, 84–93. <https://doi.org/10.1016/j.biocon.2018.01.026>
Document Version: Accepted Manuscript

Published Version: <https://doi.org/10.1016/j.biocon.2018.01.026>

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Citation:

Hardy, M, Bekessy, S, Fitzsimons, J, Mata, L, Cook, C, Nankivell, A, Smillie, K and Gordon, A 2018, 'Protecting nature on private land using revolving funds: Assessing property suitability', *Biological Conservation*, vol. 220, pp. 84-93.

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Version: Accepted Manuscript

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Link to Published Version:

<https://dx.doi.org/10.1016/j.biocon.2018.01.026>

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1 Protecting nature on private land using revolving funds: 2 Assessing property suitability

3 **Abstract**

4 Protecting biodiversity on private land is an important and growing part of global conservation efforts.
5 Revolving funds are used by conservation organisations to buy, on-sell and permanently protect private
6 land with important ecological values. By reinvesting proceeds from sales in additional properties, revolving
7 funds offer a potentially cost-effective way to protect biodiversity. Their success requires managers to
8 choose properties that can be on-sold and recover costs, with resale outcomes having consequences for
9 subsequent acquisitions. However, revolving fund property selection is a multi-dimensional decision,
10 influenced by various ecological, social and financial considerations. In conjunction with revolving fund
11 managers, we developed a Bayesian Belief Network (BBN) to understand which factors they consider to be
12 the most influential on a property's suitability for acquisition, and how much to pay for it. Sensitivity
13 analysis revealed that managers perceive property suitability to be heavily influenced by the threat to the
14 property's ecological values, the acquisition and ongoing management costs, and finding alternative
15 options for protection. Amenity values were seen to heavily influence property resale. Threat and
16 alternative options influence how much to pay, but most influential was the balance of the fund when the
17 purchasing decision is made. Our results suggest managers are taking a low risk approach to property
18 selection. Opportunities may exist to apply revolving funds to higher risk properties otherwise difficult to
19 conserve, provided the need for resale is still met. Ensuring revolving funds target properties with suitable
20 attributes could increase the contribution of this tool to conserving biodiversity on private land.

21 Keywords: conservation buyer, covenant, easement, acquisition, private land, property selection, privately
22 protected areas

Graphical abstract

1 Introduction

Protecting biodiversity on private land is an important and growing part of global conservation efforts. A number of policy approaches exist to permanently protect private land, some of which can be classified as Privately Protected Areas (PPAs) (Stolton et al., 2014). The dominant approaches currently used include acquisition (whereby private land is acquired and managed for biodiversity by a conservation organisation), and voluntary protection agreements that legally bind landowners to manage their land for biodiversity – such as conservation covenants or easements (Kamal et al., 2015).

In some countries, conservation organisations use ‘revolving funds’ to acquire private land with high conservation value and then on-sell it to new owners, in the process adding an in-perpetuity conservation covenant or easement (Brewer, 2003; Fitzsimons, 2015). The agreement permanently restricts activities harmful to biodiversity, while any proceeds from the sale are re-invested to acquire and protect additional properties, continuing the cycle of protection (Cowell and Williams, 2006). A conceptually simple model, revolving funds provide a potentially cost-effective way to achieve permanent protection by recouping costs through resale. They can be used to intervene in the property market to protect ecological values at a time when properties are under threat of development (Armsworth and Sanchirico, 2008), and are presumably at their most effective when turning over properties with conservation value quickly and maintaining fund capital. The revolving fund approach is similar to acquiring land with conservation value and transferring it to government ownership (‘pre-acquisition’), except the new landowner is typically a private party (Brewer, 2003). Revolving funds currently operate in Australia, Canada, Chile and the USA, with a combined capital pool of at least US\$384m, which to date has protected over 684 000 hectares (Hardy et al., in review).

A mix of approaches (e.g. acquisition, permanent agreements, non-binding agreements) is thought to be an effective way to implement conservation on private land (Doremus, 2003). Part of ensuring the efficient implementation of the mix involves identifying the situations and properties to which these approaches are best suited. Because of their capacity for continuing reinvestment, revolving funds have a unique and potentially important role in private land conservation, including the protection of land that may not be available via other approaches. Yet decision-making regarding property purchase is highly complex. A first step to helping with more strategic selection of revolving fund properties and increasing their contribution to private land conservation is understanding how decisions are currently made.

1.1 Revolving fund property selection

A series of interviews with revolving fund practitioners in Australia revealed a range of influences on property selection, foremost amongst these being the ability to re-sell acquired properties to new owners (Hardy et al., 2017). This work revealed that each potential property has multiple attributes that could affect its suitability for acquisition, with decision variables including: conservation values (e.g. threatened

species or ecological communities, landscape connectivity); financial values (e.g. purchase price, sale price, likely time to re-sell); and social values (e.g. amenity values such as a house site, visual attractiveness). However, the process of evaluating these attributes can be resource-intensive for conservation organisations, and in general, the relative importance of these attributes, and how they interact to impact on suitability for revolving funds has received little research attention.

