final report

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Part B - Cattle heat load toolbox upgrade

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Abstract

Heat stress in feedlot cattle can have a deleterious effect on cattle performance and in extreme cases lead to cattle death. The National Feedlot Accreditation Scheme requires feedlots to have a heat stress management plan in place to cope with weather events that can lead to excessive heat loads. The Cattle Heat Load Toolbox, developed by Katestone, alerts feedlot operators of impending adverse weather conditions that could lead to excessive heat loads in feedlot cattle. The toolbox is web based and provides access to weather and heat load forecasts out one week, plus heat load risk assessment programs.

The service is underpinned by over 10 years of research into cattle heat load funded by Meat & Livestock Australia. The Cattle Heat Load Toolbox brings all this research together and uses a world class weather forecasting system to generate accurate forecasts across Australia. This service provides useful and practical information to help feedlot operators manage heat stress in cattle through advanced warning of adverse conditions. Thus allowing operators time to undertake appropriate actions to mitigate the risk of heat stress when alerted. This report details the enhancements that have been made to the service in preparation for the 2013-14 summer period.

Executive summary

Heat stress in feedlot cattle can have a deleterious effect on cattle performance and in extreme cases lead to cattle death. The National Feedlot Accreditation Scheme requires that feedlots have a heat stress management plan in place to cope with weather events that can lead to excessive heat loads. The Cattle Heat Load Toolbox (CHLT) has been developed to alert feedlot operators of impending adverse weather conditions that could lead to excessive heat load in feedlot cattle. The toolbox is web based and provides access to weather and heat load forecasts out one week, plus heat load risk assessment programs.

Feedlot operators can subscribe to the service free of charge and request a site-specific forecast for their feedlot. Subscribers can also define risk alert levels suitable to their management plan and cattle condition. Alerts are then sent by email and SMS to designated recipients (e.g. site managers, veterinarians). Under severe heat load conditions Katestone will issue a written heat load advisory detailing the location, cause and likely duration of a heat load event. The advisory is emailed to all subscribers and posted on the toolbox web site.

New features have been added to the CHLT site for the 2013/14 summer including:

- New home page and help for easier navigation
- Updated graphics for public site forecasts
- New features for registered users including new ‘My Site’ summary page providing all critical information on one page for quick decision making, online access to manage account such as setting alerts, adding more users, updating e-mail and phone numbers.
- Integration of AWS data from registered users into the forecasting system

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1. Introduction

Katestone has provided a heat load forecast service to Australian lotfeeders since 2003. During this time the technology involved in delivering the service has changed dramatically. From the data used to initialise the model, the underlying equations for estimating heat load, to the delivery of the forecast on the Cattle Heat Load Toolbox (CHLT) website. While the technology has changed the basic principles of delivering a forecast has remained the same.

The proposed service upgrades for 2013 are based on feedback from registered users during the 2012 end of season survey and changes required to handle over 100 registered feedlots and 130 registered users. Changes are also required to enable the integration of registered feedlots weather station data into the forecasting system.

This report presents the current status of the CHLT including the new features added to the system for the 2013/14 summer period.

2. Project objectives

The CHLT was developed to assist in warning feedlot operators of impending adverse weather conditions that could lead to excessive heat loads (and potential mortality) for feedlot cattle. The objective of the project is to:

- Provide heat load forecasts for feedlot operators across Australia
- Deliver warnings of impending heat load events
- Provide access to forecasts and the Risk Analysis Program over the internet
- Provide guidance to feedlot operators to minimise losses due to heat load

3. Scope of work

The scope of work proposed for the CHLT for the 2013/14 summer period includes:

- Upgrade of the web site to facilitate online control of registered user details, ability to add a new user for a registered feedlot site (e.g. local vet or nutritionist) and alter and set alerts when required
- Integration of site Automatic Weather Station (AWS) data into the forecasting system including smart processing of incoming data to avoid errors in the system
- Modification to the proprietary Katestone Weather Research and Forecasting (K-WRF) model including:
    - implementation of a cycling algorithm to initialise the land surface model from the previous forecast
    - data assimilation from the World Meteorological Organisation (WMO) surface and upper air observations
    - introduction of a background error statistic into the model initialisation

4. Overview

The CHLT website has moved to a new home: http://chlt.katestone.com.au. The web site is now hosted by a remote server controlled by Katestone allowing the ability to provide a higher level of service and functionality to the feedlot industry, including:

- New home page and help for easier navigation
- Updated graphics for public site forecasts
- New 'My Site' for registered users, which
    - Simplifies the data to daily summaries
    - Displays critical information quickly and intuitively
    - Allows user to easily navigate to detailed forecasts and observations
    - Has a side panel display of alert logs so users can see what alerts have been sent and when
    - Provides new account management features for registered users, to:
        - Change Accumulated Heat Load Units (AHLU) alert levels
        - Change contact details
        - Be added to multiple sites (handy for veterinarians and nutritionists)
        - Add and remove users from their site
        - Update changes instantly in the online database

This season Katestone and MLA launched the Heat Load Data Network (HLDN). The HLDN has been developed to incorporate onsite weather information into the CHLT service allowing site specific subscribers to view their historical observations of weather parameters and calculated Heat Load Index (HLI) and AHLU. The service also incorporates the actual onsite AHLU in the forecast AHLU by initialising the predicted AHLU with the observations when the forecast is issued.

The HLDN has the added benefit of providing a quality assurance process to each feedlot AWS that becomes part of the network. Katestone reviews the AWS instrumentation and provides guidance on how to connect.

To date the update of the service has been slow with only three users connected to the HLDN before the start of the forecasting season. An additional 26 sites have requested to be connected and been given instructions on how to connect. The Katestone technical services team are currently working with each site to determine their reason for delayed connection to the service and provide assistance with the process.

