Modification history

Release	Comments
Release 2	This version released with AHC Agriculture, Horticulture, Conservation and Land Management Training Package Version 4.0.
Release 1	This version released with AHC Agriculture, Horticulture, Conservation and Land Management Training Package Version 1.0.

AHCARB8XX	Analyse tree structure and biomechanics
Application	This unit of competency describes the skills and knowledge required to identify and analyse aspects of tree biomechanics that affect the physical loads and strengths of trees, branches and anchorage in the ground. It requires the assessment of tree strength and the loads that occur, and the ability to assess factors that can weaken trees increasing the chance of failure.

This unit applies to individuals with advanced theoretical and technical knowledge and skills for professional or highly skilled work and/or further learning in one or more disciplines or areas of practice. This unit applies to individuals with advanced cognitive, technical and communication skills to provide specialist advice, analysis and generate and transmit solutions to complex problems. They demonstrate autonomy, well-developed judgement, adaptability and responsibility as a practitioner or learner.

No occupational licensing, legislative or certification requirements are known to apply to this unit at the time of publication. |
| **Prerequisite Unit** | Nil |
| **Unit Sector** | Arboriculture (ARB) |

Elements	Performance Criteria
Elements describe the essential outcomes.	*Performance criteria describe the performance needed to demonstrate achievement of the element.*
1. Determine existing physical loads and strengths of trees, branches and anchorage	1.1 Determine existing physical loads affecting trees
1.2 Identify source and factors causing stress on trees
1.3 Assess root plate environment and history for damage
1.4 Assess history of pruning operations to above and below ground components
1.5 Determine presence and extent of defects on trunk and root system
1.6 Assess strength and material properties of tree structural components
2. Determine wind load	2.1 Determine wind environment of tree
2.2 Determine surface area of structure exposed to wind
2.3 Determine crown surface area exposed to wind
2.4 Assess aerodynamic drag factor of tree crown
2.5 Estimate primary loads occurring in seasonal climatic events
2.6 Determine wind-load of prevailing stormy weather
2.7 Determine load and drag associated with saturated foliage
3. Determine structural integrity by static load testing	3.1 Determine static load on trees for structural integrity testing and estimate wind-equivalent load
3.2 Calibrate static load testing instruments according to manufacturer instructions
3.3 Conduct static tests according to instrument instructions and analysis procedures
3.4 Monitor loads and forces on trees to ensure safe limits to prevent damage
3.5 Record data from static tests according to workplace procedures
3.6 Compare data with benchmarks obtained from stable tree populations
3.7 Prepare a report on structural integrity testing of tree from the static load tests

Elements	Performance Criteria
Elements describe the essential outcomes.	*Performance criteria describe the performance needed to demonstrate achievement of the element.*
4. Determine tree dynamic response	4.1 Investigate tree biomechanics using dynamic methods of analysis 4.2 Review complex models of tree dynamics analyses 4.3 Calculate mass of branches of tree to determine degree of open-grown 4.4 Calculate vector of force on tree 4.5 Determine tree dynamic response under defined wind loads 4.6 Prepare a report on structural integrity testing of tree from dynamic load analysis
5. Document a structural integrity report	5.1 Investigate level of contribution of material properties (of tree species??) in tree dynamics 5.2 Investigate dynamic effect of branches on oscillation natural frequency and damping effect (dispersion of energy?) 5.3 Determine level of contribution of form and morphology in tree dynamics 5.4 Review suitability of invasive and non-invasive methods of testing 5.5 Evaluate and determine likelihood of structural failure 5.6 Confirm level of anchoring potential of root system and stability of tree 5.7 Document a structural integrity report and provide to client

Foundation Skills (NB - will be completed after confirmation of PC's)

This section describes those language, literacy, numeracy and employment skills that are essential for performance in this unit of competency but are not explicit in the performance criteria.

Skill	Description
	•
	•
	•

Unit Mapping Information

Code and title current version	Code and title previous version	Comments	Equivalence status
AHCARB8XX Analyse tree structure and biomechanics	AHCARB701 Analyse tree biomechanics	Minor changes to Performance Criteria. Name change to more accurately reflect industry outcomes. Code changed Updated Performance Evidence and Knowledge Evidence	No equivalent unit

Links	Companion Volumes, including Implementation Guides, are available at VETNet: https://vetnet.education.gov.au/Pages/TrainingDocs.aspx?q=c6399549-9c62-4a5e-bf1a-524b2322cf72

TITLE	Assessment requirements for AHCARB8XX Analyse tree structure and biomechanics

Performance Evidence

An individual demonstrating competency must satisfy all of the elements and performance criteria in this unit.