Beyond suitability, revolving fund managers face a second multi-dimensional decision over how much to pay for any given property. Acquiring conservation properties can require large capital investments, leading to difficult decisions amidst fluctuations in the property market (McDonald-Madden et al., 2008). Revolving fund programs would benefit considerably from purchasing at or below market value, but the willingness of landholders to sell can vary (Winter et al., 2005). Beyond purchase, managers need to consider the money likely to be returned to the fund upon resale (“resale price”), accounting for any change in land value that might result from adding a permanent conservation easement or covenant, which can vary considerably between properties (Anderson and Weinhold, 2008). There is uncertainty over the time it will take to on-sell the property (“resale time”) (Armsworth and Sanchirico, 2008), where long resale times can tie up capital and impact future purchases. Also relevant are the management costs whilst the property is in the organisation’s possession (Hunter and Kohring, 2009), and the costs of providing ongoing stewardship support for landholders after resale (Adams et al., 2012). Finally, acquisition decisions often have to be made rapidly when properties appear on the open market (Fitzsimons and Looker, 2012).

Probabilistic reasoning approaches to decision-making, such as Bayesian Belief Networks (BBNs), can be useful for these complex, uncertain problems. BBNs provide a structured way to integrate limited and disparate information sources, including both quantitative and qualitative information, and are useful for modelling systems characterised by inherent uncertainty (Aalders, 2008). They have been used to understand a range of conservation issues (see Aguilera et al., 2011), including the identification of suitable areas for conservation and development to avoid conflict (McCloskey et al., 2011), landholder participation in conservation (Torabi et al., 2016) and guiding reserve system acquisitions (Schapaugh and Tyre, 2012). Here we apply the BBN approach to assessing the suitability of properties for revolving fund purchase, based on current decision-making.

1.2 Revolving fund property selection in Australia

In Australia, there are five major revolving fund programs of various sizes operated by land trusts (Table 1), with the broadly similar purpose of increasing the amount of private land protected by conservation covenants. They operate in similar ways: identifying, assessing and purchasing private freehold land in rural landscapes with high conservation value, before then on-selling it with the condition that the new owners enter into an in-perpetuity conservation covenant. The programs typically focus on lifestyle properties and in some programs, agricultural properties with conservation values. Before purchase, staff assess a

property's suitability, negotiate a purchase price, and then make a recommendation to a board or governing committee who make the final purchasing decision. Often properties initially identified are not purchased, either because they are found unsuitable (ecologically or financially), or because they are sold before negotiations are finalised. Collectively, these programs have protected 164 properties covering almost 150 000 hectares (Table 1). The similarity in operations between these programs, the number of properties revolved and area protected, as well as the breadth of operations, provides an opportunity to draw on the collective expertise of managers and gain insights into what makes a property suitable for the revolving fund approach.

Table 1. Key statistics for the major revolving fund programs currently operating in Australia*.

Organisation	Australian State	Years operating	Total fund size (AUD approx.)	Properties "revolved"	Area protected (hectares)
Nature Conservation Trust of NSW	New South Wales	15	\$10m	34	23,424
Queensland Trust for Nature	Queensland	13	\$7m	17	104,000
Nature Foundation SA	South Australia	15	\$1.4m	28	12,242
Tasmanian Land Conservancy	Tasmania	13	\$6.5m	28	2,928
Trust for Nature (Victoria)	Victoria	28	\$4m	57	6,852
		Total	\$28.9m	164	149,446

* As of June 2017

Using the experience of revolving fund managers in Australia, we built a probabilistic reasoning model (a Bayesian Belief Network) to integrate and systematically explore the factors relevant to revolving fund property selection. From this model based on managers' reasoning we sought to answer: i) how do decision factors interact to affect the suitability of a property for purchase?; ii) which factors do managers consider to be most influential on property suitability?; and iii) which factors are most influential on how much managers are willing to pay for a given property? Understanding how decision-making happens can facilitate critical analysis of the strategies that are used, and furthermore generates an opportunity to explore current approaches with the view to increasing the efficacy of revolving fund programs.

2 Material and methods

2.1 Bayesian Belief Networks

A BBN is a directed acyclic graphical representation of a system that can be used to examine a network of interactions between different variables (Chen and Pollino, 2012). BBNs consist of parent and child nodes that represent important variables in a system, with related nodes connected by links (Aalders, 2008; Korb and Nicholson, 2011). Each node has a set of 'states', representing categories of values within the variable.

117 The interaction between nodes is defined using Conditional Probability Tables (CPTs), which are set for
118 each child node and define how the child node responds to changes in probabilities of the parent node/s
119 states. Once the BBN has been defined, users can enter quantitative or qualitative information ('evidence')
120 into the parent nodes, then assess how that evidence changes the probability distribution of the child
121 node/s of interest. To provide greater clarity over the network structure in this study, hereafter we refer to
122 'input' nodes as those earliest in the chain, 'intermediate' nodes as those internal to the network, and
123 'decision' nodes as those at the final point in the chain capturing summary information from the network
124 relevant to decision-making.