The HLDN (http://chlt.katestone.com.au/heat-load-data-network-hldn/) has the following functions:

- Feedlot weather station data can now be uploaded to the remote server and displayed on the CHLT website through the 'My Site' observation page
- HLDN data feeds into the forecast by initialising the AHLU
- Data is quality checked before calculating the HLI and AHLU
- Discrepancies between the HLI and AHLU retrieved from the AWS and calculated by Katestone are flagged and corrective action taken

Along with the new location of the site, and the introduction of the HLDN, Katestone has also upgraded the hardware used to provide the service:

- The Katestone Weather Research and Forecasting (K-WRF) model now runs on a much faster system, reducing the time required to run the model from 6 hours to 4 hours.
- The reduced modelling time means that the forecast and alert are now available at 4.00am
- Improvements to the database that stores the forecast data:
    - The structure for the database was previously created on Microsoft SQL Server running on Windows. The database structure has been upgraded to MariaDB, running on Linux, which is more flexible and robust.
    - The hardware for the server hosting the data storage has been upgraded. The current setup has been upgraded to two databases located on two servers, serving as mirrors for each other.
    - The entire system is hosted on a remote server located in a data centre, allowing Katestone to have control over the hardware and the implementation of the software
    - Aside from improvements to the backup system, the dual server setup allows faster and direct online access to the data by the users, without compromising security.

5. Katestone - Weather research and forecasting model

Katestone has been running a high resolution numerical model for the feedlot industry for the past 3 three years. The modelling system is the result of extensive research and is configured specifically to simulate and forecast Australian weather. Continuous performance reviews of this forecasting system are made by Katestone's scientists to ensure ongoing improvements to its performance and delivery of data into the future.

The K-WRF uses the Weather Research and Forecasting (WRF) Model to simulate meteorological conditions on a 12 km grid for all of Australia out to four days. The K-WRF forecast is extended out to 7 days using output from the Global Forecasting System (GFS).

Katestone is currently maintaining the operational status of the CHLT service. The service is a technological ecosystem that incorporates multiple connections to external data sources across Australia and overseas. The technical requirements to operate a system of this magnitude necessitate supervision and human intervention to reduce downtime and ensure the continuous flow of data.

Work on improving the forecast accuracy is continuing in parallel with the delivery of the service. Katestone is currently testing a cycling scheme where the previous forecast data is used to initialise the next forecast. This process also allows for the assimilation of observations which may improve the performance of the forecast.

Katestone is also trialling the inclusion of a custom background error statistic template (BEST) for the Australian region. This is similar to a model output statistic (MOS) post processing step to correct the bias inherent in the model, except that the BEST does the correction prior to the forecast. This way the dynamic relationships between variables such as temperature and humidity are preserved.

6. Website

6.1 Public access

6.1.1 Home

A screenshot of the CHLT homepage is shown in Figure 1. This page is accessible to public users and registered subscribers.

As an initial stop, the CHLT home page provides a short description of CHLT, and a link to a short video regarding the practical use of the service for cattle heat load management in Australian feedlots.

Links to pages for registration, login, information on the HLDN, and weather warnings are also shown.

6.1.2 Heat Load Data Network

A screenshot of the HLDN page is shown in Figure 2. This page is accessible to public users and registered subscribers. Access to this page is available as a submenu under homepage and from various links throughout the site.

The HLDN page gives a summary of the service, added benefits, an invitation to participate, and a link to the contact page.

6.1.3 Major town forecasts

A screenshot of the major town forecast page is shown in Figure 3. This page can be accessed directly from the menu.

Once a major town is selected from the drop down menu the user is taken to the detailed forecast page and 7-day outlook table. The page displays 7 day outlooks for minimum and maximum HLI, average daily wind speed, and total rainfall. The detailed forecast table displays hourly predictions of:

- HLI
- AHLU
- Black Globe Temperature (BGT)
- temperature
- relative humidity
- wind direction
- wind speed
- rain

Colour coded AHLU risk indicators have been introduced this season as a new initiative. The arrows adjust to the direction of the AHLU risk level, up for increasing, down for decreasing and horizontal for no change. If the user hovers the mouse pointer over the arrow, the numeric value of the AHLU will be displayed (Figure 4).

6.1.4 Major town observations

A screenshot of the major town observation page is shown in Figure 5. This page is only accessible as a link from the major town forecast page (Section 6.1.3).

The detailed forecast page shows hourly data, for the next four days on the following variables:

- HLI
- AHLU
- BGT
- temperature
- relative humidity
- wind direction
- wind speed
- rain

New data quality checks have been introduced this year to remove erroneous data from the Bureau of Meteorology AWS data files.

6.1.5 Australia-wide overview – HLI

A screenshot of the Australia-wide overview – HLI page is shown in Figure 6. This page can be accessed directly from the menu, and shows snapshots of HLI contours for the next four days.

The page also contains a link to the Australia-wide overview of Mean Sea-Level Pressure (MSLP) and Rainfall (Section 6.1.6), as well as links to animated loops of HLI and MSLP.

6.1.6 Australia-wide overview – MSLP and Rainfall

A screenshot of the Australia-wide overview – MSLP and Rainfall page is shown in Figure 7. This page can be accessed directly from the menu, and shows snapshots of MSLP and rainfall contours for the next four days.

The page also contains a link to the Australia-wide overview of HLI (Section 6.1.5), as well as links to animated loops of HLI and MSLP.

6.1.7 Heat Load Index Calculator

A screenshot of the HLI calculator is shown in Figure 8. This page is accessible to public users and registered subscribers from the menu and through numerous links within the site.

The page presents different options for calculating HLI, depending on available variables. The page also provides an overview of HLI in the side panel, as well as a link to the RAP calculator.

This page should be updated in the future to improve user access.

6.1.8 Risk Analysis Program Calculator

A screenshot of the Risk Analysis Program (RAP) calculator is shown in Figure 9. This page is accessible to public users and registered subscribers from the menu and through numerous links within the site, particularly where alert options for users are discussed.

The page prompts the user to enter variables to calculate the RAP. The page also provides an overview of RAP in the side panel. The side panel also contains a link to the user management page and HLI calculator.

This page should be updated in the future to improve user access.

6.1.9 Guides

Guides to assist potential and registered users to utilise the services offered in the CHLT website are available as a direct link from the menu. Information on registration, setting of alert preferences, and interpretation of the forecast are provided.

6.1.10 Glossary

A glossary of terms, particularly acronyms, is also available as a direct link from the menu. In this section, the discussion of the terms commonly used throughout the website is intended to be a general description, rather than a technical discussion.

6.1.11 Documentation

The documentation for the more technical aspects of the CHLT service is available as a direct link from the main menu. This section discusses a more detailed discussion of the forecast models, RAP, BGT, HLI, and AHLU.

6.1.12 Reports

Reports related to the CHLT service, as well as tips and tools for the feedlots are provided as a direct link from the menu.

