Hort Innovation

Final Report

Tree Costing Tool

Project leader:

Dr Dom Blackham

Delivery partner:

Alluvium Consulting

Project code:

NY18003

Project:

Tree Costing Tool NY18003

Disclaimer:

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Level 7
141 Walker Street
North Sydney NSW 2060

Telephone: (02) 8295 2300

www.horticulture.com.au

Content

Summary

Mosaic Insights, in partnership with Natural Capital Economics and Alluvium Consulting Australia were by Hort Innovation to develop a Tree Budget Tool to provide decision-makers with realistic and defensible costs for all stages of establishing, maintaining and ultimately replacing urban trees. This simple-to-use tool is underpinned by robust economics and was designed to address the challenges in accurately estimating the life cycle costs of urban trees, which is a barrier to effective urban greening. Understanding the true life-cycle cost of trees will lead to better investment decisions, properly costed operational management, greater community confidence and ultimately a healthier urban forest. It is also an important step in ensuring that our natural capital (green assets) can be managed using frameworks and approaches typically used for built assets.

Information provided by the tool will ensure the cost of large-scale planting schemes is not underestimated, the true cost of maintenance is understood and can be factored into budget bids, and the benefits or otherwise of investing in larger or higher quality trees on the total life cycle cost can be understood. It can also be used as a defensible basis for financial compensation where an existing tree (or trees) must be cleared and a compensation liability is created. Estimating the economic benefits from urban trees was outside the scope of this project.

This project had two stages. In Stage 1 we conducted significant stakeholder engagements with relevant contacts throughout Australia and internationally to:

- Determine and define critical steps to achieve the successful establishment of a tree in the urban landscape, inclusive of tree supply, planting, maintenance and removal.
- Determine current costs to deliver the critical steps in successful tree establishment.
- Identify and review any comparable tools that are publicly available globally.

In Stage 2, we used the knowledge gained from the stakeholders to build the Tree Costing Tool, ensuring the products and insights developed best met the needs of industry. This was then tested in four stakeholder workshops in Adelaide, Melbourne, Sydney and Brisbane and in one online webinar. In these sessions participants tested the tool for real world situations and provided feedback on its functionality and ease of use. The tool was then updated and revised to its final iteration with this report. As a result of the feedback the name of the tool was changed from the original title of “Tree budget tool” to the “Tree Costing Tool”. The Tree Costing Tool is attached with instructions and is freely available to interested parties.

The Tree Costing Tool can be used by a range of practitioners including urban forest and parks staff at local governments and contractors.

Based on insights from the consultation and development of the Tree Costing Tool, four key follow-up projects were identified as propitious investment areas that will contribute to an efficient and effective use of the tool.

1) Development of an online version of the tool. This would enable continuous improvement in the data in the tool and ensure users’ were accessing the latest and best information.
2) An assessment of tree benefits for the Australian urban climate and urban environments. This should use an ecosystem services framework to ensure the broad scope of benefits can be robustly captured.
3) The research and development of a better understanding of causal relationships between tree choice and establishment and the likelihood of tree mortality.
4) Integration between the Tree Costing Tool and the Interactive Plant Features tool which is being developed within the Which Plant Where? Project.

Keywords

Urban forestry, tree, economic, costing, life cycle cost, budget, local government, price, contractor

Introduction

The nursery industry is in a unique position to directly affect the widespread planting of trees and to promote their positive impacts among the community to developers and stakeholders at all three levels of government. Hort Innovation has highlighted the nursery industry as a research and investment opportunity to position itself as the supplier of these beneficial trees to the public and private sectors.

However, as noted by the Nursery Strategic Advisory Panel, there is a lack of awareness of the true life cycle cost of planting and establishing trees in the landscape.

Developing a costing tool to accurately calculate the cost of urban trees would allow industries to effectively plan for the implementation of trees in urban landscapes. Currently there is no industry best practice tool for determining and analysing the economics of an urban tree (and more broadly, urban forests), despite them being crucial to the development of healthy, productive and liveable cities.

The foundation of this project emerged from the Nursery Strategic Investment Plan, which is a roadmap to guide investment programs into the nursery industry. The Nursery Strategic Investment Plan outcomes revolved around increasing demand and sales for nursery product, increasing marketing effectiveness around the product and improving productivity and profitability. This project addresses the desired increase in sales for nursery products by allowing council, state and federal authorities to calculate the cost of establishing urban trees. Having this capability means that they will be able to account for trees in their developing landscapes. This project also continues the Greener Spaces Better Places aims of making cities more liveable through creating more and better urban greenspace.

This project involved the understanding of the economics of the life cycle of a tree in urban areas across Australia and building an accessible tool that can be easily used by contractors, local government and state and federal authorities. It also provides a framework, tool and data to enable trees (as natural capital) to be mainstreamed into asset management in the same way as built capital.

Methodology

Stage 1

Stakeholder engagement with relevant contacts throughout Australia and internationally to:

- Determine and define critical steps to achieve the successful establishment of a tree in the urban landscape, inclusive of tree supply, planting, maintenance and removal.
- Determine current costs to deliver the critical steps in successful tree establishment.
- Identify and review any comparable tools that are publicly available globally.

The Tree Costing Tool was designed to incorporate the various factors influencing tree life cycle costs identified during the stakeholder engagement.

Engagement with 31 stakeholders across Australia and internationally was conducted with local government, landscape architects, state government, research bodies and industry leaders such as nursery owners and horticultural contractors (Table 1). Throughout March to July 2019 we sent out surveys, conducted interviews and ran workshops with stakeholders in all six Australian states. The majority of stakeholders were from capital cities, particularly along the east coast, where 80% of wholesale trees are grown. Most stakeholders were local government practitioners (planning or operational asset managers), industry leaders (such as nursery owners) and consulting arborists.

Table 1. The list of stakeholders who participated in the engagement through surveys, workshops or interviews.

Name	Institution	Segment	State/Country
Pat Bourke	Brisbane City Council	Local government	Queensland
Keith Foster	Brisbane City Council	Local government	Queensland
Vicki Grieshaber	Brisbane City Council	Local government	Queensland
Andrew Vondeling	Brisbane City Council	Local government	Queensland
Neridah Parke	Brisbane City Council	Local government	Queensland
Kristin Dangerfield	Brisbane City Council	Local government	Queensland
Tim Davies	Brisbane City Council	Local government	Queensland
Barnaby Resch	Logan City Council	Local government	Queensland
Lyndal Plant	Urban Forester Pty Ltd	Industry leaders/Research bodies	Queensland
Gwilym Griffiths	Inner West Council	Local government	New South Wales
Steve Wall	Mosman Council	Local government	New South Wales
Phillip Julian	City of Sydney	Local government	New South Wales
Karen Sweeney	City of Sydney	Local government	New South Wales
Kirsty McIntyre	Local Government NSW	Local government	New South Wales
Adrian Gray	Brimbank Council	Landscape architect	Victoria
Hasan Mustafa	Brimbank Council	Local government	Victoria
Tony Collins	Kingston Council	Local government	Victoria
Lia De Gruchy	Nillumbik Council	Local government	Victoria
Jason Summers	Hume City Council	Local government	Victoria
David Callow	City of Melbourne	Local government	Victoria
Hamish Mitchell	Speciality Trees	Industry leaders	Victoria
Leanne Gillies	Flemings Nursery	Industry leaders	Victoria
Liz Denman	Vic Roads	State government	Victoria
Ruby Wilson	City of Hobart	Local government	Tasmania
Tim Johnson	Mitcham City Council	Local government	SA
Glenn Williams	Treeenet	Industry leaders	SA
Adrian Vlok	Formerly Urban development Institute of Australia	Industry leaders	WA
Withheld	Two unnamed consulting horticultural companies	Industry leaders	Withheld
Pete Smith	Arborday	Industry leaders	USA
Nikos Thymakis	Hellenic Plant Material Exporters and Importers Association (HEPEXIA)	Industry leaders	Greece

The stakeholders were asked a series of questions about their decision-making process for urban trees:

- Context (single street tree vs planting a park)
- Amenity (why are more trees being added? Shade? Biodiversity?)
- Constraints (powerlines? Pipes and wires underground?)
- Do you use contractors?
- What are your mortality rates?
- How long are your maintenance periods?
- How do you currently cost projects?
- What are the biggest challenges physically and institutionally for implementing urban trees?
- Rank the importance of different functions for a tree costing tool
- Demographic questions

Based on the stakeholder engagement the steps in the life cycle of an urban tree were defined (see below). The different decisions made by stakeholders for these steps (e.g. one or two-years maintenance) are a large determinant in the life cycle cost of an urban tree, and highlights the costs that should be included in the Tree Costing Tool. Costs for these steps were obtained from multiple stakeholders during the tool development phase. Statistical analysis was undertaken of the received data, and an indicative ranges of input variables (physical and financial) for the Tree Costing Tool were developed using Monte Carlo simulations. Qualitative data from stakeholders also informed the tool development, and fell into three categories: tree establishment, tree survival and tree acceptance in the community. The critical steps are:

1. Tree purchase
2. Hole preparation
3. Delivery from nursery to site
4. Traffic control
5. Post-delivery site
6. Soil preparation
7. Irrigation decisions
8. Planting
9. Mulching
10. Staking
11. Maintenance
12. Weeding, nutrition, formative pruning
13. Handover
14. Ongoing maintenance – pruning for canopy density
15. Inspections
16. Replacement

More details on the three categories of steps are provided below.

Tree establishment

- Stakeholders discussed that the size of the tree is a large determinant of the cost as it affects transportation costs, installation costs and maintenance costs as smaller trees can be proactively pruned.
- The watering regime is a critical factor in the successful establishment of an urban tree where the timing is different for natives or deciduous trees.
- The watering technique including covering the whole root ball, passive irrigation through water sensitive urban design and using water trucks affects costs.
- Tree protection such as fencing and staking also require different levels of investment.

Tree survival

- Tree maintenance regimes are a large factor in tree survival with stakeholders preferring to conduct proactive maintenance. However, large portions of the urban forestry budgets are on defective tree removal and reactive maintenance.
- Tree removal is often driven by development, tree failure and actual/perceived tree risk requests.
- Tree maintenance is often conducted by third-party contractors for local government who do the tree supply, installation and maintenance.
- Powerlines are treated differently by stakeholders where some create a V-shape of the tree around the power lines, some plant shorter cultivars on the powerline side of the road and others completely avoid the side of the street with powerlines.

Tree acceptance

- Vandalism due to community discontent with trees affects tree replacement numbers and the overall costs.
- Council's often incur costs associated with tree mapping and tree inventory assessments.

Stage 2

The knowledge gained from the stakeholder engagement was then built into the economic tool to calculate the cost of an urban tree project throughout the tree's life cycle. This was then tested in four interactive workshops in Adelaide, Melbourne, Sydney and Brisbane, and in one online webinar where participants were able to test the tool for real world situations and provide feedback on its functionality and ease of use. The tool was then updated and revised to its final iteration with this report. As a result of the feedback the name of the tool was changed from the "Tree Budget Tool" to the "Tree Costing Tool".