125 **2.2 Conceptual model**

126 We built an initial conceptual BBN model (Chen and Pollino, 2012) of the revolving fund property selection
127 decision in Netica (Norsys 1992-2014) based on an influence diagram developed from interviews with
128 revolving fund managers (Hardy et al., 2017). This conceptual BBN model contained the main factors that
129 managers had identified in those interviews as being influential in property suitability.

130 **2.3 Revising, parameterising and assessing the model**

131 We held a one-day workshop in July 2015 with practitioners from the five major revolving fund programs
132 currently operating in Australia. The practitioners were selected due to their experience and knowledge of
133 revolving fund operations, and had previously participated in semi-structured interviews about revolving
134 fund property selection (Hardy et al., 2017). Whilst practitioners from each major Australian program were
135 invited, only three were able to attend.

136 The context for the workshop was a common revolving fund property assessment problem. Practitioners
137 were asked to assume they had a list of potential properties that had already been through initial checks
138 (e.g. size, price, location) and were considered to be worth protecting (i.e. met covenanting criteria). The
139 workshop was aimed at eliciting how managers combine all relevant information to make two primary
140 decisions: 1) whether or not to recommend a property for purchase, and 2) how much to pay for it.
141 Participants were shown the initial conceptual BBN model and invited to discuss its components and
142 structure as a group. They were then asked to draw on their collective experience to refine the nodes, links
143 and structure of the network to make a generalised model, including the addition or removal of factors.
144 During the process, some intermediate nodes were added to assist with the conceptualisation of the
145 decision and the elicitation of the CPTs. Following the guidance of Marcot (2006), we kept the number of
146 parent nodes for any single child node to three or less, and the number of node states and model layers to
147 five or less. Once the model structure was finalised, for each node participants identified the node state
148 categories (all having three, e.g. low, medium and high) and relevant values (e.g. presence of threatened
149 species or ecological communities).

150 We then elicited the values of the CPTs for the intermediate and decision nodes from participants. For each
151 of these nodes, each participant was handed a worksheet containing an empty CPT to fill in individually,
152 resulting in three independently parameterised BBNs with identical node structures ('final workshop
153 BBNs'). Following this, we conducted a live preliminary interrogation of the BBN to explore how the
154 'Property suitability' and 'How much to pay' nodes were affected by selecting different property attributes,
155 checking that the model produced results representing the participants' beliefs.

156 Following the workshop, we migrated the BBN into the R statistical environment v3.0.2 (R Core Team,
157 2016), using the gRain (Højsgaard, 2012) and gRbase (Dethlefsen and Højsgaard, 2005) packages. We
158 created a single consensus BBN model using the structure from the final workshop BBNs, and populated its
159 CPTs using the mean of the CPT values elicited from each participant during the workshop.

160 **2.4 Sensitivity analysis**

161 We undertook a global sensitivity analysis of the consensus BBN, to assess the relative influence of each of
162 the model factors on the 'Property suitability' and 'How much to pay' nodes. We randomly allocated
163 probability values to the states of each input node in the BBN (for details see Supplementary Materials) and
164 recorded the resulting probability values for each of the intermediate and decision nodes. We then
165 compared the randomised network results to those of the neutral network (i.e. that with equal probability
166 values for all input node states). The comparison was done by calculating the distances between the high
167 and low values for all nodes, where:

$$168 \quad \text{Distance} = \sqrt{(H_b - H_g)^2 + (M_b - M_g)^2 + (L_b - L_g)^2}$$

169 and H is the value of the 'high' state in the node, M is the value of the 'medium' state in the node and L is
170 the value of the 'low' state in the node. The subscript b represents the value in the neutral network, and
171 the subscript g represents the sampled values in each realisation of the global sensitivity analysis.

172 We ran the sensitivity analysis 10 000 times, in each run recording the distance values for all nodes, and
173 afterwards standardised the distance values across all model runs. Setting each of the intermediate and
174 decision node distances in turn as the dependent variable, and all input node distances as independent
175 variables, we then fitted linear regressions to each of the dependent variables using the same set of
176 independent variables. The resulting coefficient values were then used as an indicator of the relative
177 influence (or 'sensitivity') of each input node on the intermediate and decision nodes, with greater values
178 of the regression coefficient indicating a greater influence.

179 **2.5 Scenario evaluation**

180 Following the sensitivity analysis, we used a range of four predefined property types as scenarios to explore
181 the interaction between conservation and property resale. The property types were defined by varying the

182 conservation and resale characteristics to create best and worst-case property scenarios, as well as mixed
183 cases of low conservation values and high resale prospects, and high conservation values and low resale
184 prospects. The input node states used for each scenario are provided as Supplementary Material (Table
185 A1).