6.1.13 Contact page

A screenshot of the contact page is shown in Figure 10, and is available as a direct link from the menu. This page is accessible to public users and registered subscribers, and simply requires name, email and a message, which is then sent to Katestone.

6.1.14 Registration

A screenshot of the registration page is shown in Figure 11. This page is accessible to public users and registered subscribers.

The registration page can be accessed directly from the menu prior to login, and from a few links within the CHLT site.

The registration process for CHLT requires the site name, NFAS accreditation number, name and contact details for the proposed subscriber.

During the registration process, the potential subscribers also have the option to register either an existing AWS, or an expression of interest for one.

The potential subscriber also has the option to configure alert preferences at time of registration.

On submission, the information provided by the potential subscriber is sent to Katestone, where a member of the team performs the necessary checks, adds the subscriber to the database, and sends an email of confirmation plus login details to the subscriber.

Due to the manual verification required, the processing time for responding to a registration may take from 24-48 hours, and could be longer if the registration request is lodged during the weekend or on public holidays.

6.1.15 Log-in

A screenshot of the login page is shown in Figure 12.

The login page has a standard format, with a form requiring a username and password. Links to the main CHLT site (with no access to subscriber features), registration, and option to reset password details are available, and do not require login details.

Upon a successful login, the subscriber is redirected to the My sites summary page (Section 6.2.1).

6.2 Registered user access

6.2.1 My sites summary

A screenshot of the registration page is shown in Figure 13. This page is only available to registered users. Once logged in, the page can be accessed directly from the menu. The page is also the initial page shown upon log in.

Subscribers registered for more than one site can change the site through the use of a dropdown selection box, which lists all the sites the user has access to. Site selection is followed by an immediate update of the page.

The summary page for each site presents a summary of daily weather data on the following parameters for the next four days:

- minimum/maximum HLI
- minimum temperature
- average wind speed
- total rain
- daily AHLU risk level

Links to detailed forecast and historical observations are available from the site. The side panel of the page also displays the AHLU risk level key, alerts log for the site being viewed, links to the RAP calculator and user management page (Section 6.2.5).

6.2.2 Detailed forecast

The detailed forecast page can be accessed as a link from the My sites summary (Section 6.2.1) and observations (Section 6.2.3) pages.

It provides the same type of data as the major town detailed forecast but for the users selected site:

- HLI
- AHLU
- BGT
- temperature
- relative humidity
- wind direction
- wind speed
- rain

Subscribers registered for more than one site can change the site through the use of a dropdown selection box, which lists all the sites the user has access to. Site selection is followed by an immediate update of the page.

The page also provides a quick access to the My sites summary (Section 6.2.1) and observations (Section 6.2.3) pages.

6.2.3 Observations

The observations page can be accessed as a link from the My sites summary (Section 6.2.1) and detailed forecast (Section 6.2.2) pages, and is only available to subscribers with a registered AWS that are uploading to the HLDN.

The observations page shows hourly data for the most recent four days on the following variables:

- HLI
- AHLU
- BGT
- temperature
- relative humidity
- wind direction
- wind speed
- rain

Subscribers with access to more than one site with a registered AWS can change the site through the use of a dropdown selection box, which lists all the sites the user has access to. Site selection is followed by an immediate update of the page.

The page also provides a quick access to the My sites summary (Section 6.2.1) and detailed forecast (Section 6.2.2) pages.

6.2.4 Account management

A screenshot of the account management page is shown in Figure 14. This page is only accessible to registered users. Once logged in, the page can be accessed directly from the menu.

The account management provides a user the ability to change their contact details, password, and alert preferences directly on the database. The changes take place instantly and any changes to the alert preferences will be applied to the next forecast.

The page also shows the AHLU risk level key as a reference for alert options, a link to the RAP calculator, and the alerts log.

6.2.5 User management

The user management page is shown in Figure 15. This page is accessible to registered users who are nominated as site administrators. Once logged in, the page can be accessed directly from the menu. Registered subscribers who are not site administrator will be asked to contact their site administrators to manage user accounts.

The user management page provides control to the site administrator with a list of all users registered to the site, and a link to each person's account management page (Section 6.2.4). The site administrator is then able to update contact details and alert preferences to the subscribers registered for the managed sites. The site administrator also has the option to delete users and add new users to the site.

6.2.6 Add users

A screenshot of the account management page is shown in Figure 16. This page is accessible as a link from the user management page, and as such is only accessible to registered users who are nominated as site administrators.

The add users page prompts for the username, nominated password, contact details and alert preferences for the subscriber being added. Once added, the user is immediately added to the database, and can access subscriber pages and services (including automated alerts for the next forecast).

7. Site layout

7.1 Public access

Prior to login

- Home
  - Heat Load Data Network (HLDN) – *(/heat-load-data-network-hldn/)*
- Forecasts – *(/major-town-forecast/)*
  - Select a major town forecast – *(/major-town-forecast/)*
  - Australia Wide Overview – HLI – *(/hli-contour-overview/)*
  - Australia Wide Overview – MSLP and Rainfall – *(/mslp-contour-overview/)*
- Tools
  - HLI Calculator – *(/hli-calculator/)*
  - RAP Calculator – *(/rap-calculator/)*

- Register – *(/register/)*
    - Why Register? – *(/why-register/)*
- Help – *(/help/)*
    - Guides – *(/help/guides/)*
    - Glossary – *(/help/glossary/)*
    - Documentation – *(/help/documentation/)*
        - Forecast Models – *(/help/documentation/forecasting-models/)*
        - Risk Analysis Program (RAP) – *(/help/documentation/risk-analysis-program-rap/)*
        - Black Globe Temperature (BGT) – *(/help/documentation/black-globe-temperature-bgt/)*
        - Heat Load Index (HLI) – *(help/documentation/heat-load-index-hli/)*
        - Accumulated Heat Load Units (AHLU) – *(/help/documentation/accumulated-heat-load-units-ahlu/)*
- Contact Us – (/contact/)