Outputs

Outputs are the products (e.g. manuals, workshops) or knowledge (scientific or other) produced by the investment. There were several outputs from this project, and these are listed below:

The Tree Costing Tool and its user instructions can be found at the following link: https://we.tl/t-mz0s0kQZIR

1 x training workshop in Adelaide, November 14 2019, with nine attendees.

1 x training workshop in Melbourne, November 15 2019, with nine attendees.

1 x training workshop in Brisbane, November 18 2019, with five attendees.

1 x training workshop in Sydney, November 19 2019, with five attendees.

1 x training workshop webinar with participants from all states in Australia, December 11 2019, with 22 attendees

1 x Tree Costing Tool in a Microsoft Excel file.

1 x User manual.

1 x report on the stakeholder engagement research results.

1 x summary report on the user feedback after the training workshops and webinar.

1 x final project report.

Outcomes

The outcomes of this project will be fully realised once the Tree Costing Tool is publicly released and socialised to a wider audience of potential users (nurseries, planners, tree asset managers, landscape architects, developers etc.). The potential outcomes from this project include:

- Improvements in tree planting budget estimation across Australia.
- Improved understanding of the tradeoffs between tree stock choices (size, cost) and lifecycle costs.
- Enhanced business-case development processes for tree planting initiatives.
- Reduced risk of mortality attributable to underinvestment in maintenance.
- Increased understanding of the true costs of planting and managing trees in the urban landscape.
- Contribution to funding of important future projects such as linking of the Tree Costing Tool with the Interactive Futures plant features tool.
- Improved estimation of compensation payable for clearing of existing trees.
- Increased perception of the value of urban trees.
- Alignment of costing and financial decision making for natural capital with built capital. This will facilitate the mainstreaming of urban trees into asset management.

Key observations from the initial users of the Tree Costing Tool in the training workshops include:

1. An online version would be an improvement as there can be a central place to store and access the tool. The online version has potential to be more versatile while still remaining compact and simple. There are also opportunities to track users through an online subscription which could also allow further improvements to the inbuilt data. This will allow people to upload their own data and help avoid a situation where the tool and inbuilt data become obsolete.
2. The tool will be a lot more valuable if it can be progressed to include some indicative benefits of trees. This lack of credible information is a major impediment to investment.
3. More studies around mortality given various variables such as location, species, pot size, maintenance in the early and later stages, etc. would be beneficial. This is probably best addressed as a science research project.
4. A link between the costing tool, the Interactive Plant Features tool for species selection and estimation of benefits would be a great achievement and a significant benefit for the industry.

These observations have been addressed in more detail in the recommendations for future work.

Monitoring and evaluation

The outcomes of this project will be fully realised once the Tree Costing Tool is publicly released and advertised to a wider audience, hence the impact of the Tree Costing Tool project cannot be fully evaluated yet using the Key Evaluation Questions (KEQ) from the M&E Plan.

Effectiveness

KEQ: To what extent have the project's ultimate goals been achieved?

The ultimate goals (below) have not yet been achieved as the final version of the Tree Costing Tool is has not yet been approved and circulated to the urban forestry community. However, leaders in urban forestry across the six states have participated in the development of the Tree Costing Tool, which will help its future promulgation.

Ultimate goals

1. Councils and developers incorporating more green space
2. Increased liveability among the community, and
3. Community has more access to green spaces.

This project has developed a tool to enhance decision-making and investment in urban trees. To the extent that the tool facilitates this investment (it will if socialised and used), this should contribute to achieving these ultimate goals.

KEQ: To what extent have the project intermediate outcomes been achieved?

Three of the four intermediate outcomes (below) have been achieved with stakeholders having improved confidence in using the Tree Costing Tool after attending the training workshops and as a result they have an increased capacity to budget for their urban trees and an increased perception of the value of urban trees.

Intermediate outcomes

1. Improved confidence in Tool
2. Increased stakeholder capacity in budgeting for urban trees
3. Increased perception of value of urban trees
4. Increased ease of stakeholders integrating the tool in their planning procedures.

Early indications from the workshop and feedback received to date indicate these intermediate outcomes will be achieved rapidly once the tool is fully socialised and is in regular use.

Efficiency

KEQ: To what extent did program governance arrangements support the efficient delivery of the Tree Costing Tool?

The three companies of Alluvium, Natural Capital Economics and Mosaic Insights under the management of Byron de Kock supported the timeliness and cost-effectiveness of delivering the project. From the research team's perspective, project management and managerial and technical inputs from Hort Innovation staff was both effective and efficient.

Impact

KEQ: Has the Tree Costing Tool contributed to a higher perceived value of urban trees by stakeholders across Australia?

The stakeholders across Australia who participated in the training workshops now have a deeper understanding of the full lifecycle costs of urban trees. This will become more widespread as the Tree Costing Tool is publicised more after the finalisation of this project.

KEQ: What, if any, positive or negative unanticipated outcomes have resulted from the Tree Costing Tool?

The results from the Tree Costing Tool show that often the life cycle cost of urban tree projects is higher than many stakeholders thought could be a disincentive for potential projects. However, the Tool showing the significant difference in life cycle cost for different mortality rates demonstrates the advantages of early

investment in the tree stock and proactive maintenance.

Appropriateness

KEQ: Is the Tree Costing Tool an appropriate tool to facilitate the diffusion of urban green spaces in Australia?

Yes as stakeholders can now quickly and accurately cost their projects and plan their budgets appropriately for future years.

Recommendations

It is recommended that the Tree Costing Tool continues to be socialised to ensure that the tool becomes widely used and part of the workflow of practitioners to help this project achieve its ultimate goals.

Based on insights from the consultation and development of the Tree Costing Tool, four key projects were identified as propitious investment areas that will contribute to an efficient and effective use of the tool. The four future projects are recommended to help support the industry and contribute to an efficient and impactful process for selecting projects, identifying the most suitable plant species based on local climatic and urbanisation conditions, costs and associated benefits. The four projects are: (1) development of an online version of the Tree Costing Tool, (2) an assessment of tree benefits for the Australian urban climate and urban environments and (3) develop mortality functions to improve the costing tool, and (4) integration between the Tree Costing Tool and the Which Plant Where? Interactive Plant Features Tool. These projects are discussed in further detail below. Projects 1 to 3 could be undertaken concurrently, while project 4 should be undertaken at a later date once earlier projects are completed.

Projects 1 – 3 relate to enhancing the robustness and scope of the existing tree costing (expanded to include comprehensive benefits estimation functionality) tool and increasing use by industry. Project 4 would involve the integration of the biophysical modelling from the Which Plant Where? project and an enhanced Tree Costing Tool into an integrated decision support system for planning and investment into urban trees. To our knowledge, this would be a world first.

1. Development of an online version of the tool

Description

During the stakeholder consultation process, it was suggested multiple times that an online or web-based version of the Tree Costing Tool should be considered. The online version will provide a common point of access for the tool to ensure that there is only one version of the tool being used by the industry even after several changes have been made to the tool.

Justification

An online version of the tool would provide a reliable, efficient and a common platform to access the most recent version of the tool. This platform would allow users to access and use the full functionality of the tool as well as upload their own data that could enhance the overall database underpinning the tool.

Another important benefit of the online tool will be the ability to collect data to inform monitoring and evaluation to improve future tool revisions. Information that could be collected by a web-based version of the tool includes users, projects types, project locations, preferred cost values and the frequency of tool usage across different geographic locations and industry partners.

User information could be used to identify future industry stakeholders that could be engaged for further and regular monitoring and evaluation exercises by Hort Innovation. In instances where users enter their own cost information, the online tool will capture this information and the data could be used to inform future revisions of estimated costs.

An understanding of who the users are, what they use the tool for, and the range of input costs used across different localities would provide valuable information that can be used to inform further tool improvements. The continual improvements will contribute to reliability in costs in the short to long-term.

This would also facilitate a ‘community of practice’ for better urban tree management. Ultimately and ideally, a common online platform for the Tree Costing Tool and the Which Plant Where? Interactive Plant Features Tool would be recommended, including their eventual integration (see Recommended Project 4).

Another key benefit of the online tool is that it would allow integration with other industry tools such as the “Interactive Plant Features Tool” which is currently being funded by Hort Innovation.

Indicative approach

The online tool development will initially rely on the existing spreadsheet version. Thus, the tool should still provide users with a dashboard for entering project details and costs. It should also provide some easy to read results and simplified charts for inclusion in user reports.

Skills requirement

The conversion of the Tree Costing Tool spreadsheet will require input from an economic analyst as well as a programming and website development specialist. The economist will ensure that the correct functions are used to estimate life-cycle costs. This would not be a long project. Given the fact that many of the input paramaters in the tool would be based on additional inputs from users, periodic statistical updates (e.g. bi-annually) would be recommended to ensure the 'currency' of information is maintained.

2. A comprehensive assessment of the economic benefits of urban trees and forests

Brief description

The Tree Costing Tool provides estimated life cycle costs for planting trees. These costs cover initial establishment costs as well as ongoing maintenance costs. The estimated costs will provide decision-makers with more realistic budget estimates, however, there will also be a need to justify investments in establishing and maintaining trees. It is, therefore, recommended that a tree benefit estimation project be considered to compliment the cost information. The estimated benefits will provide decision-makers with further information to justify funding for tree planting and maintenance.

Justification

In effect, once the costs from this current project are combined with a robust economic estimate of the benefits (this proposed project), proper business cases can be developed using the same framework that is used for built assets and infrastructure. Consultation undertaken for this project consistently identified the lack of credible data on the benefits of urban trees was a major impediment to investment. In effect, urban trees are often seen as a cost or liability only as their benefits and subsequent asset values are so poorly understood by mainstream decision makers.

It is important that the benefits of urban tree planting projects are carefully assessed and estimated in monetary terms. The results can be used to help to:

- provide evidence to support the communication of benefits to the community,
- support funding/business case future tree planting works, and
- determine resource allocation and prioritise different tree planting works.

Trees provide multiple important ecosystem services or benefits. Overall, the availability of quantified costs and benefits for tree planting will provide tree planting managers or advocates with valuable information for decision-makers or investors consideration.

Indicative approach

Urban trees provide multiple benefits, the majority of which don't typically have financial values that can be observed from market transactions. Ideally, an ecosystem services valuation approach should be used to scope and quantify benefits of urban trees. The current best practice ecosystem services framework is outlined in the Common International Classification of Ecosystem Services (CICES)[1]. This valuation approach should seek to identify and quantify benefits such as: climate change mitigation, urban cooling, enhancement of urban biodiversity, water quality regulation, air quality regulation, property price premiums, and contributions to physical and mental health, among others. The output from this recommended project will be a list of unit values and their ranges that are applicable to different urban settings. The unit values will then be used to estimate benefits for different tree planting projects. It is recommended that the unit values are peer-reviewed and tested using existing tree planting projects. Because of the wide range of benefit streams from urban trees, multiple valuation approaches will be required. These range from started preference surveys, through to energy cost savings modelled (coupled with existing urban cooling models).

Skills requirement

This benefit estimation study would require a skills and experience with market and non-market evaluation methods.