186 **3 Results**

187 **3.1 The consensus Bayesian Belief Network**

188 The consensus BBN model is composed of 16 nodes, nine of which are input nodes, five are intermediate
189 nodes, and two are decision nodes (Figure 1). The node names, types, states and descriptions are provided
190 in Table 2. Managers linked property suitability directly to its conservation value, its financial impact on the
191 fund, and the likelihood of protecting it through other (non-revolving fund) approaches. A property's
192 conservation value was derived from its on-site ecological values (e.g. presence of threatened species
193 and/or communities), landscape values (e.g. connectivity and additions to the protected area network), and
194 the threat to the persistence of these ecological values (e.g. from residential/agricultural/commercial
195 development). A property's financial value to the fund was determined by its ability to be on-sold, here
196 represented by its expected resale time and resale price, as well as the anticipated costs of acquisition and
197 ongoing management (e.g. maintenance). Resale time and price were linked to the property's
198 marketability, itself consisting of the site's amenity values (e.g. the availability of utilities, a house site,
199 aesthetic appeal), community context values (e.g. proximity to local town, schools) and market conditions
200 (e.g. increasing or decreasing activity in the local real estate market). The question of how much to pay was
201 linked directly to the suitability of a property, but also to the amount of money currently available in the
202 fund (account balance).

Figure 1. The consensus BBN model of revolving fund property selection. Green boxes represent conservation factors, yellow boxes social factors, blue boxes financial factors, orange box represents other options for purchase, and purple boxes represent the suitability and how much to pay decisions. CAR = enhancing the comprehensiveness, adequacy or representativeness of the reserve system. All input nodes have been set to their neutral settings.

Node	Type	Description	BBN states	State description
Site ecological value	Input	A measure of the ecological values present on the site, represented by: the presence of threatened species or ecological communities	Low	No presence of threatened species or communities
			Medium	Presence of either threatened species or communities
			High	Presence of both threatened species and communities
Landscape value	Input	A measure of the property's landscape conservation values, represented by: the property's contribution to enhancing the comprehensiveness, adequacy, or representativeness (CAR) of the protected area network, or its broader landscape context values (e.g. connectivity, buffering of protected areas etc.)	Low	Neither CAR criteria nor landscape context values
			Medium	Meets CAR criteria or landscape context values
			High	Meets both CAR criteria and landscape context values
Ecological threat	Input	An estimate of the threat the property is under (e.g. from residential, agricultural or commercial development, land use change)	Low	Less than 30% chance that the property's ecological values will be lost
			Average	30-70% chance that the property's ecological values will be lost
			High	Greater than 70% chance that the property's ecological values will be lost
Conservation value	Intermediate	An aggregate node, providing an overall estimate of the property's conservation value	Low	Property has low conservation value
			Medium	Property has medium conservation value
			High	Property has high conservation value
Acquisition and ongoing costs	Input	An estimate of the costs of purchasing the property and its ongoing management for the conservation organisation, relative to other revolving fund properties	Low	Costs are less than 80% of average
			Average	Costs are 80-120% of average
			High	Costs are greater than 120% of average
Expected resale time	Intermediate	An estimate of the time it will take to on-sell the property	Short	Less than 12 months
			Average	12-24 months
			Long	Longer than 24 months
Expected	Intermediate	An estimate of the price at	Low	Less than 90% of purchase costs

resale price	date	which the property will be on-sold to new owners	Average	90-110% of purchase costs
			High	Greater than 110% of purchase costs
Financial value	Intermediate	An aggregate node, providing an estimate of the property's return on investment – combining the expected resale price and time (resale value) and the acquisition and ongoing costs	Loss	Less than -15% return on investment
			Neutral	-15-15% return on investment
			Profit	Greater than 15% return on investment
Marketability	Intermediate	An estimate of the property's marketability/appeal to the conservation property market	Low	Property has low marketability
			Medium	Property has medium marketability
			High	Property has high marketability
Market conditions	Input	An estimate of how the local real estate market is currently trending (demand, property prices etc.)	Decreasing	Property market is trending down
			Stable	Property market is stable
			Increasing	Property market is trending up
Site amenity value	Input	A measure of the property's amenity values, represented by: the presence of utilities (power, water) and house site, road access, and aesthetic appeal	Low	One or less of utilities, access or aesthetics
			Medium	Any two of utilities, access or aesthetics
			High	All three of utilities, access or aesthetics
Community context value	Input	A measure of the community context values beyond the property, represented by: the property's proximity to town, conservation-minded social context of the surrounding community, and proximity to lifestyle activities (e.g. recreation, eateries, wineries)	Low	One or less of community context criteria
			Medium	Two of community context criteria
			High	All three community context criteria
Options for protection	Input	An estimate of the likelihood that the property will be protected through non-revolving fund means	Low	Less than 10% chance of other options
			Medium	10-50% chance of other options
			High	Greater than 50% chance of other options
Account balance	Input	The amount of funds currently available for purchasing properties	Low	Less than 33% total funds remaining
			Medium	33-66% of total funds remaining
			High	Greater than 66% of funds remaining