7.2 Registered user access

- Home
    - Heat Load Data Network (HLDN) – *(/heat-load-data-network-hldn/)*
- Forecasts – *(/major-town-forecast/)*
    - Select a major town forecast – *(/major-town-forecast/)*
    - Australia Wide Overview – HLI – *(/hli-contour-overview/)*
    - Australia Wide Overview – MSLP and Rainfall – *(/mslp-contour-overview/)*
- My sites – *(/my-site-summary/)*
    - My sites – *(/my-site-summary/)*
    - My Account – *(/my-site-summary/my-account/)*
        - Manage Users – *(/my-site-summary/manage-users/)*
- Tools
    - HLI Calculator – *(/hli-calculator/)*
    - RAP Calculator – *(/rap-calculator/)*
- Help – *(/help/)*
    - Guides – *(/help/guides/)*
    - Glossary – *(/help/glossary/)*
    - Documentation – *(/help/documentation/)*
        - Forecast Models – *(/help/documentation/forecasting-models/)*
        - Risk Analysis Program (RAP) – *(/help/documentation/risk-analysis-program-rap/)*
        - Black Globe Temperature (BGT) – *(/help/documentation/black-globe-temperature-bgt/)*
        - Heat Load Index (HLI) – *(help/documentation/heat-load-index-hli/)*
        - Accumulated Heat Load Units (AHLU) – *(/help/documentation/accumulated-heat-load-units-ahlu/)*
- Contact Us – (/contact/)

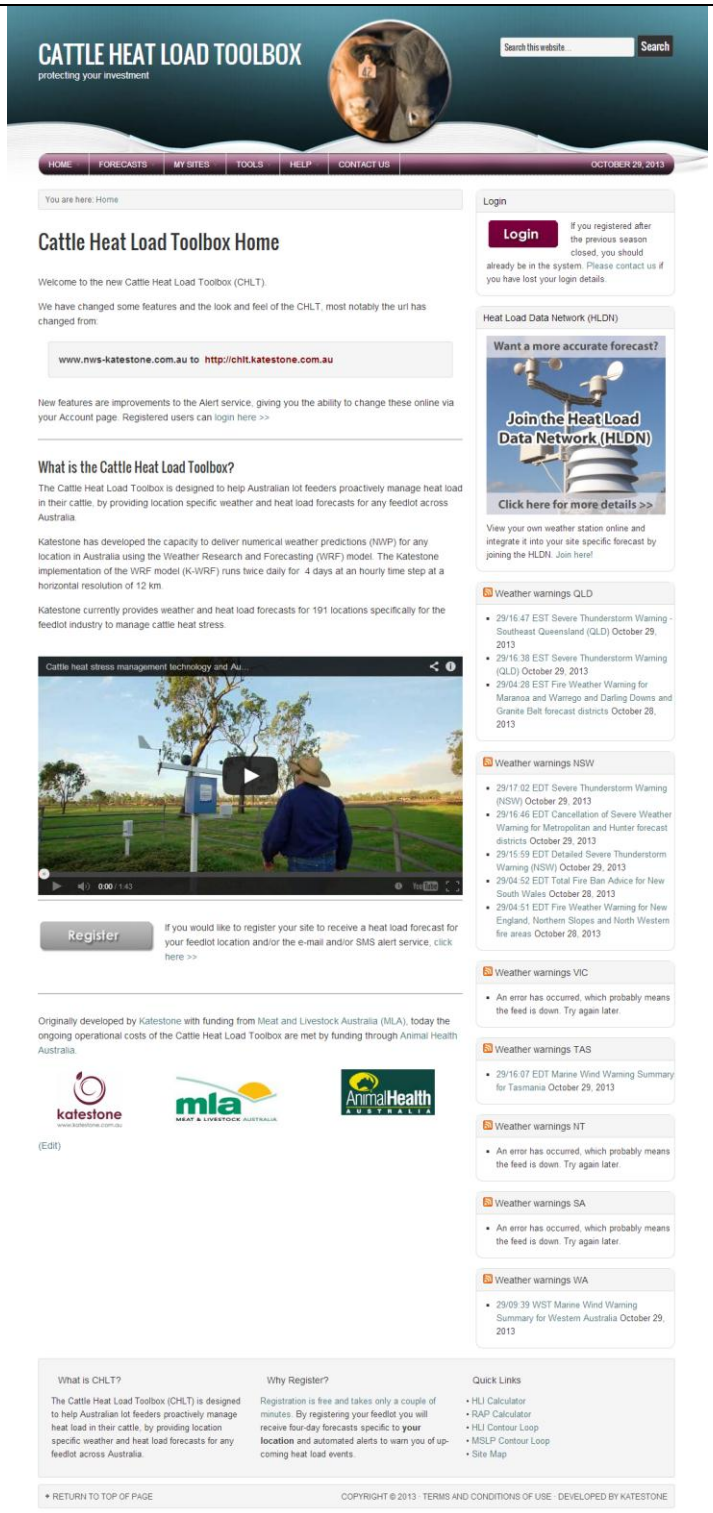


Figure 1 CHLT Home

(**http://chlt.katestone.com.au/**)