[1] CICES (2018) Towards a Common International Classification of Ecosystem Services (CICES) for Integrated Environmental and Economic Accounting, CICES V5.1. Accessed November 2019 cices.eu/resources/

3. Developing mortality functions to optimise investments

Brief description

The costing tool already has a rudimentary function to address the tradeoffs between tree establishment and management strategies and tree mortality. However, the data and functions developed in the model are very limited. This project would involve research and analysis of the relationships between tree establishment techniques, management regimes and tree mortality rates.

Justification

Tree mortality is a major cost to industry. The Tree Costing Tool already incudes functionality to explore the tradeoffs between alternative tree establishment and management regimes and the lifecycle costs of tree mortality. Consultation identified that a quantitative understanding of mortality and these tradeoffs was a major impediment to more substantial upfront investment in urban tree establishment.

Undertaking this research would fill a major identified information gap and enhance industry understanding of the lifecycle cost of urban tree establishment and maintenance.

Indicative approach

This is primarily a biophysical research project where arborists and other relevant scientists would undertake a literature review, consultation and potentially in-field trials to establish information and data to underpin the development of a series of 'mortality functions'.

Skills requirement

Skilled arborists would be required to undertake this research in conjunction with a statistician to generate the causal functions for inclusion in the enhanced tree costing model.

4. Integration between the Tree Costing Tool and the "Which Plant where?"

Brief description

Horticulture Innovation is currently funding the "Which Plant Where?" project. This project is being undertaken by a team of researchers from Macquarie University, Western Sydney and the NSW Office of Environment and Heritage. The objective of the project is to develop a tool[2] that will help identify plant species that will thrive under different and increasingly harsh environments across the Australian urban landscape. The integration of the "Which plant where?" tool, would be of added value to the industry as practitioners will be able to undertake their project cost assessment based on trees that are most suited to their regions. It is recommended that a project that seeks to bring together the Tree Costing Tool and the findings from the Interactive Plant Features Tool from the "Which Plant Where?" project be considered to help capitalize on the inherent capabilities of both tools and the insights from the "Which Plant Where?" project.

Justification

The Tree Costing Tool provides a much-needed industry tool to inform decision-makers on the life cycle cost of planting trees. The "Which Plant Where?" project is aimed at identifying trees that will thrive in different environments across Australia. Integrating the two provides will provide industry stakeholders with the ability to identify species that are most suited for their regions and undertake a better-informed cost assessment. This process will potentially lead to increased tree survival rates and thus a lowering of life cycle costs. The integration will lead to some efficiency gains and enhanced impact from both tools.

Indicative approach

The integration of the Interactive plant features tool and the Tree Costing Tool is not simply about using both tools separately. It is more about integrating the findings from the "Which plant where?" into the Tree Costing Tool. The integration will work best with the recommended web-based version of the Tree Costing Tool. Thus, users will have the ability select their project regions, and to select a list of suitable plants. An assessment of costs for the selected plants in specified regions will then provide the associated costs to inform a bespoke estimation of life

[2] The Interactive plant features tool (see: https://www.whichplantwhere.com.au/research-projects/developing-the-interactive-plant-features-tool/)

cycle costs.

The integration process will require an analysis of the insights from the tree the results from the Interactive plant features tool.

Skills requirement

A broad set of skills covering economics, science, programming and web development. This project should not be undertaken until the Which plant where project is completed.

Refereed scientific publications

None to report.

References

1. CICES (2018) Towards a Common International Classification of Ecosystem Services (CICES) for Integrated Environmental and Economic Accounting, CICES V5.1. Accessed November 2019 cices.eu/resources/
2. The Interactive plant features tool (see: https://www.whichplantwhere.com.au/research-projects/developing-the-interactive-plant-features-tool/)

Intellectual property, commercialisation and confidentiality

No project IP, project outputs, commercialisation or confidentiality issues to report.

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Appendices

Tree Costing Tool instructions manual

Tree costing tool

Hort Innovation

Introduction

The Tree Costing Tool is designed to assist users to conduct a comprehensive life cycle cost analysis of urban tree projects. These costs include the costs of sourcing plants, ground preparation, planting costs and other costs such as traffic control and installation of road barriers. It also includes future maintenance costs and the costs associated with tree mortality. All costs associated with planting and maintaining trees over the life of the project are covered in the life cycle costs.

The Tree Costing Tool provides a systematic and user-friendly approach to project cost evaluation based on project size and location requirements. For example, in some locations, there may be a need to cut concrete to plant a tree or to a need to involve traffic controllers during the planting process. To estimate the life cycle costs for a tree planting project, users work through the spreadsheet step by step to enter their project details.

After entering all the required values, the tool provides a results summary where the total costs of the whole project are summarised. Users have the option to analyse and compare three projects within the tool. The tool allows for costing projects based on desired number of trees or proposed planting area.

This tool is unique because different decisions that affect the cost and health of urban trees can be quantified through the life of the tree. For example, if a tree has a more rigorous proactive maintenance early in the tree life it will be cheaper over the life of the tree than one that is poorly maintained and needs lots of reactive maintenance.

Cost explanations

A list of costs captured in the Tree Costing Tool and their descriptions is provided in Table 1 .

Table 1. Costs covered by the Tree Costing Tool

Cost type	Description
Arborist tree health inspection	Average cost of tree health inspection report by an arborist
Arborist tree health inspection	Cost of a professional arborist tree health inspection
Concrete cutting	Cost associated with cutting through roads surface and kerbside concretes (exclude the soil digging costs)
GIS mapping and inventory assessment	Cost of a GIS mapping survey, this is a once off cost for recording tree locations
Guard rails	Cost of purchasing, delivering and installing any guard rails
Installation cost	Cost of installing a tree, excludes any machinery costs
Machine rate	Cost hiring machinery to facilitate tree installation
Maintenance	Cost of maintenance in the first year after planting, includes any formative pruning
Mulch cost	Cost of purchasing, delivering and spreading mulch around the tree
Seeding	Cost of purchasing and planting seeds
Soil cost	Cost of purchase and delivery of soil
Stakes and ties	Cost of purchasing and delivering stakes and ties to site
Strata cells/vault installation	Cost of purchase, delivery and installation of a Strata Vault per tree
Supply	Cost of purchasing and delivering the tree to the project site
Traffic control	Cost of controlling traffic during tree planting activities
Tree installation	Labour and equipment cost of digging a hole and planting a tree
Tree protection fencing	Cost purchasing and installing a protection fence
Tree removal	Cost of removing and disposing existing trees at the project site
Tubestock supply and planting	Cost of purchasing and planting tubestock
Tubestock tree guards / protection sleeve	Cost purchasing and delivery of tree guards or protection sleeve
Visual tree inspection	Cost of a rapid visual tree inspection
Watering	Cost of watering activity including cost of the water and watering activity

It is recommended that all users familiarise themselves with the accompanying project report and this user manual before using the Tree Costing Tool. If you are not clear on what the cost entails, please refer to the descriptions in Table 1 above.

There are four worksheets that allow users to enter their own data, these are: "Data Entry", "Dashboard 1", "Dashboard 2" and "Dashboard 3".

- "Data Entry" can be used when users would like to define their own range of costs for an activity/item based on their prior knowledge.
- "Dashboard 1" and "Dashboard 2" are for entering data for projects based on number of trees (e.g. planting 100 trees in 45L pots alongside an urban streets).
- "Dashboard 3" is for entering data for an area-based project (e.g. direct seeding or planting tubestock in 1 ha urban park)

1. "Data Entry" – use this worksheet to enter your own estimates for each of the cost types you have. It is advised that you enter three costs level: *Low*, *Most Likely* and *Highest* for a given tree pot size. Where:

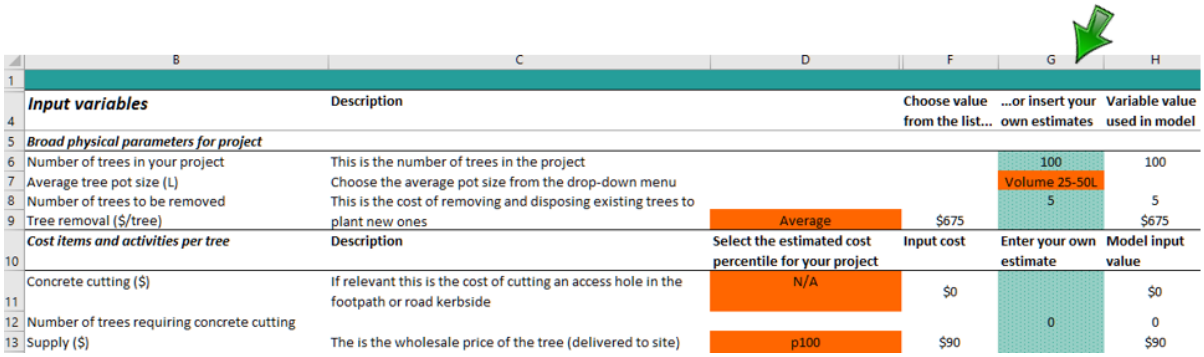
   Low = lowest price you expect to be charged,
   Most likely = the most likely price you expect to be charged, and
   Highest = the highest price you expect to be charged

In some instances, you may have a single quotation for the activity/item, in such a case then enter that value across the *Low*, *Most likely* and *Highest* price columns as shown for *Supply* in the screenshot below. Otherwise, enter your *Low*, *Most likely* and *Highest* price as shown for *Concrete cutting*.

	Volume 25-50L		
Item/Activity	**Low**	**Most likely**	**Highest**
Concrete cutting ($)	$1,000	$1,500	$1,800
Supply ($)	$150	$150	$150
Tree installation ($)			

2. Dashboard worksheets – alternatively, you can use the Dashboard worksheets to enter your quoted price or best price in column G. See screen shot below.

When using model inbuilt cost ranges or when you have entered your own cost estimates in the "Data Entry" worksheet, make sure Column G in the Dashboard worksheet is clear.



	B	C	D	F	G	H
1						
4	***Input variables***	**Description**		**Choose value from the list...**	**...or insert your own estimates**	**Variable value used in model**
5	***Broad physical parameters for project***					
6	Number of trees in your project	This is the number of trees in the project			100	100
7	Average tree pot size (L)	Choose the average pot size from the drop-down menu			Volume 25-50L	
8	Number of trees to be removed	This is the cost of removing and disposing existing trees to plant new ones			5	5
9	Tree removal ($/tree)		Average	$675		$675
10	***Cost items and activities per tree***	**Description**	**Select the estimated cost percentile for your project**	**Input cost**	**Enter your own estimate**	**Model input value**
11	Concrete cutting ($)	If relevant this is the cost of cutting an access hole in the footpath or road kerbside	N/A	$0		$0
12	Number of trees requiring concrete cutting				0	0
13	Supply ($)	The is the wholesale price of the tree (delivered to site)	p100	$90		$90

Use the following legend as a guide in using the Dashboard.