Suitability	Decision	Decision node showing the property's suitability for revolving fund purchase	Low	Property is of low suitability for revolving fund purchase
			Medium	Property is of medium suitability for revolving fund purchase
			High	Property is highly suitable for revolving fund purchase
How much to pay?	Decision	Decision node providing an estimate of how much managers would be prepared to pay for the property, as it relates to the property's market value	Below market value	Less than 90% of market value
			Market value	90 to 100% of market value
			Above market value	Greater than 100% of market value

208 3.2 Sensitivity analysis results

209 The results of the global sensitivity analysis for the decision nodes are shown in Figure 3. The x-axis shows
210 the value of the coefficient estimates associated with the regression undertaken as part of the sensitivity
211 analysis (see methods). Larger values indicate nodes with greater influence.

212 Looking at input nodes only, for suitability (Figure 3a) the three nodes with the greatest influence were
213 ecological threat, options for protection, and acquisition and ongoing costs, respectively. In general, the
214 results showed a diminishing influence of nodes with distance from the decision node, therefore the nodes
215 in Figures 3a and 3b are grouped together by their distance from the decision nodes (e.g. two layers back,
216 three layers back) to facilitate comparison of sensitivity at equal distances. Restricting to just the nodes two
217 layers away from suitability, ecological threat had by far the greatest influence, double that of acquisition
218 and ongoing costs, and more than three times that of landscape value.

219 The top three input nodes influencing the how much to pay node (Figure 3b) were account balance (with by
220 far the greatest influence, more than all other nodes combined, but it is also the closest input node),
221 followed by ecological threat (three layers back) and other options for protection (two layers back).
222 Restricting to nodes three layers away, ecological threat had twice the influence of landscape value, and 3.5
223 times the influence of acquisition and ongoing costs.

Figure 2. Barplots of the sensitivity analysis for a) suitability node and b) how much to pay node. Bars show the coefficient estimates from the linear regression, for input nodes above the decision nodes. Larger bars indicate greater influence, and error bars show standard errors on the coefficient estimates. Dashed lines separate nodes at different layers, and grey numbers indicate the number of layers away the input node is from the decision node. Nodes at 3 layers (a) and 4 layers (b) above are not shown because they are intermediate nodes.

224 For the intermediate conservation value node, ecological threat was by far the most influential input node,
 225 almost 2.5 times the influence of landscape and site ecological values combined (Figure 4a). Site ecological
 226 values had by far the smallest relative influence on conservation value. For financial value (Figure 4b), the
 227 acquisition and ongoing costs node had by far the greatest influence, more than three times that of the

228 next largest influence (site amenity value), although the acquisition and ongoing costs node is only one
 229 layer away. The influence of market conditions and community context value was less than a fifth of that
 230 from site amenity values.

231 The ability to re-sell the property is central to property selection. For resale time and resale price, looking at
 232 the input nodes two layers away (Figure 4c and 4d), site amenity was by far the most influential for both of
 233 these nodes, more than 4.5 times the influence of market conditions and community context value
 234 combined.

235 **Figure 3. Barplots of the sensitivity analysis for the a) conservation value node, b) financial value node, c) resale time node and**
 236 **e) resale price node.** Bars show the co-efficient estimates from the linear regression. Larger bars indicate greater influence, and
 237 error bars show standard errors. The dashed line separates nodes at different layers, with grey numbers indicating the number of
 238 layers away from the financial value node. Nodes at 2 layers (b) and 1 layer (c and d) above are not shown because they are
 239 intermediate nodes.

240 3.3 Scenario evaluation results

241 The scenario evaluation (Table 3) showed that the most suitable property, according to managers' beliefs,
 242 had high conservation values and high resale prospects ('Best-case'), whereas that least suitable had low
 243 conservation values and low resale prospects ('Worst-case'). The suitability of a property with low
 244 conservation value and high resale prospects ('Mixed-case 2') was not far behind the Worst-case, with a
 245 high likelihood of low suitability. A property with high conservation value, but low resale prospects ('Mixed-
 246 case 1'), showed a high likelihood of low to medium suitability.

247 Across all property types the scenario evaluation showed that managers would most likely pay at or below
 248 market value, though if the properties are of high suitability ('Best-case' and 'Mixed-case 1') there is a small
 249 likelihood that managers might consider paying above market value. Properties with low suitability ('Worst-
 250 case' and 'Mixed-case 2') would unlikely be pursued, and correspondingly showed no likelihood of
 251 managers paying above market value.

252 **Table 3. Scenario evaluation of the expected suitability for potential revolving fund properties, and how much to pay for them,**
253 **using the consensus BBN.** The probabilities of the decision nodes being in each of the three states given for each scenario.