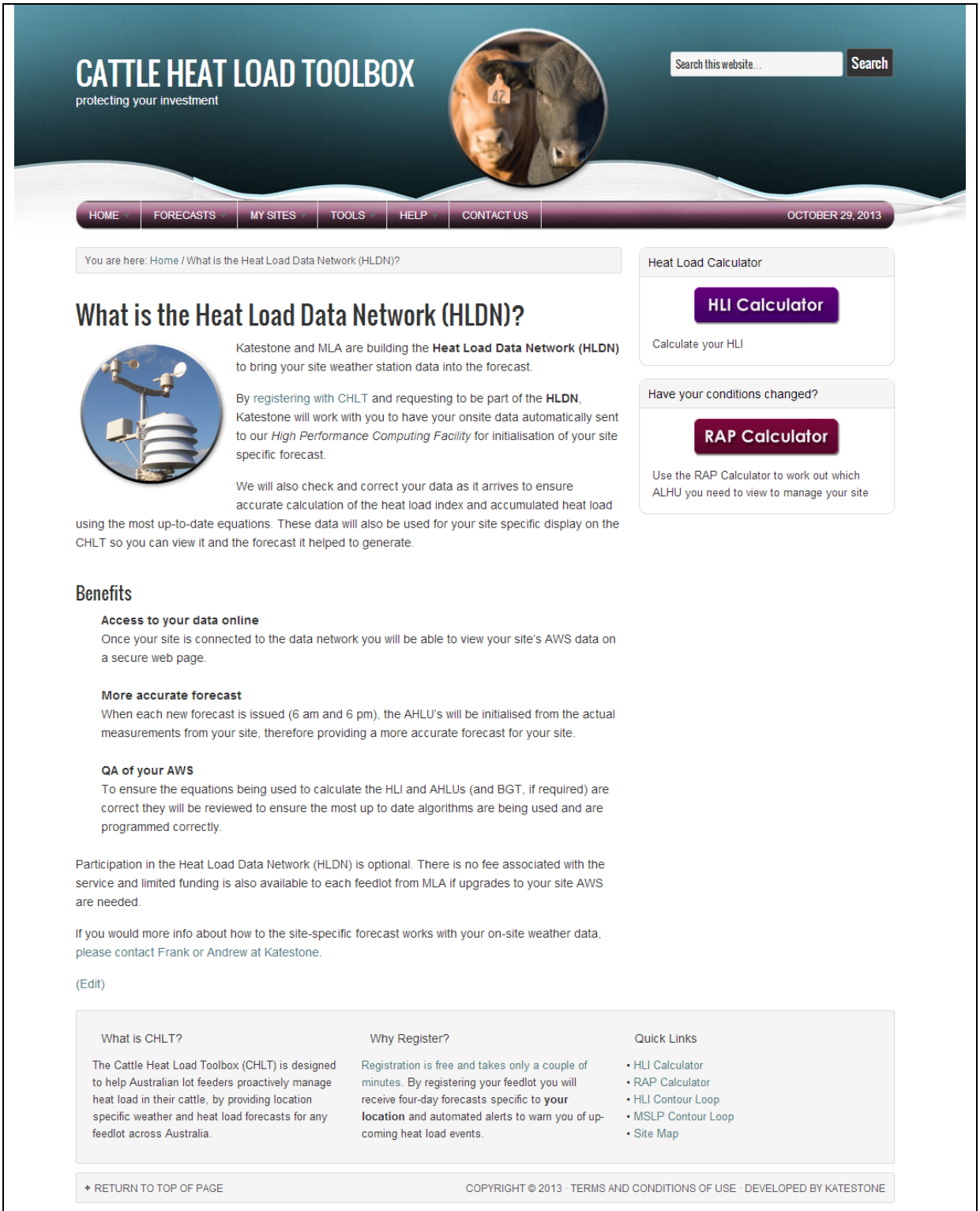


Figure 2 Heat Load Data Network

(http://chlt.katestone.com.au/heat-load-data-network-hldn/)