Enter a value

Choose value from a drop-down list

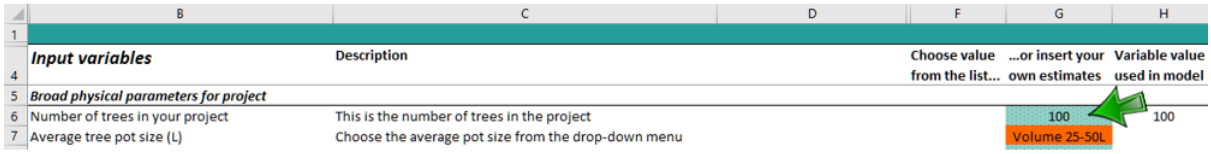
Step-by-step instructions for using the Tree Costing Tool

Dashboard 1 and 2

It is suggested that users carefully follow the following step-by-step instructions on how to estimate the life cycle costs of planting trees with a specified tree pot size. Users have the option to just estimate costs for one project using "Dashboard 1" or to enter costs for a second project using "Dashboard 2". Entering details for two projects allows for subsequent comparison of the two projects in the results summary worksheet.

Step 1: Entering the number of trees for your project

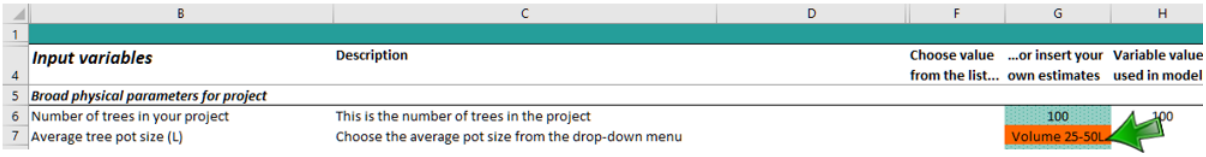
Question 1. Go to "Dashboard 1", enter the number of trees for your proposed project in the Question 1 row under Column G.



	B	C	D	F	G	H
1						
4	***Input variables***	**Description**		**Choose value from the list...**	**...or insert your own estimates**	**Variable value used in model**
5	***Broad physical parameters for project***					
6	Number of trees in your project	This is the number of trees in the project			100	100
7	Average tree pot size (L)	Choose the average pot size from the drop-down menu			Volume 25-50L	

Step 2: Selecting the plant pot size

Question 2. Use the drop-down menu to select your desired plant pot size (25-50L, 75-100L and 250L)

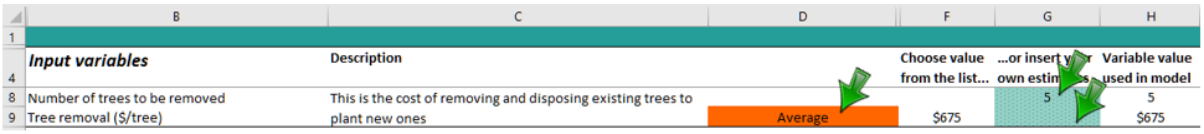


	B	C	D	F	G	H
1						
4	***Input variables***	**Description**		**Choose value from the list...**	**...or insert your own estimates**	**Variable value used in model**
5	***Broad physical parameters for project***					
6	Number of trees in your project	This is the number of trees in the project			100	100
7	Average tree pot size (L)	Choose the average pot size from the drop-down menu			Volume 25-50L	

Step 3: Cost of removing any pre-project trees

Question 3a. Where it is relevant, enter the number of trees to be removed prior to planting project trees at a given site under Column G.

Question 3b. Select a tree removal cost ($ per tree) using the drop-down menu under Column D, alternatively enter you preferred tree removal cost under Column G.

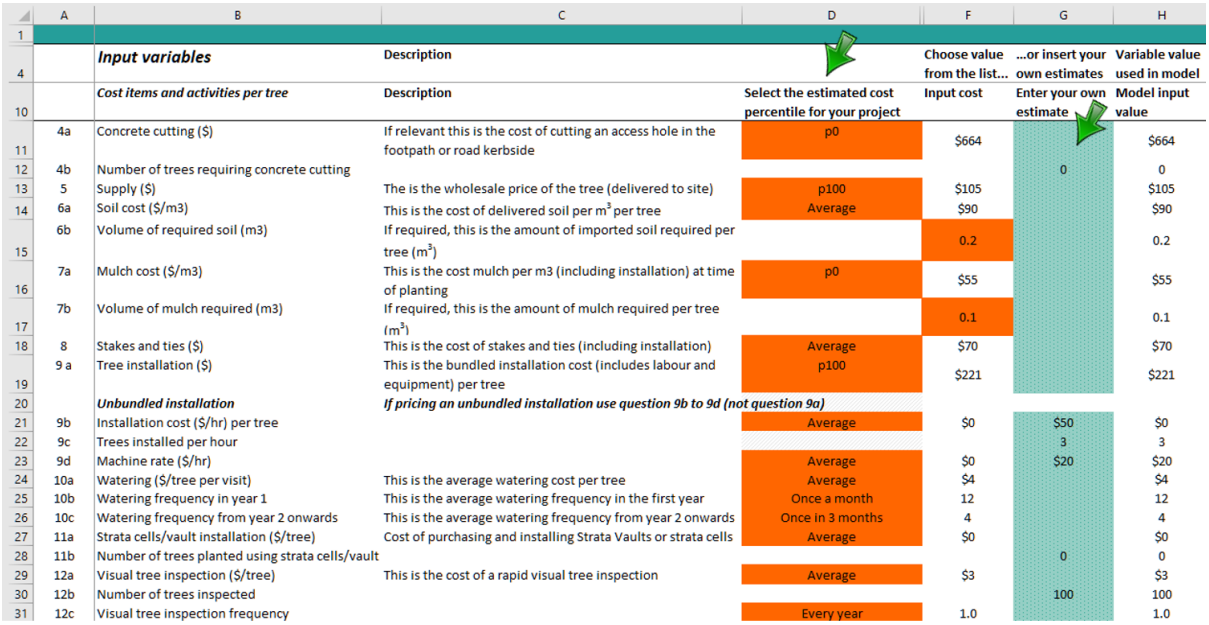


	B	C	D	F	G	H
1						
4	***Input variables***	**Description**		**Choose value from the list...**	**...or insert your own estimates**	**Variable value used in model**
8	Number of trees to be removed	This is the cost of removing and disposing existing trees to plant new ones			5	5
9	Tree removal ($/tree)		Average	$675		$675

When using model inbuilt costs range or when you have entered your own cost estimates in the "Data Entry" worksheet, make sure Column G in the Dashboard worksheet is clear for that row.

Step 4: Selecting or entering your cost for various tree planting inputs/activities

Questions 4 to 12. Enter your project cost values using the drop-down menu or using Column G.



	A	B	C	D	F	G	H
1							
4		***Input variables***	**Description**		**Choose value from the list...**	**...or insert your own estimates**	**Variable value used in model**
10		***Cost items and activities per tree***	**Description**	**Select the estimated cost percentile for your project**	**Input cost**	**Enter your own estimate**	**Model input value**
11	4a	Concrete cutting ($)	If relevant this is the cost of cutting an access hole in the footpath or road kerbside	p0	$664		$664
12	4b	Number of trees requiring concrete cutting				0	0
13	5	Supply ($)	The is the wholesale price of the tree (delivered to site)	p100	$105		$105
14	6a	Soil cost ($/m3)	This is the cost of delivered soil per m^3 per tree	Average	$90		$90
15	6b	Volume of required soil (m3)	If required, this is the amount of imported soil required per tree (m^3)		0.2		0.2
16	7a	Mulch cost ($/m3)	This is the cost mulch per m3 (including installation) at time of planting	p0	$55		$55
17	7b	Volume of mulch required (m3)	If required, this is the amount of mulch required per tree (m^3)		0.1		0.1
18	8	Stakes and ties ($)	This is the cost of stakes and ties (including installation)	Average	$70		$70
19	9 a	Tree installation ($)	This is the bundled installation cost (includes labour and equipment) per tree	p100	$221		$221
20		***Unbundled installation***	***If pricing an unbundled installation use question 9b to 9d (not question 9a)***				
21	9b	Installation cost ($/hr) per tree		Average	$0	$50	$0
22	9c	Trees installed per hour				3	3
23	9d	Machine rate ($/hr)		Average	$0	$20	$20
24	10a	Watering ($/tree per visit)	This is the average watering cost per tree	Average	$4		$4
25	10b	Watering frequency in year 1	This is the average watering frequency in the first year	Once a month	12		12
26	10c	Watering frequency from year 2 onwards	This is the average watering frequency from year 2 onwards	Once in 3 months	4		4
27	11a	Strata cells/vault installation ($/tree)	Cost of purchasing and installing Strata Vaults or strata cells	Average	$0		$0
28	11b	Number of trees planted using strata cells/vault				0	0
29	12a	Visual tree inspection ($/tree)	This is the cost of a rapid visual tree inspection	Average	$3		$3
30	12b	Number of trees inspected				100	100
31	12c	Visual tree inspection frequency		Every year	1.0		1.0

For *Questions 4 to 12* (Input costs related questions) – the base price is the national average price. However, you have an option to choose a higher or a lower price depending on your understanding of your project and associated projects costs. There are three options for lower than average prices. These are the lowest price (**p0**), the 5th percentile (**p5**) and the 25th percentile (**p25**). Similarly, there are three higher than average prices, the 75th percentile (**p75**), the 95th percentile (**p95**) and the highest price (**p100**). If a given cost is not applicable select "**N/A**" in the drop-down menu.

There are two options for including your **tree installation** cost.

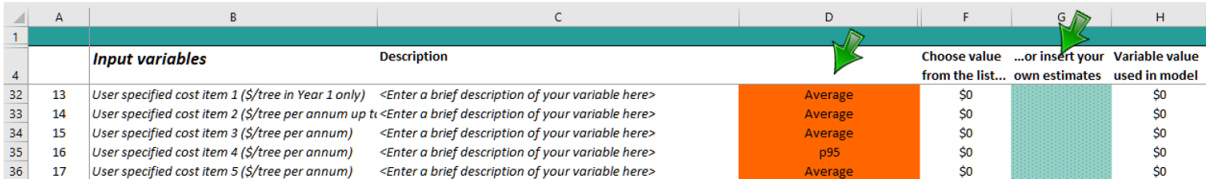
1. If you have a quote that includes the labour and machine, the enter your quoted/estimated price per tree under *Question 9a*, alternatively,
2. If you have separate installation and machinery hire costs per tree, then use *Question 9b* to *Question 9d*.

Step 5: Selecting or entering your own specified cost items

Questions 13 to 17. If there is cost item you would like to include in the model but that item is not already included in the model use the "Data Entry" worksheet to include that item. Make sure that you include an average annual value.

Please note the following uses for question 13 to 17:

- For Question 13, please enter a Year 1 once-off cost item and value.
- For Question 14, please enter a Year 1 and 2 cost item and value.
- For Questions 15 to 17, enter an annual item with a cost value for every year from year 1 to the end of the appraisal period.