Property scenario	Probability of suitability			Probability of how much to pay		
	Low	Medium	High	Below market value	At market value	Above market value
Best-case (high conservation value, high resale prospects)	8.8	19.8	71.4	36.5	53.5	9.98
Worst-case (low conservation value, low resale prospects)	99.5	0.4	0.13	99.9	0.1	0
Mixed-case 1 (high conservation value, low resale prospects)	56.4	32.3	11.3	64.7	31.3	4.01
Mixed-case 2 (low conservation value, high resale prospects)	86.2	9.74	4.03	97.2	2.81	0

254 **4 Discussion**

255 Choosing appropriate properties is central to the ongoing efficacy of revolving funds, and amongst the
256 many properties available that managers can purchase, only some are suitable. The suitability of a property
257 is made up of multiple factors, including ecological and financial characteristics. Using the experience of
258 practitioners, we developed a probabilistic reasoning model to systematically step through the revolving
259 fund property selection problem and identify the factors they believe to be the most influential on property
260 suitability. The model suggests that broadly, managers consider suitable properties to be those with high
261 conservation value and: i) where the resale price is likely to be similar to the purchase, management and
262 transaction costs associated with revolving the property; ii) under high threat and a low likelihood of being
263 protected through other means; and iii) with a high likelihood of resale (particularly in areas of high
264 amenity value). The model also provides a structured and transparent way to examine trade-offs between
265 these factors. With a focus on improving the operation of revolving funds, we use the findings of the model
266 to: i) discuss current decision-making around property suitability, ii) explore the potential limitations of
267 current thinking, and iii) develop guidance for revolving fund programs to assist in property selection.

268 **4.1 Current decision-making**

269 The model showed the clear importance to managers of the financial impact that each property transaction
270 will likely have on the fund. This is evidenced through the influence of costs, account balance and resale
271 factors, relating to decisions on both property suitability and how much to pay (Figure 2; Table 3).
272 Managers were particularly focussed on properties with low acquisition and ongoing management costs,

including those incurred whilst the property is held by the organisation, and the costs of providing support to the landowner once on-sold. Given the common objective for these programs of ongoing fund sustainability, and their ability to continue purchasing additional land being driven by the cumulative financial impact of individual purchases, the focus on low cost properties is unsurprising. Whilst cost is also important for other types of conservation acquisition decisions (e.g. Adams et al., 2012; Carwardine et al., 2008), for revolving fund managers the focus is largely on the financial impact after resale, specifically how much of the costs incurred are covered by the resale price. In many cases this would be very difficult to predict before purchase, and the uncertainty likely leads managers to select properties with low investment risk; highlighting a bias towards properties with a high likelihood of recouping costs. Whilst providing greater certainty over fund sustainability, this likely limits the pool of properties to choose from, for example those that can be purchased at or below market value, where the impact of a restrictive covenant on resale price will be low, and in regions with stable or increasing property prices.

On the ecological side, the model highlights the importance managers place on protecting properties under threat (Figure 3a). Properties under threat (e.g. from commercial, residential or agricultural development) with a low likelihood of being protected through other means were considered to be of higher suitability, and the scenario evaluation suggested managers may consider paying more for these properties (Table 3). For the programs involved in this study, properties need to hold high conservation value in order to meet the required protection standards of a conservation covenant (and thus be considered for purchase), predominantly relating to the existence of high quality remnant ecological values. The managers' emphasis on threat suggests they are using revolving funds to intervene in the property market and protect properties at risk of losing their ecological values, a risk that can be higher under a new owner (Whelan, 1997). Threat would also provide a way for managers to prioritise amongst the multiple properties available for purchase at any one time. The focus on threat and remnant ecological values also explains why managers might perceive a property to be of higher suitability if it is unlikely to be protected through other means (Figure 2), such as voluntary permanent protection agreements (e.g. covenants), direct acquisition and holding (Parker, 2004), or pre-acquisition and transfer to government (Hunter and Kohring, 2009).

The model also shows the likelihood of a property being on-sold as a dominant focus for managers when determining suitability (represented in the model as resale time and resale price; Figure 1). The focus on resale is to be expected given that the conservation gains made by revolving funds are driven in large part by property turnover. Site amenity was shown in the sensitivity analysis as the primary influence on resale (Figure 3c and d), which managers had linked to three specific property attributes: utilities, road access and aesthetics. These attributes highlight the importance managers place on the social dimension of revolving fund properties, and aligns with their preference for properties with multiple values beyond conservation; for example, the potential for a dwelling and areas suitable for hobby farming (Hardy et al., 2017). Surprisingly, site amenity and community context values had less influence on overall suitability relative to

308 other decision factors (e.g. conservation value, ecological threat and financial impact; Figure 2a). This may
309 be due to the structure of the model constraining their influence (n.b. in the final workshop and consensus
310 models the social nodes were furthest from the decision nodes). Nonetheless, social factors are likely key
311 contributors to revolving fund property resale (Hardy et al., 2017), and in conjunction with the focus on
312 remnant conservation values and threat, the preference for properties with amenity values would greatly
313 limit the number of properties seen as suitable for purchase.