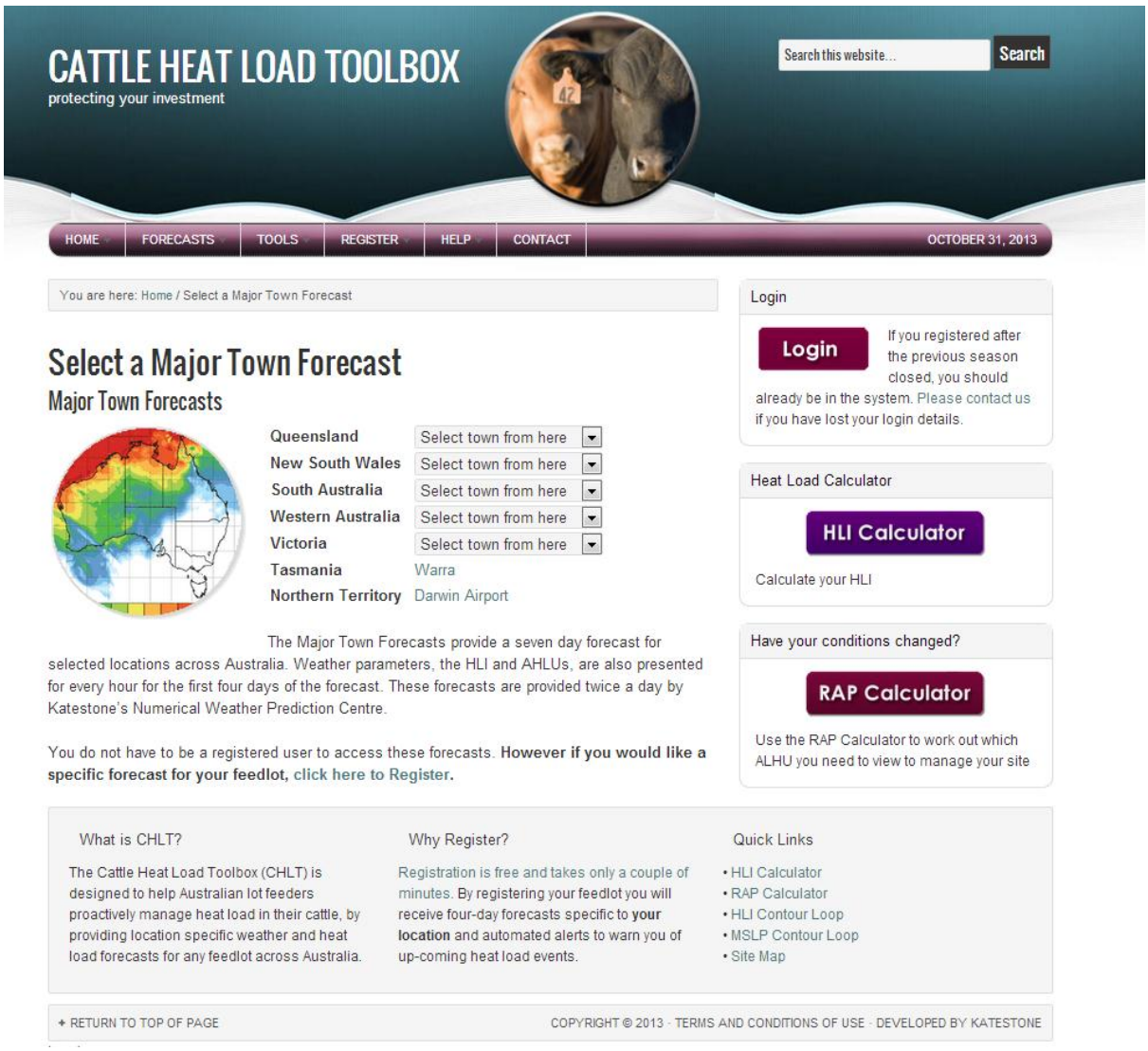
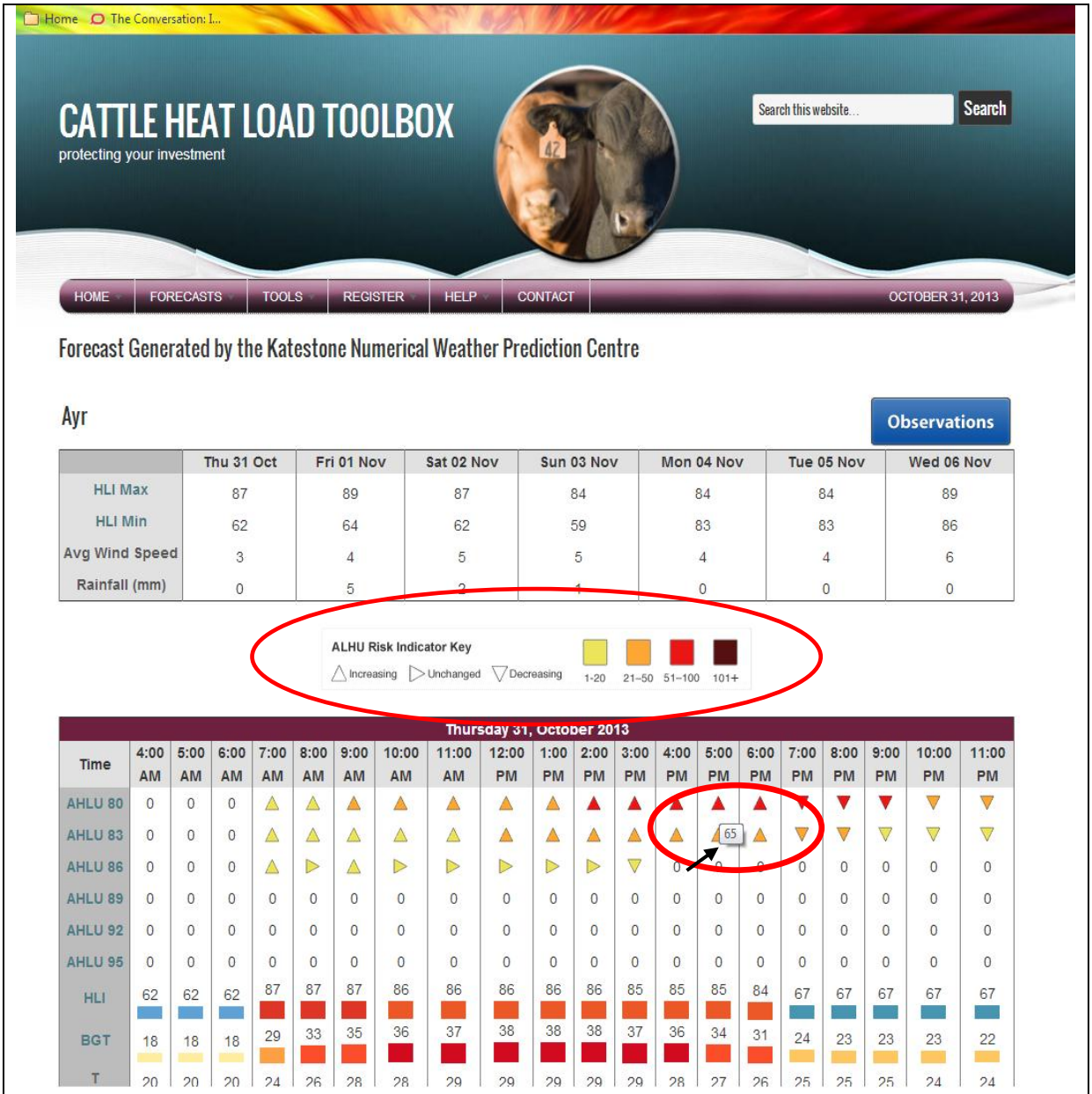


Figure 3 Major Town Forecast

(http://chlt.katestone.com.au/heat-load-data-network-hldn/)