There must be evidence that the individual has analysed the structure and biodynamics of a minimum of five different trees including performed the following:

- five (5) static load tests, and
- five (5) dynamic load analyses

There must also be evidence that the individual has:

- determined existing physical loads affecting trees
- identified areas of high stress on trees and the factors that affect these areas of high stress
- assessed root plate environment for damage
- assessed history and effect tree pruning operations on tree roots and stems
- determined presence and extent of tree defects
- assessed strength and material properties of structural tree structural components
- determined wind environment of tree
- determined surface area of structure exposed to wind
- determined crown surface area exposed to wind
- assessed aerodynamic drag factor of tree crown
- estimated primary loads occurring in seasonal climatic events
- determined wind-load of prevailing storms
- determined load associated with saturated foliage
- determined static load on trees for structural integrity testing as an estimate of a wind equivalent load
- calibrated static load testing instruments
- conducted static tests that must include:
  - loads to the tree
  - measures the trunk strength
  - assesses root plate anchorage
- monitored loads and forces using electronic equipment
- monitored trees to ensure loads are kept within safe limits to prevent damage
- maintained records of all data from static tests
- compared data against benchmarks from stable tree populations and prepared a report on structural integrity testing
- investigated tree biomechanics using dynamic methods of analysis
- reviewed complex models of tree dynamics analysis
- calculated mass of branches to determine degree of open-grown form of tree
- calculated vector of force on the tree
- determined tree dynamic response under defined wind loads
- investigated level of contribution of material properties in tree dynamics
- investigated the dynamic effect of branches on frequency and damping
- determined the level of contribution of form and morphology in tree dynamics
- reviewed suitability of invasive and non-invasive methods of testing
- evaluated and determined likelihood of structural failure
- confirmed level of anchoring potential of root system and stability of tree
- documented a structural integrity report and provided to client.

Knowledge Evidence

An individual must be able to demonstrate the knowledge required to perform the tasks outlined in the elements and performance criteria of this unit. This includes knowledge of:

- tree dynamics and impact of tree form and morphology
- tree stability and physical loads affecting trees particularly in high stress environments
- root plate environment including:
  - depth and consistency of soil
  - spatial limitations

Knowledge Evidence

- • site excavations and potential damage
- arboricultural activity and impact on tree structure and stability including:
  - • pruning operations to branches and roots
- presence and impact of defects on tree structure including:
  - • extent of decay and damage of trunk and root system
  - • assessment of strength and material properties of structural wood
- biomechanical impact of wind on tree structure including:
  - • seasonal wind patterns, and tree exposure
  - • surface area and tree structure
  - • aerodynamic drag factor of tree crown in relation to trunk diameter and extent of hollowness
  - • estimation of primary loads occurring in seasonal climatic events
  - • severe wind-load due to storms and extreme weather conditions
  - • load associated with rain and snow saturated foliage
  - • additional drag associated with saturated foliage
  - • open-grown form of tree
- testing principles for static load including:
  - • use of and purpose of a static load on trees during structural integrity testing as an estimate of a wind equivalent load
  - • calibrating static load testing instruments
  - • limits of structural safety during a static testing
  - • measurement of trunk strength
  - • invasive and non-invasive methods of testing trees
- assessment of root plate anchorage in the ground
- methods and reasons for monitoring loads and forces on trees including:
  - • electronic monitoring
  - • monitoring of tree to ensure loads are kept within safe limits
- value and purpose of benchmarks obtained from stable tree populations
- tree biomechanics studies using dynamic methods of analysis including:
  - • simple models of tree dynamics
  - • complex models and finite element analyses
  - • multimodal approaches representing dynamics of branches on trees
- calculations required for structural and biomechanical assessments of trees including:
  - • mass of branches
  - • vector of force on trees
  - • tree dynamic response
  - • wind velocity and direction
  - • statistical analysis and interpretation of test results
- dynamic effect of branch movement on tree stability and failure rate including:
  - • oscillation frequency
  - • energy dissipation and damping effect of canopy structure
  - • likelihood of structural failure
  - • level of anchoring potential of root system
  - • stability of tree
- records and reporting procedures for analysis of structural integrity testing.

Assessment Conditions

Assessment of skills must take place under the following conditions:
- physical conditions:
  - • access to an arboriculture worksite or environment that accurately represents workplace
  - • conditions
- resources, equipment and materials:
  - • computer with word processing software and internet connection
  - • wind environment statistics
  - • static load test equipment
  - • models of tree dynamics

Assessment Conditions

- specifications:
  - access to test equipment manuals, standard procedures and quality standards for performing load tests
  - access to sample reports for the diagnostic test methods listed in the performance criteria.

Assessors must satisfy current standards for RTOs in the assessment of arboriculture units of competency.

Assessment must be conducted only by persons who have:
- arboriculture vocational competencies at least to the level being assessed
- current arboriculture industry skills directly relevant to the unit of competency being assessed.

Links	Companion Volumes, including Implementation Guides, are available at VETNet: https://vetnet.education.gov.au/Pages/TrainingDocs.aspx?q=c6399549-9c62-4a5e-bf1a-524b2322cf72