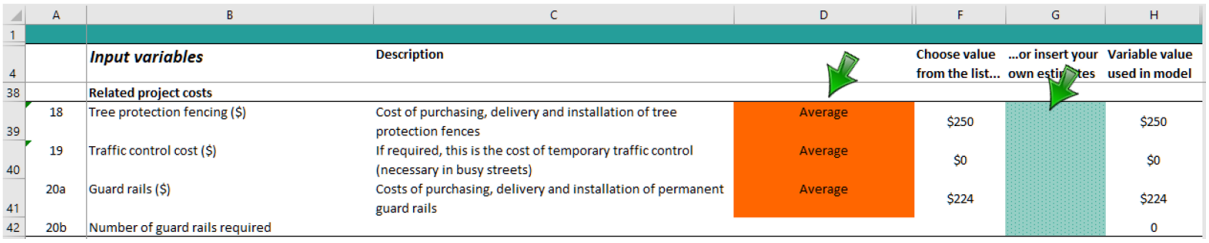


		Input variables	Description		Choose value from the list...	...or insert your own estimates	Variable value used in model
32	13	User specified cost item 1 ($/tree in Year 1 only)	<Enter a brief description of your variable here>	Average	$0		$0
33	14	User specified cost item 2 ($/tree per annum up t	<Enter a brief description of your variable here>	Average	$0		$0
34	15	User specified cost item 3 ($/tree per annum)	<Enter a brief description of your variable here>	Average	$0		$0
35	16	User specified cost item 4 ($/tree per annum)	<Enter a brief description of your variable here>	p95	$0		$0
36	17	User specified cost item 5 ($/tree per annum)	<Enter a brief description of your variable here>	Average	$0		$0

Step 6: Selecting or entering your related project costs

For Question 18 and 19 select your relevant cost amount or use the Column G to enter your preferred total cost estimate.

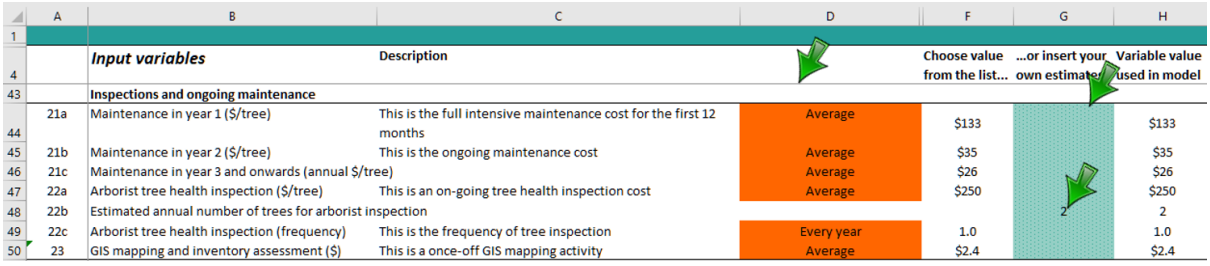
For Question 18a, select your relevant cost amount or use the Column G to enter your preferred total cost estimate and then enter the number of guard rails required.



		Input variables	Description		Choose value from the list...	...or insert your own estimates	Variable value used in model
38		Related project costs					
39	18	Tree protection fencing ($)	Cost of purchasing, delivery and installation of tree protection fences	Average	$250		$250
40	19	Traffic control cost ($)	If required, this is the cost of temporary traffic control (necessary in busy streets)	Average	$0		$0
41	20a	Guard rails ($)	Costs of purchasing, delivery and installation of permanent guard rails	Average	$224		$224
42	20b	Number of guard rails required					0

Step 7: Selecting or entering your inspections and ongoing maintenance costs

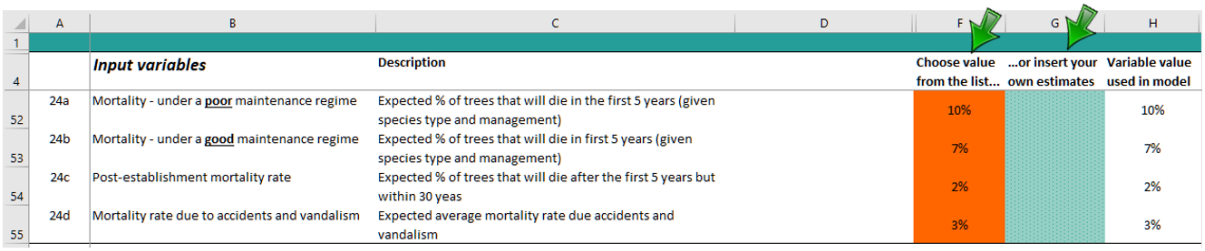
Question 21 to 23. Delect your relevant values or use the Column G to enter your preferred values.



		Input variables	Description		Choose value from the list...	...or insert your own estimates	Variable value used in model
43		Inspections and ongoing maintenance					
44	21a	Maintenance in year 1 ($/tree)	This is the full intensive maintenance cost for the first 12 months	Average	$133		$133
45	21b	Maintenance in year 2 ($/tree)	This is the ongoing maintenance cost	Average	$35		$35
46	21c	Maintenance in year 3 and onwards (annual $/tree)		Average	$26		$26
47	22a	Arborist tree health inspection ($/tree)	This is an on-going tree health inspection cost	Average	$250		$250
48	22b	Estimated annual number of trees for arborist inspection				2	2
49	22c	Arborist tree health inspection (frequency)	This is the frequency of tree inspection	Every year	1.0		1.0
50	23	GIS mapping and inventory assessment ($)	This is a once-off GIS mapping activity	Average	$2.4		$2.4

Step 8: Selecting or entering your estimated mortality rates

Question 24. Select your estimated mortality rates using the drop-down menus in Column F or Enter the values in Column G.

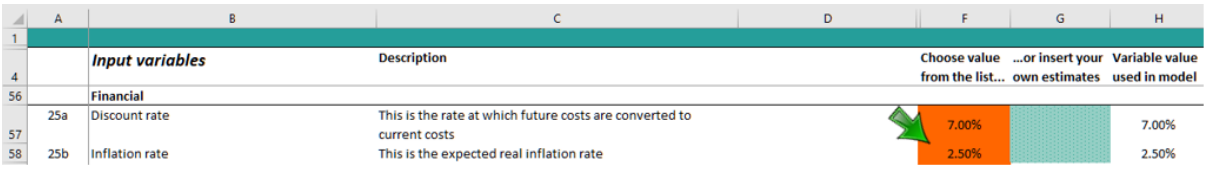


		Input variables	Description	Choose value from the list...	...or insert your own estimates	Variable value used in model
52	24a	Mortality - under a **poor** maintenance regime	Expected % of trees that will die in the first 5 years (given species type and management)	10%		10%
53	24b	Mortality - under a **good** maintenance regime	Expected % of trees that will die in first 5 years (given species type and management)	7%		7%
54	24c	Post-establishment mortality rate	Expected % of trees that will die after the first 5 years but within 30 yeas	2%		2%
55	24d	Mortality rate due to accidents and vandalism	Expected average mortality rate due accidents and vandalism	3%		3%

Step 9: Selecting your discount rate and inflation rate values

Question 25a. Select your preferred discount rate. This should be informed by your state treasury department. As a start we recommend a 7% discount rate which is the preferred discount for the Office of Best Practice and Regulation and for Infrastructure Australia.[1]

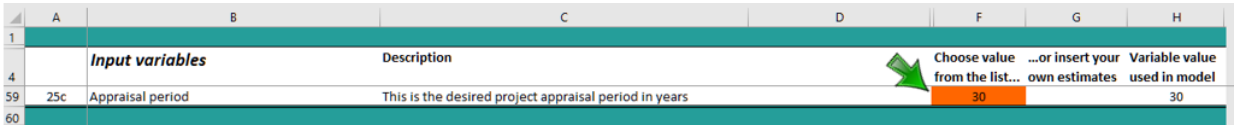
Question 25b. Select an inflation rate, we currently recommend 2.5%, based on the Reserve Bank of Australia inflation target of 2-3%.[2]



		Input variables	Description	Choose value from the list...	...or insert your own estimates	Variable value used in model
56		**Financial**				
57	25a	Discount rate	This is the rate at which future costs are converted to current costs	7.00%		7.00%
58	25b	Inflation rate	This is the expected real inflation rate	2.50%		2.50%

Step 10: Selecting project appraisal period

Question 25c. Select your preferred appraisal period using the drop-down menu. The model allows for six different appraisal periods ranging from a 5 years' to 50 years' appraisal period.



		Input variables	Description	Choose value from the list...	...or insert your own estimates	Variable value used in model
59	25c	Appraisal period	This is the desired project appraisal period in years	30		30

[1] See, Infrastructure Australia (www.infrastructureaustralia.gov.au/publications/assessment-framework-initiatives-and-projects), Office of Best Practice and Regulation (https://www.pmc.gov.au/resource-centre/regulation/cost-benefit-analysis-guidance-note)

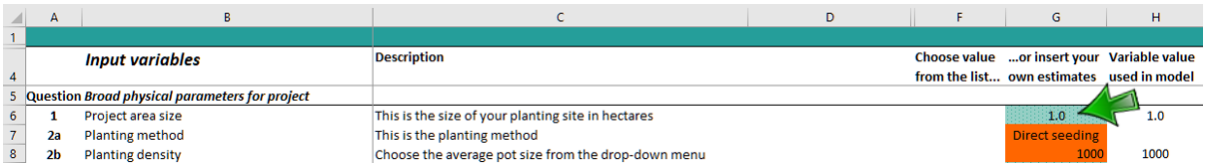
[2] Reserve Bank of Australia (https://www.rba.gov.au/inflation/inflation-target.html)

Dashboard 3

Users should use "Dashboard 3" to estimate tree planting costs for area-based projects that rely on either direct seeding or tubestock.

Step 1: Entering your project planting area

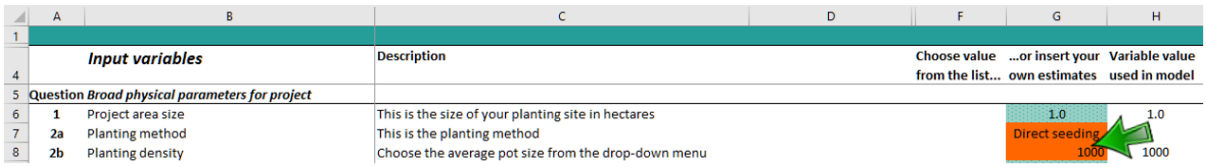
Question 1. Go to "Dashboard 3", enter the area (in hectares) for your proposed project in Column G.