314 **4.2 Limitations and implications of current decision-making**

315 Whilst contributing to the ongoing sustainability of revolving funds, the emphasis on low investment risk
316 and financial impact, threat to remnant ecological values, and resale may be precluding the purchase of
317 otherwise suitable conservation properties. This includes properties with high conservation values that are
318 difficult to conserve through other means, but have the potential to diminish fund capital. For instance,
319 properties in agricultural areas provide some of the greatest opportunities for private land conservation
320 (Fischer et al., 2012), where the shift to productive land uses threatens remnant ecological values. The high
321 land values in these areas often prohibit acquisition without resale, while landholders may be less likely to
322 enter into permanent conservation agreements (Moon and Cocklin, 2011). Similarly, opportunities may
323 exist in peri-urban areas to protect priority properties at risk of development. The challenge here is that
324 properties of high vulnerability and quality (i.e. under threat) can be more expensive (Newburn et al.,
325 2005), coupled with the potential for a restrictive protection agreement to lower resale values. However,
326 even with some financial losses on individual properties, revolving funds could still provide a cost-effective
327 approach to protecting priority properties in these areas, due to their ability to resell and offset the high
328 acquisition costs – an opportunity often unavailable to other conservation approaches. This could be
329 particularly useful for agricultural properties where only a relatively small proportion of the property
330 requires protection. In peri-urban areas, high amenity values could assist resale, and conservation
331 properties may even attract price premiums from prospective buyers (Hannum et al., 2012). Whilst some
332 programs already actively consider these types of properties, it is likely that even with resale some are
333 simply too expensive (Merenlender et al., 2009). The relative efficiency of using revolving funds in these
334 areas compared to other conservation approaches needs further research.

335 The focus on resale might also mean acquisition opportunities are excluded where properties may be
336 difficult to on-sell (e.g. due to limited amenity values). With some exceptions, the dominant focus for
337 programs in this study is on properties attractive to lifestyle amenity buyers (e.g. see Cooke and Lane,
338 2015), in part because of the likely faster resale times. Yet the ability to use revolving funds proactively in
339 the real estate market (Whelan, 1997) to protect strategic conservation assets beyond lifestyle properties is
340 worth considering. There may be other markets that managers can leverage – even if extended resale times
341 are likely. For example, there may be benefit in purchasing a remote property containing an internationally
342 significant wetland important for migratory species, with low amenity values and a limited number of

343 potential buyers, but unlikely to receive protection through other means. In this case, extended resale
344 times would be likely and managers may need to dedicate considerable time and effort to find a suitable
345 buyer, maintain flexibility in the terms or timing of the sale (e.g. if a community group needs to raise the
346 funds to acquire the property), and cover management costs in the interim (Armsworth et al., 2011). There
347 would also be a major risk of tying up fund capital if a buyer cannot be found. Whilst some of this risk could
348 be reduced by assessing demand in advance of purchase (e.g. via surveys, market analysis and talking to
349 partners), the risk involved suggests that this use would only be worth considering for extremely high
350 priority properties available below market value (e.g. 'Mixed-case 1', Table 3), or by funds with large
351 amounts of capital. A large fund, relative to the cost of conservation properties, would provide flexibility to
352 acquire this type of property whilst the remainder of the fund focuses on properties with faster turnover
353 (i.e. a portfolio approach), but there would be less capacity for this in small funds. This opportunity
354 notwithstanding, the need for eventual resale means that properties with a very low likelihood of resale are
355 unlikely to be suitable for revolving fund acquisition.

356 There may also be opportunities to protect properties with high conservation value but low remnant
357 ecological value. For example, a property may hold high amenity values, but be in poor ecological condition
358 and have high potential for restoration, providing an important extension to the habitat of a highly
359 threatened species. In this situation revolving funds could help deliver substantial conservation gains, but
360 managers would need to factor in the costs of restoration (Evans et al., 2015) and ongoing management –
361 to the organisation whilst the property is held, and to the new owner once the property is on-sold. The
362 need for restoration could impede resale, particularly if the property's current state means it has low
363 aesthetic values, or will require substantial time or financial investment from the new owners. Additional
364 financial and technical support may be required to increase the capacity and motivation of the new owners
365 to continue restoration activities (Selinske et al., 2015). Whilst it is unlikely that the resale price would be
366 sufficient to cover all restoration and management costs, some costs could be reduced by negotiating
367 assistance from partner organisations (e.g. restoration specialists), or wherever possible, restricting this
368 approach to properties available well below market value. The result may still be cost-effective compared
369 with other approaches, especially where partnerships can be leveraged. The extent to which revolving
370 funds can contribute to the restoration of properties with strategic conservation value remains worthy of
371 further exploration.