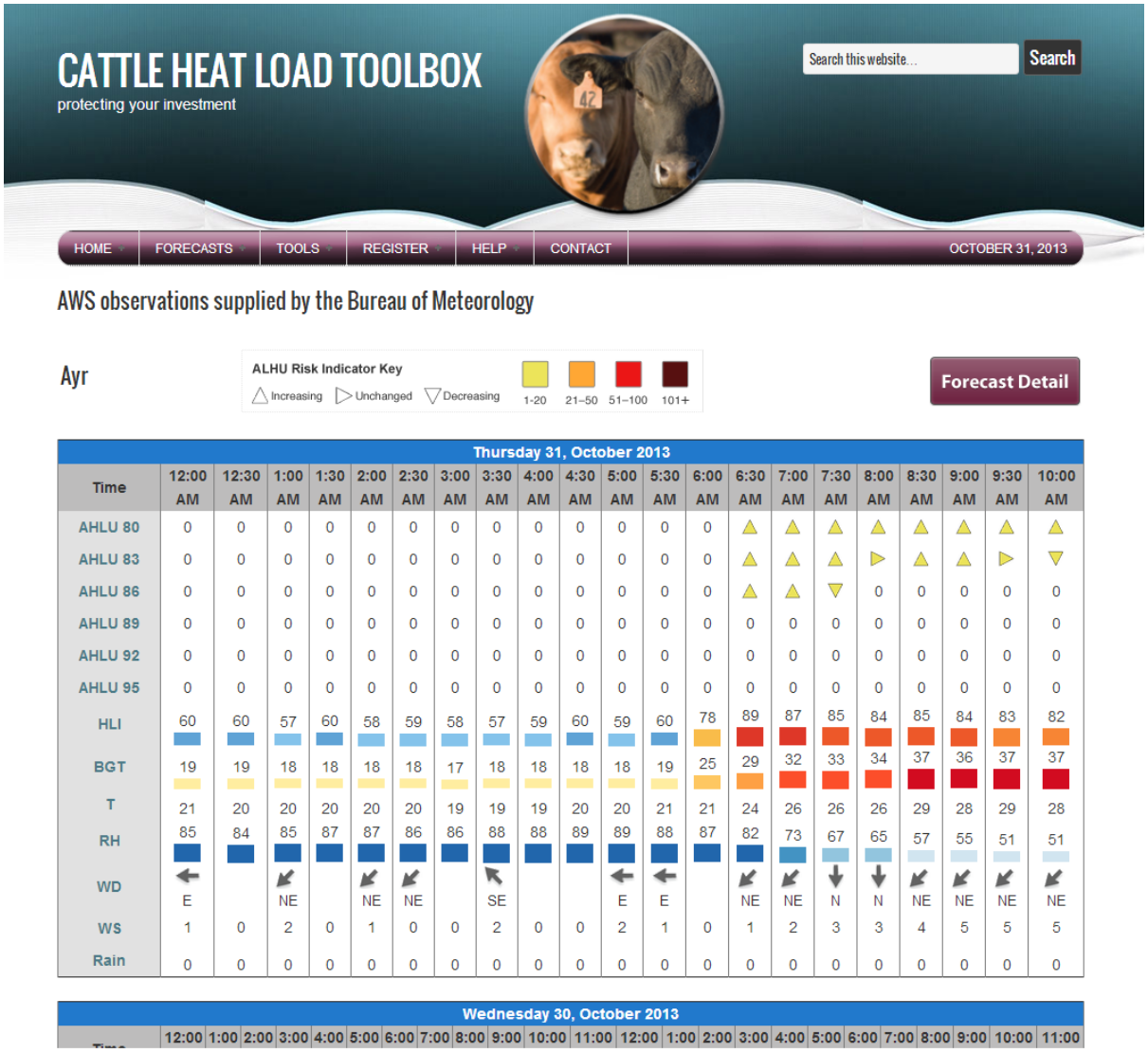


	Thu 31 Oct	Fri 01 Nov	Sat 02 Nov	Sun 03 Nov	Mon 04 Nov	Tue 05 Nov	Wed 06 Nov
HLI Max	87	89	87	84	84	84	89
HLI Min	62	64	62	59	83	83	86
Avg Wind Speed	3	4	5	5	4	4	6
Rainfall (mm)	0	5	2	1	0	0	0

Time	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
AHLU 80	0	0	0	△	△	△	△	△	△	△	▲	▲	▲	▲	▲	▼	▼	▼	▽	▽
AHLU 83	0	0	0	△	△	△	△	△	△	△	△	△	△	65	△	▽	▽	▽	▽	▽
AHLU 86	0	0	0	△	▷	△	▷	▷	▷	▷	▷	▽	0	0	0	0	0	0	0	0
AHLU 89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AHLU 92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AHLU 95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HLI	62	62	62	87	87	87	86	86	86	86	86	85	85	85	84	67	67	67	67	67
BGT	18	18	18	29	33	35	36	37	38	38	38	37	36	34	31	24	23	23	23	22
T	20	20	20	24	26	28	28	29	29	29	29	29	28	27	26	25	25	25	24	24

Figure 4 AHLU risk levels

(http://chlt.katestone.com.au/heat-load-data-network-hldn/)



Thursday 31, October 2013

Time	12:00 AM	12:30 AM	1:00 AM	1:30 AM	2:00 AM	2:30 AM	3:00 AM	3:30 AM	4:00 AM	4:30 AM	5:00 AM	5:30 AM	6:00 AM	6:30 AM	7:00 AM	7:30 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:00 AM
AHLU 80	0	0	0	0	0	0	0	0	0	0	0	0	0	△	△	△	△	△	△	△	△
AHLU 83	0	0	0	0	0	0	0	0	0	0	0	0	0	△	△	△	▷	△	△	▷	▽
AHLU 86	0	0	0	0	0	0	0	0	0	0	0	0	0	△	△	▽	0	0	0	0	0
AHLU 89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AHLU 92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AHLU 95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HLI	60	60	57	60	58	59	58	57	59	60	59	60	78	89	87	85	84	85	84	83	82
BGT	19	19	18	18	18	18	17	18	18	18	18	19	25	29	32	33	34	37	36	37	37
T	21	20	20	20	20	20	19	19	19	20	20	21	21	24	26	26	26	29	28	29	28
RH	85	84	85	87	87	86	86	88	88	89	89	88	87	82	73	67	65	57	55	51	51
WD	← E		↙ NE		↙ NE	↙ NE		↖ SE			← E	← E		↙ NE	↙ NE	↓ N	↓ N	↙ NE	↙ NE	↙ NE	↙ NE
WS	1	0	2	0	1	0	0	2	0	0	2	1	0	1	2	3	3	4	5	5	5
Rain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Wednesday 30, October 2013

Time	12:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00

Figure 5 Observations

(http://chlt.katestone.com.au/public-observations/)