	A	B	C	D	F	G	H
1							
4		***Input variables***	**Description**		**Choose value from the list...**	**...or insert your own estimates**	**Variable value used in model**
5	**Question**	***Broad physical parameters for project***					
6	**1**	Project area size	This is the size of your planting site in hectares			1.0	1.0
7	**2a**	Planting method	This is the planting method			Direct seeding	
8	**2b**	Planting density	Choose the average pot size from the drop-down menu			1000	1000

Step 2: Selecting the planting method and tree density

Question 2. Use the drop-down menu to select your planting method and tree density

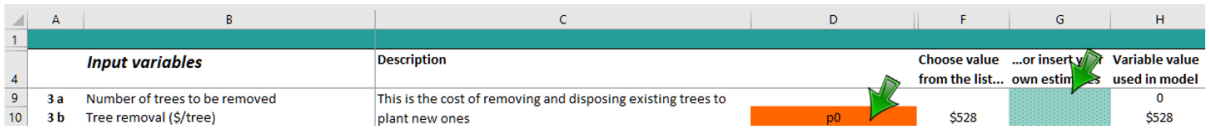


	A	B	C	D	F	G	H
1							
4		***Input variables***	**Description**		**Choose value from the list...**	**...or insert your own estimates**	**Variable value used in model**
5	**Question**	***Broad physical parameters for project***					
6	**1**	Project area size	This is the size of your planting site in hectares			1.0	1.0
7	**2a**	Planting method	This is the planting method			Direct seeding	
8	**2b**	Planting density	Choose the average pot size from the drop-down menu			1000	1000

Step 3: Cost of removing any pre-project trees

Question 3a. Where it is relevant, enter the number of trees to be removed prior to planting project trees at a given site under Column G.

Question 3b. Select a tree removal cost ($ per tree) using the drop-down menu under Column D, alternatively enter you preferred cost under Column G.

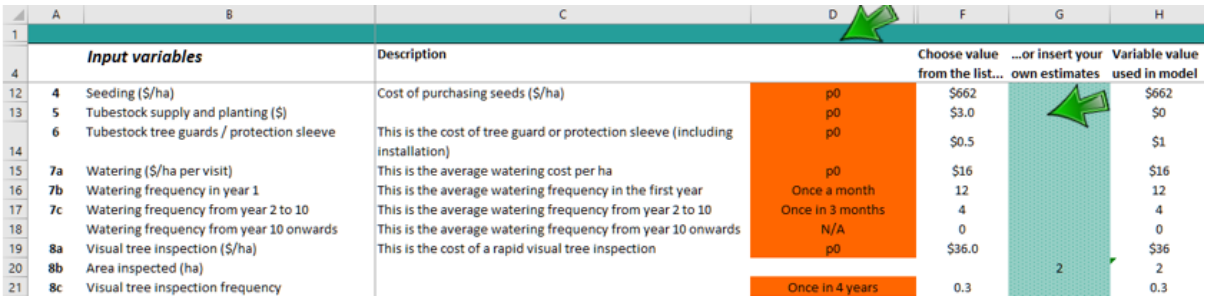


	A	B	C	D	F	G	H
1							
4		***Input variables***	**Description**		**Choose value from the list...**	**...or insert your own estimates**	**Variable value used in model**
9	**3 a**	Number of trees to be removed	This is the cost of removing and disposing existing trees to plant new ones				0
10	**3 b**	Tree removal ($/tree)		p0	$528		$528

When using model inbuilt costs range or when you have entered your own cost estimates in the "Data Entry" worksheet, make sure Column G in the Dashboard worksheet is clear for that row.

Step 4: Selecting or entering your cost for various tree planting inputs/activities

Questions 4 to 8.Select the most appropriate cost from the drop-down menu in column D, alternatively enter you own best estimate in Cell G11.



		Input variables	Description		Choose value from the list...	...or insert your own estimates	Variable value used in model
12	4	Seeding ($/ha)	Cost of purchasing seeds ($/ha)	p0	$662		$662
13	5	Tubestock supply and planting ($)		p0	$3.0		$0
14	6	Tubestock tree guards / protection sleeve	This is the cost of tree guard or protection sleeve (including installation)	p0	$0.5		$1
15	7a	Watering ($/ha per visit)	This is the average watering cost per ha	p0	$16		$16
16	7b	Watering frequency in year 1	This is the average watering frequency in the first year	Once a month	12		12
17	7c	Watering frequency from year 2 to 10	This is the average watering frequency from year 2 to 10	Once in 3 months	4		4
18		Watering frequency from year 10 onwards	This is the average watering frequency from year 10 onwards	N/A	0		0
19	8a	Visual tree inspection ($/ha)	This is the cost of a rapid visual tree inspection	p0	$36.0		$36
20	8b	Area inspected (ha)				2	2
21	8c	Visual tree inspection frequency		Once in 4 years	0.3		0.3

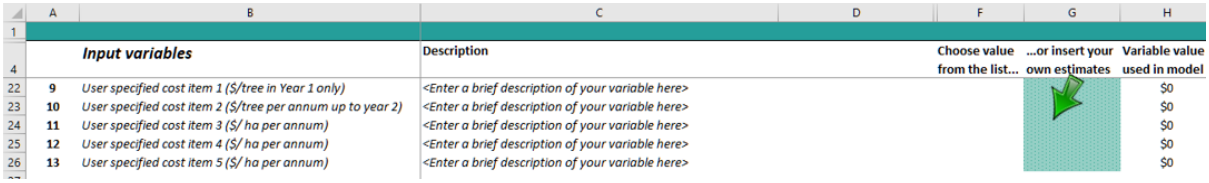
For *Questions 4 to 8* (Input costs related questions) - the base price is the national average price. However, you have an option to choose a higher or a lower price depending on your understanding of your project and associated projects costs. There are three options for lower than average prices. These are the lowest price (**p0**), the 5th percentile (**p5**) and the 25th percentile (**p25**). Similarly, there are three higher than average prices, the 75th percentile (**p75**), the 95th percentile (**p95**) and the highest price (**p100**). If a given cost is not applicable select **"N/A"** in the drop-down menu.

Step 5: Entering your own specified cost items

Questions 9 to 13. If there is cost item you would like to include in the model but that item is not already included in the model use the “Data Entry” worksheet to include that item. Make sure that you include an average annual value.

Please note the following uses for question 9 to 13:

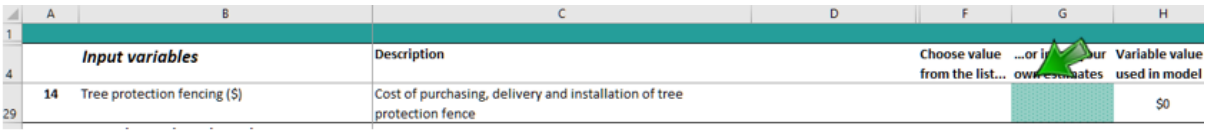
- For Question 9, please enter a Year 1 once-off cost item and value.
- For Question 10, please enter a Year 1 and 2 cost item and value.
- For Questions 11 to 13, enter an annual item with a cost value for every year from year 1 to the end of the appraisal period.



		Input variables	Description	Choose value from the list...	...or insert your own estimates	Variable value used in model
22	9	*User specified cost item 1 ($/tree in Year 1 only)*	*<Enter a brief description of your variable here>*			$0
23	10	*User specified cost item 2 ($/tree per annum up to year 2)*	*<Enter a brief description of your variable here>*			$0
24	11	*User specified cost item 3 ($/ ha per annum)*	*<Enter a brief description of your variable here>*			$0
25	12	*User specified cost item 4 ($/ ha per annum)*	*<Enter a brief description of your variable here>*			$0
26	13	*User specified cost item 5 ($/ ha per annum)*	*<Enter a brief description of your variable here>*			$0

Step 6: Selecting or entering your related project costs

For Question 14 Use the Column G to enter your preferred total cost estimate.

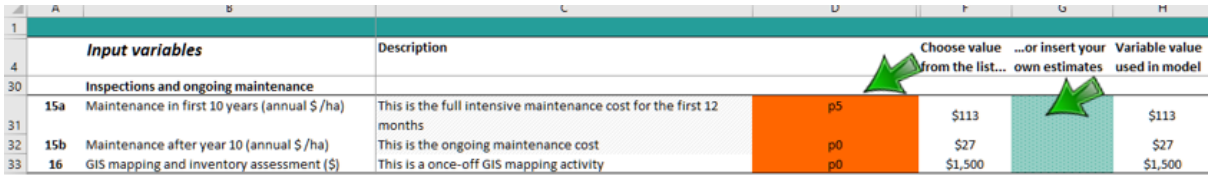


		Input variables	Description	Choose value from the list...	...or insert your own estimates	Variable value used in model
29	14	Tree protection fencing ($)	Cost of purchasing, delivery and installation of tree protection fence			$0

Step 7: Selecting or entering your inspections and ongoing maintenance costs

For Question 15 select your relevant annual maintenance costs per ha or use the Column G to enter your preferred values.

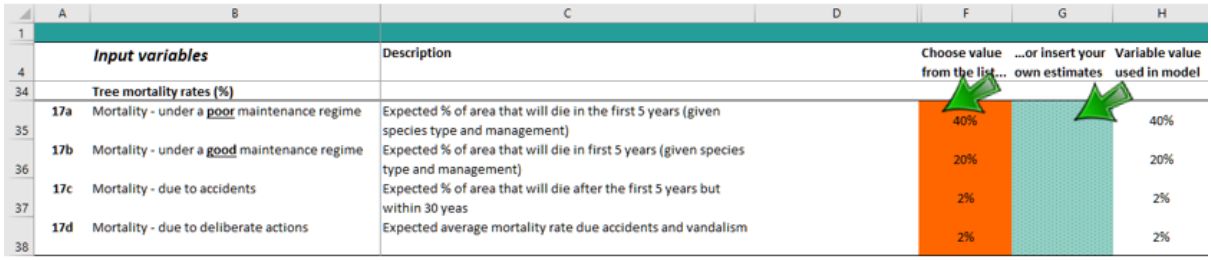
For Question 16 select your relevant GIS and inventory assessment costs or use the Column G to enter your preferred values.



		Input variables	Description		Choose value from the list...	...or insert your own estimates	Variable value used in model
30		Inspections and ongoing maintenance					
31	15a	Maintenance in first 10 years (annual $ /ha)	This is the full intensive maintenance cost for the first 12 months	p5	$113		$113
32	15b	Maintenance after year 10 (annual $ /ha)	This is the ongoing maintenance cost	p0	$27		$27
33	16	GIS mapping and inventory assessment ($)	This is a once-off GIS mapping activity	p0	$1,500		$1,500

Step 8: Selecting or entering your estimated mortality rates

Question 17. Select your estimated mortality rates using the drop-down menus in Column F or Enter the values in Column G.