372 **4.3 Developing guidance for revolving fund property selection**

373 Drawing from the current thinking of managers as captured here in the BBN, and the potential
374 opportunities for conservation that revolving funds might provide, the following guidance is proposed to
375 assist managers in their search for suitable properties.

- 376 1. *Set clear strategic conservation priorities to target.* Priorities will be program-specific, but may include,
377 for example, protecting threatened species or regions under-represented in reserve systems. Programs
378 may look to prioritise properties in high-threat areas (Byrd et al., 2009), potentially using predictors of
379 habitat conversion to agricultural use (Stephens et al., 2008) and/or basic economic and demographic
380 information (Radeloff et al., 2012) to predict future development and land use patterns.
- 381 2. *Establish clear guidelines on the characteristics that make a property suitable for purchase.* These
382 would likely be a mix of characteristics, including the priority conservation values, estimates of
383 acquisition and management costs (whilst held, and once on-sold), social values (e.g. amenity and
384 community context values) and also estimates of resale factors (e.g. maximum resale time, minimum
385 resale price). The BBN approach presented in this study could be used to identify these characteristics.
386 Ideally the guidelines would be accompanied by an adaptive decision-making process, using resale
387 experience to help reduce uncertainty (see for example Johnson et al. (2007)). The guidelines should
388 also support the manager's need to turn down properties if they are not suitable.
- 389 3. *Identify regions where the supply and demand for conservation properties overlaps with conservation*
390 *priorities.* Using conservation priorities, property characteristics, and real estate market data, programs
391 could identify regions with a supply of properties suitable to revolving funds. Managers could assess
392 the willingness of landholders to sell (Knight et al., 2011), either via direct approach or surveys, which
393 may also work to reduce acquisition costs. For demand, the historic and potential buyers of revolving
394 fund properties could be surveyed to understand what motivates the purchasing decision, high quality
395 data on the local real estate market could be obtained (Armsworth and Sanchirico, 2008), and regular
396 updates about conservation properties could be sought from agents and property valuers.
- 397 4. *Establish clear guidelines to help identify how much to pay for properties, and in what circumstances to*
398 *accept a financial loss.* Based on the experience of programs in this study, often managers will aim to
399 pay at or below market value to reduce the financial risk. In some instances, however, managers may
400 need to consider re-selling at a price below costs to secure high priority properties. Setting clear criteria
401 defining the circumstances under which to accept a resale price lower than purchase price plus costs
402 would be beneficial. For example, where the loss on resale is likely more efficient than using alternative
403 conservation approaches.
- 404 5. *Develop strong partnerships with other conservation organisations.* Partner organisations could help
405 identify potential properties and buyers, and assist with ecological restoration and management. This
406 would help identify which properties revolving funds can best help conserve in landscape conservation
407 strategies alongside alternative protection mechanisms (Bode et al., 2011).

408 **5 Conclusions**

409 Revolving funds are part of a mix of approaches available in private land conservation and offer an
410 alternative to acquisition for holding (with associated ongoing management) or voluntary permanent
411 conservation agreements. The ability to re-invest proceeds from sales offers unique potential, and selecting
412 appropriate properties that can be on-sold is central to their effectiveness. We have developed a structured
413 probabilistic reasoning model of property suitability, using the experience of revolving fund managers, to
414 better understand the relative influence of the multiple decision factors and help identify which properties
415 might be most suitable. The results suggest that in their assessments of property suitability, managers show
416 preference for properties with low investment risk. This likely limits how revolving funds are currently
417 applied, and there may be other applications where revolving funds could contribute to conservation (some
418 of which are explored above) that warrant further investigation. In other contexts, the main influences on
419 suitability may differ from those here, and the BBN process provides a useful framework for identifying the
420 characteristics of suitable properties. Ensuring revolving fund acquisitions target properties with suitability
421 attributes could help programs reduce the number of properties to assess and allow more efficient
422 implementation of this tool, allowing other approaches to focus on other types of properties and
423 facilitating a more efficient and effective approach to conservation of important private land.

424 **6 Acknowledgements**

425 This research was supported by the Australian Research Council's Centre of Excellence for Environmental
426 Decisions, the Australian Government's National Environmental Science Programme – Threatened Species
427 Hub and RMIT University. SB was supported by an ARC Future Fellowship and LM by the National
428 Environmental Science Programme — Clean Air and Urban Landscapes Hub. Maria Plancarte Fexas assisted
429 with the development of Figure 1. Anna Backstrom helped facilitate the workshop where much of the data
430 for this paper was elicited. The authors would like to thank the revolving fund programs Trust for Nature
431 (Victoria), Nature Foundation SA and the Nature Conservation Trust of New South Wales for supporting this
432 research and the decision workshop, and Queensland Trust for Nature and the Tasmanian Land
433 Conservancy for prior and subsequent discussions. Ethics approval through RMIT University DSC CHEAN A
434 Project No. 0000019426-05/15.

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