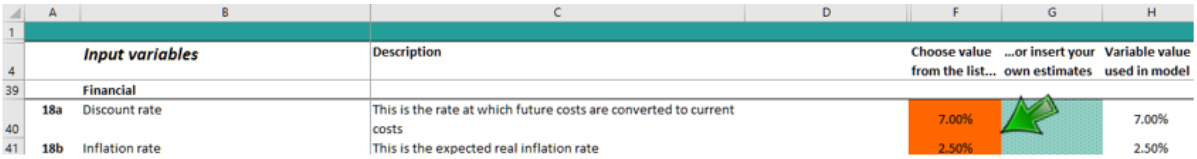


		Input variables	Description	Choose value from the list...	...or insert your own estimates	Variable value used in model
34		Tree mortality rates (%)				
35	17a	Mortality - under a poor maintenance regime	Expected % of area that will die in the first 5 years (given species type and management)	40%		40%
36	17b	Mortality - under a good maintenance regime	Expected % of area that will die in first 5 years (given species type and management)	20%		20%
37	17c	Mortality - due to accidents	Expected % of area that will die after the first 5 years but within 30 yeas	2%		2%
38	17d	Mortality - due to deliberate actions	Expected average mortality rate due accidents and vandalism	2%		2%

Step 9: Selecting your discount rate and inflation rate values

Question 18a. Select your preferred discount rate. This should be informed by your state treasury department. As a start we recommend a 7% discount rate which is the preferred discount for the Office of Best Practice and Regulation and for Infrastructure Australia.[3]

Question 18b. Select an inflation rate, we currently recommend 2.5%, based on the Reserve Bank of Australia inflation target of 2-3%.[4]



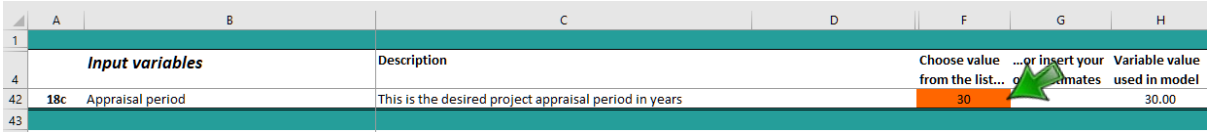
		Input variables	Description	Choose value from the list...	...or insert your own estimates	Variable value used in model
39		Financial				
40	18a	Discount rate	This is the rate at which future costs are converted to current costs	7.00%		7.00%
41	18b	Inflation rate	This is the expected real inflation rate	2.50%		2.50%

[3] See, Infrastructure Australia (www.infrastructureaustralia.gov.au/publications/assessment-framework-initiatives-and-projects), Office of Best Practice and Regulation (https://www.pmc.gov.au/resource-centre/regulation/cost-benefit-analysis-guidance-note)

[4] Reserve Bank of Australia (https://www.rba.gov.au/inflation/inflation-target.html)

Step 10: Selecting project appraisal period

Question 18c. Select your preferred appraisal period using the drop-down menu. The model allows for six different appraisal periods ranging from a 5 years' to 50 years' appraisal period.



	A	B	C	D	F	G	H
1							
4		***Input variables***	**Description**		**Choose value from the list...**	**...or insert your o... estimates**	**Variable value used in model**
42	**18c**	Appraisal period	This is the desired project appraisal period in years		30		30.00
43							

Project Models

Models 1 and 2

The information entered in either the Dashboard 1 or 2 or the "Data Entry" worksheets is the input data for "Model 1" and "Model 2" worksheets. These "Model" worksheets present the discounted and undiscounted cashflows, and the life cycle costs in present value terms. The structure of the model worksheets is presented in the figure below, where rows marked:

- **A -** provide a summary of tree establishment costs,
- **B** - are the flow of annual tree inspection and maintenance cost,
- **C** - are any additional cost items which were included by the user and were not already covered in A and B
- **D** - are the flow of mortality costs,
- **E -** are the estimated present value of costs associated with establishment, maintenance and net mortality costs, and
- **F -** are the annual cashflow amounts adjusted for inflation

"Model" worksheets only provide the cashflows and users are not required to enter any information on this worksheets**.**

Cost item	Year 1	Year 2	Year 3	Year 4	Year 5
Establishment costs					
Concrete cutting ($)	$ -				
Supply ($)	$ 10,512				
Tree installation ($)	$ 22,105				
Unbundled installation	$ -				
Mulch cost ($/m3)	$ 549				
Stakes and ties ($)	$ 7,020				
Tree removal	$ 3,949				
Soil cost ($/m3)	$ 1,790				
Tree protection fencing ($)	$ 250				
Traffic control cost ($)	$ -				
Guard rails	$ -				
StrataVault or Strata cells ($)	$ -				
Total establishment costs	**$ 46,175**	**$ -**	**$ -**	**$ -**	**$ -**
Inspections and maintenance costs					
Watering costs in year 1 ($)	$ 4,800				
Watering costs year 2 onwards ($)		$ 1,600	$ 1,600	$ 1,600	$ 1,600
Maintenance in year 1 ($)	$ 13,299				
Maintenance in year 2 ($)		$ 3,510			
Maintenance in year 3 to 30 (annual $)			$ 2,633	$ 2,633	$ 2,633
Arborist tree health inspection ($)	$ 500	$ 500	$ 500	$ 500	$ 500
Visual tree inspection ($)	$ 300	$ 300	$ 300	$ 300	$ 300
GIS mapping and inventory assessment ($)	$ 240				
Additional use specified cost items					
User specified cost item 1 ($/tree in Year 1 only)	$ -				
User specified cost item 2 ($/tree per annum up to year 2)	$ -	$ -			
User specified cost item 3 ($/tree per annum)	$ -	$ -	$ -	$ -	$ -
User specified cost item 4 ($/tree per annum)	$ -	$ -	$ -	$ -	$ -
User specified cost item 5 ($/tree per annum)	$ -	$ -	$ -	$ -	$ -
Total maintenance costs	$ 19,139	$ 5,910	$ 5,033	$ 5,033	$ 5,033
Cost of mortality					
Mortality - under a poor maintenance regime		$ 4,198	$ 3,778	$ 3,400	$ 3,060
Mortality - under a good maintenance regime		$ 2,938	$ 2,733	$ 2,541	$ 2,363
Avoided mortality costs associated with good maintenance		$ 1,259	$ 1,045	$ 859	$ 697
Post-establishment mortality rate					
Mortality rate due to accidents and vandalism		$ 1,259	$ 1,259	$ 1,259	$ 1,259
Net cost of mortality	$ -	$ 4,198	$ 3,992	$ 3,801	$ 3,623
Total cost, undiscounted	**$ 38,278**	**$ 10,108**	**$ 9,024**	**$ 8,833**	**$ 8,655**
Life cycle costs (present value)	**PV costs**	**PV costs**			
	$	**%**			
Establishment	$ 78,466	34.8%			
Inspections and maintenance	$ 81,746	36.3%			
Net mortality	$ 65,195	28.9%			
Total life cycle costs	$ 225,407	100.0%			
Option 1 - Cashflow (adjusted for inflation)	0	1	2	3	4
Cashflow budget data					
	Year 1	Year 2	Year 3	Year 4	Year 5
Concrete cutting ($)	$ -	$ -	$ -	$ -	$ -
Supply ($)	$ 10,512	$ -	$ -	$ -	$ -
Tree installation ($)	$ 22,105	$ -	$ -	$ -	$ -
Unbundled installation	$ -	$ -	$ -	$ -	$ -
Mulch cost ($/m3)	$ 549	$ -	$ -	$ -	$ -
Stakes and ties ($)	$ 7,020	$ -	$ -	$ -	$ -
Tree removal	$ 3,949	$ -	$ -	$ -	$ -
Soil cost ($/m3)	$ 1,790	$ -	$ -	$ -	$ -
Tree protection fencing ($)	$ 250	$ -	$ -	$ -	$ -
Traffic control cost ($)	$ -	$ -	$ -	$ -	$ -
Guard rails	$ -	$ -	$ -	$ -	$ -
StrataVault or Strata cells ($)	$ -	$ -	$ -	$ -	$ -
Watering costs	$ 4,800	$ 1,640	$ 1,681	$ 1,723	$ 1,766
Maintenance	$ 13,299	$ 3,598	$ 2,766	$ 2,835	$ 2,906
Arborist tree health inspection ($)	$ 500.00	$ 512.50	$ 525.31	$ 538.45	$ 551.91
Visual tree inspection ($)	$ 300.00	$ 307.50	$ 315.19	$ 323.07	$ 331.14
GIS mapping and inventory assessment ($)	$ 240.00	$ -	$ -	$ -	$ -
User specified cost item 1 ($/tree in Year 1 only)	$ -	$ -	$ -	$ -	$ -
User specified cost item 2 ($/tree per annum up to year 2)	$ -	$ -	$ -	$ -	$ -
User specified cost item 3 ($/tree per annum)	$ -	$ -	$ -	$ -	$ -
User specified cost item 4 ($/tree per annum)	$ -	$ -	$ -	$ -	$ -
User specified cost item 5 ($/tree per annum)	$ -	$ -	$ -	$ -	$ -

Model 3

The information entered in either the Dashboard 3 or the "Data Entry" worksheets is the input data for "Model 3" worksheet. This worksheet presents the discounted and undiscounted cashflows, and the life cycle costs in present value terms. The structure of the model worksheets is presented in the figure below, where rows marked:

- **A -** provide a summary of tree establishment costs,
- **B** - are the flow of annual tree inspection and maintenance cost,
- **C** - are any additional cost items which were included by the user and were not already covered in A and B
- **D** - are the flow of mortality costs,
- **E -** are the estimated present value of costs associated with establishment, maintenance and net mortality costs, and
- **F -** are the annual cashflow amounts adjusted for inflation

Cost item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Establishment costs								
Direct seeding ($/ha)	$ 662							
Tubestock supply and planting ($)	$ -							
Tubestock tree guards / protection sleeve	$ 500							
Watering in year 1 ($)	$ 192							
Watering from year 2 to 10 ($)		64	64	64	64	64	64	64
Watering from year 10 onwards ($)								
Tree removal ($)	$							
Tree protection fencing ($)	$ -							
User specified cost item 1 ($/ year)	$ -							
User specified cost item 2 ($/ year)	$ -							
Total establishment costs	**$ 1,354**	**$ 64**	**$ 64**	**$ 64**	**$ 64**	**$ 64**	64	**$ 64**
Inspections and maintenance costs								
Maintenance in first 10 years ($)	$	$ 113	$ 113	$ 113	$ 113	$ 113	$ 113	$ 113
Maintenance after year 10 ($)								
GIS mapping and inventory assessment ($)	$ 1,500							
Visual tree inspection ($)	$ 18	$ 18	$ 18	$ 18	$ 18	$ 18	$ 18	$ 18
User specified cost item 3 ($/ year)	$							
User specified cost item 4 ($/ year)	$							
User specified cost item 5 ($/ year)	$ -							
Total maintenance costs	**$ 1,631**	**$ 131**	**$ 131**	**$ 131**	**$ 131**	**$ 131**	**$ 131**	**$ 131**
Cost of mortality								
Mortality - under a **poor** maintenance regime	$ 542	$ 325	$ 195	$ 117	$ 70	$ 42	$ 25	$ 15
Mortality - under a **good** maintenance regime	$	$ 162	$ 97	$ 58	$ 35	$ 21	$ 13	$ 8
Avoided mortality costs associated with good maintenance	$	$ 162	$ 97	$ 58	$ 35	$ 21	$ 13	$ 8
Mortality - due to accidents	$ 27	$ 27	$ 27	$ 27	$ 27	$ 27	$ 27	$ 27
Mortality - due to deliberate actions	$ 27	$ 27	$ 27	$ 27	$ 27	$ 27	$ 27	$ 27
Net cost of mortality	$ 325	$ 217	$ 152	$ 113	$ 89	$ 75	$ 67	$ 62
Total cost, undiscounted	**$ 2,004**	**$ 412**	**$ 347**	**$ 308**	**$ 284**	**$ 270**	**$ 262**	**$ 257**
Life cycle costs (present value)	**PV costs $**	**PV costs %**						
Establishment	$1	50%						
Inspections and maintenance	$1	42%						
Net mortality	$332	9%						
Total life cycle costs	$ 3,897	100%						
Option 3 - Cashflow (adjusted for inflation)	0	1	2	3	4	5	6	7
Cashflow budget data								
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Direct seeding ($/ha)	$	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tubestock supply and planting ($)	$	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tubestock tree guards / protection sleeve	$ 500	$ -	$ -	$ -	$ -	$ -	$ -	$ -

A

B

C

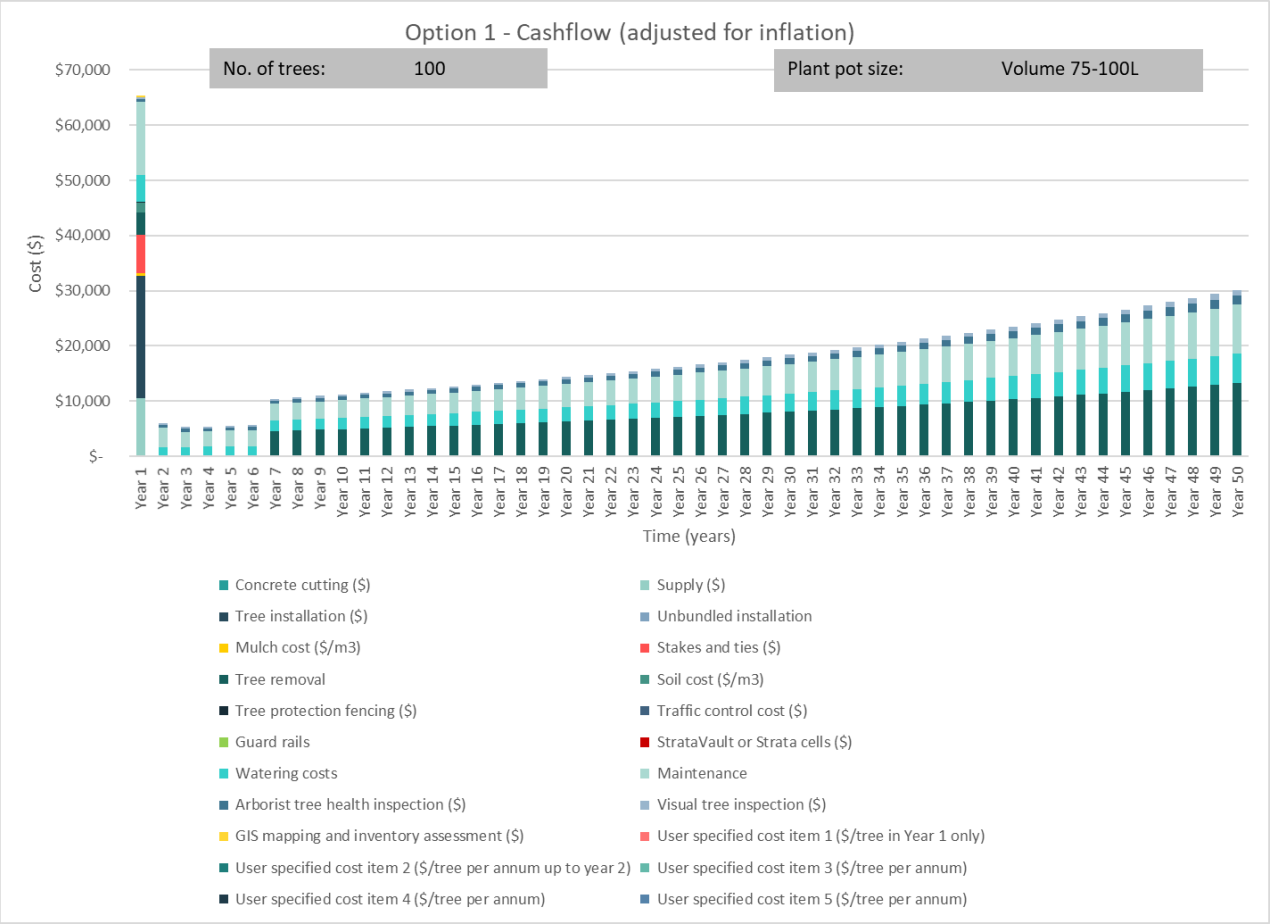
D

E

F

Project Cashflow

The "Cashflow" worksheets provide a summary of the undiscounted but inflation adjusted cashflows. This is based on data from the model worksheets. This chart summarises the cashflow and provides input details (number of trees and plant pot size or area and planting method).



Project Results

The “Results Summary” worksheet provides a summary of the tree costing exercise. The summary provides the tree planting project details such as the proposed number of trees, size of trees purchased for planting, aggregated costs and the life cycle costs for the whole project and per tree basis or per ha basis for a tubestock or direct seeding project.

Summary of results - whole project

Option 1	
Number of trees	100
Pot size (L)	75-100L
Appraisal period (years)	30

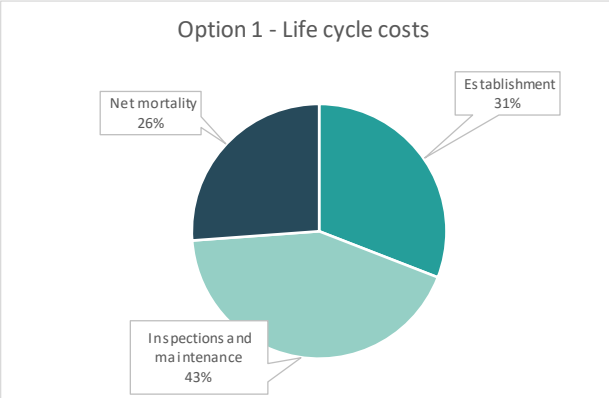
Aggregated costs	Cost ($)
Establishment cost (undiscounted)	$26,503
Average annual maintenance costs	$5,516
Average annual net mortality costs	$4,411

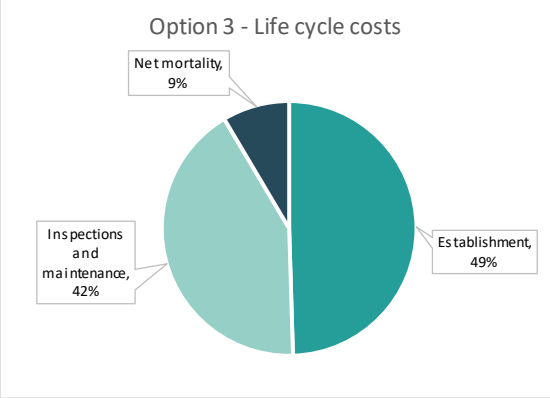
Life cycle costs (total project)	Cost ($)	Proportion (%)
Establishment	$58,794	30.9%
Inspections and maintenance	$81,746	43.0%
Net mortality	$49,775	26.2%
Total life cycle costs	$190,315	100.0%

Option 3 Tubestock or direct seeding	
Area (ha)	1.0
Planting type	Direct seeding
Appraisal period (years)	30

Aggregated costs	Cost ($)
Establishment cost (undiscounted)	$1,930
Average annual maintenance costs	$76
Average annual net mortality costs	$68

Life cycle costs (total project)	Cost ($)	Proportion (%)
Establishment	$1,930	49.5%
Inspections and maintenance	$1,635	42.0%
Net mortality	$332	8.5%
Total life cycle costs	$3,897	100.0%





Summary of results - average cost per tree or hectare

Option 1	
Aggregated costs	Cost ($)
Establishment cost (undiscounted)	$265
Average annual maintenance costs	$55
Average annual net mortality costs	$44
Appraisal period (years)	30
Life cycle costs (total project)	**Cost ($)**
Establishment	$588
Inspections and maintenance	$817
Net mortality	$498
Total life cycle costs	$1,903

Option 3	
Aggregated costs	Cost ($)
Establishment cost (undiscounted)	$1,930
Average annual maintenance costs	$76
Average annual net mortality costs	$68
Appraisal period (years)	30
Life cycle costs (total project)	**Cost ($)**
Establishment	$1,930
Inspections and maintenance	$1,635
Net mortality	$332
Total life cycle costs	$3,897

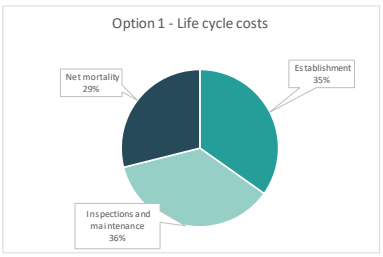
If you have entered details for two projects using "Dashboard 1" and "Dashboard 2" then you can compare *Option 1*, *Option 2* and/or Option 3 for your tree planting project. See figure below for results when two projects are compared.

Summary of results - whole project

Option 1	
Number of trees	100
Pot size (L)	75-100L
Appraisal period (years)	30

Aggregated costs	Cost ($)
Establishment cost (undiscounted)	$46,175
Average annual maintenance costs	$5,516
Average annual net mortality costs	$5,492

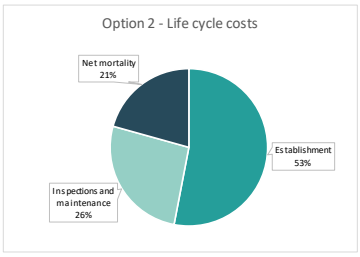
Life cycle costs (total project)	Cost ($)	Proportion (%)
Establishment	$78,466	34.8%
Inspections and maintenance	$81,746	36.3%
Net mortality	$65,195	28.9%
Total life cycle costs	$225,407	100.0%



Option 2	
Number of trees	10
Pot size (L)	250L
Appraisal period (years)	30

Aggregated costs	Cost ($)
Establishment cost (undiscounted)	$21,615
Average annual maintenance costs	$939
Average annual net mortality costs	$912

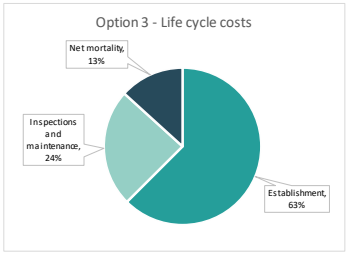
Life cycle costs (total project)	Cost ($)	Proportion (%)
Establishment	$27,355	53.0%
Inspections and maintenance	$13,568	26.3%
Net mortality	$10,667	20.7%
Total life cycle costs	$51,590	100.0%



Option 3 Tubestock or direct seeding	
Area (ha)	1
Planting type	Tubestock
Appraisal period (years)	30
Tubestock density	1000

Aggregated costs	Cost ($)
Establishment cost (undiscounted)	$2,134
Average annual maintenance costs	$40
Average annual net mortality costs	$92

Life cycle costs (total project)	Cost ($)	Proportion (%)
Establishment	$2,134	62.5%
Inspections and maintenance	$827	24.2%
Net mortality	$453	13.3%
Total life cycle costs	$51,590	100.0%



Cumulative costs

The cumulative costs worksheets provide the cumulative costs at a project and at an individual tree or ha.