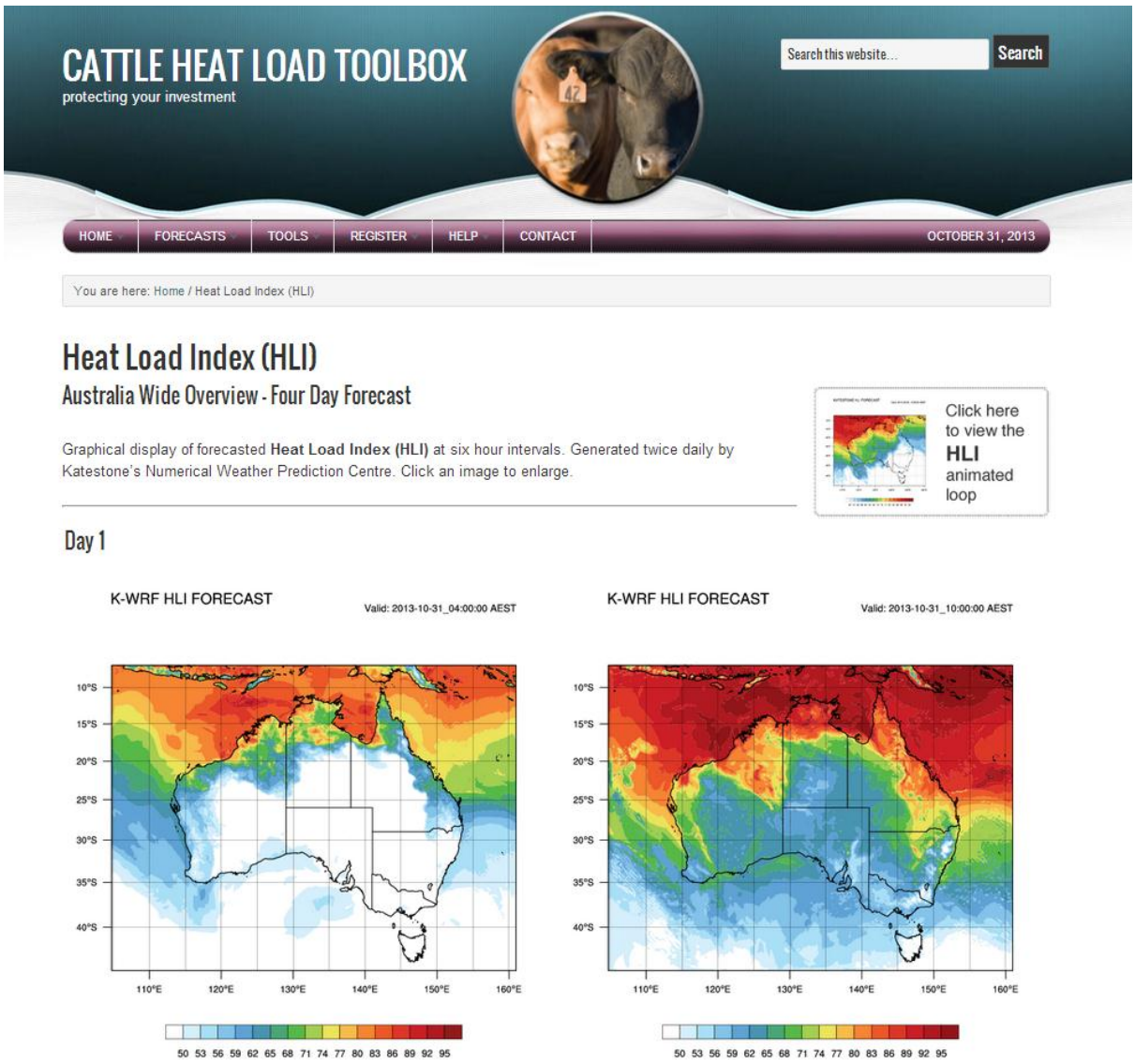


Figure 6 Australia-wide overview - HLI

(http://chlt.katestone.com.au/hli-contour-overview/)

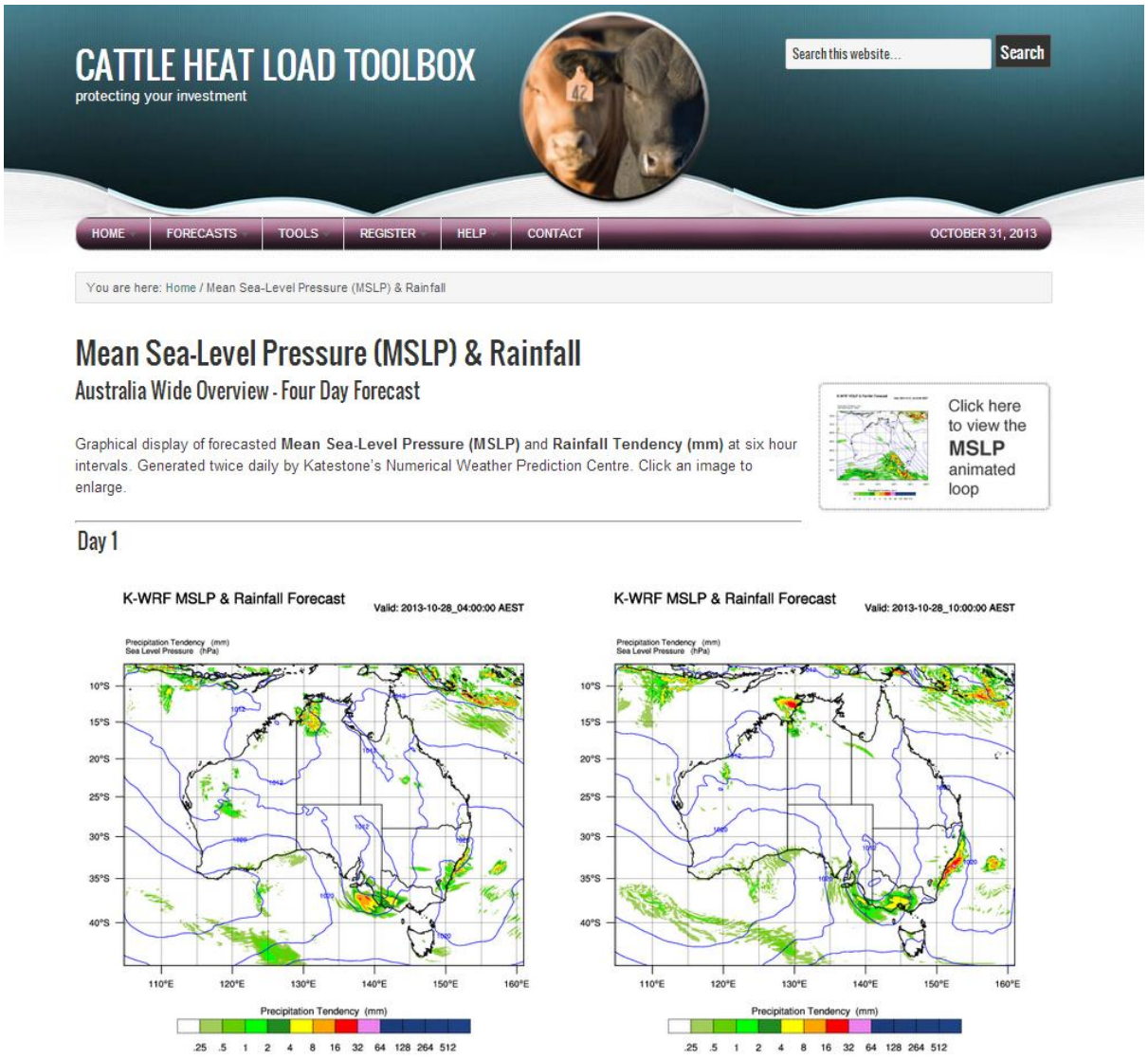


Figure 7 Australia-wide overview – MSLP and Rainfall

(http://chlt.katestone.com.au/mslp-contour-overview/)

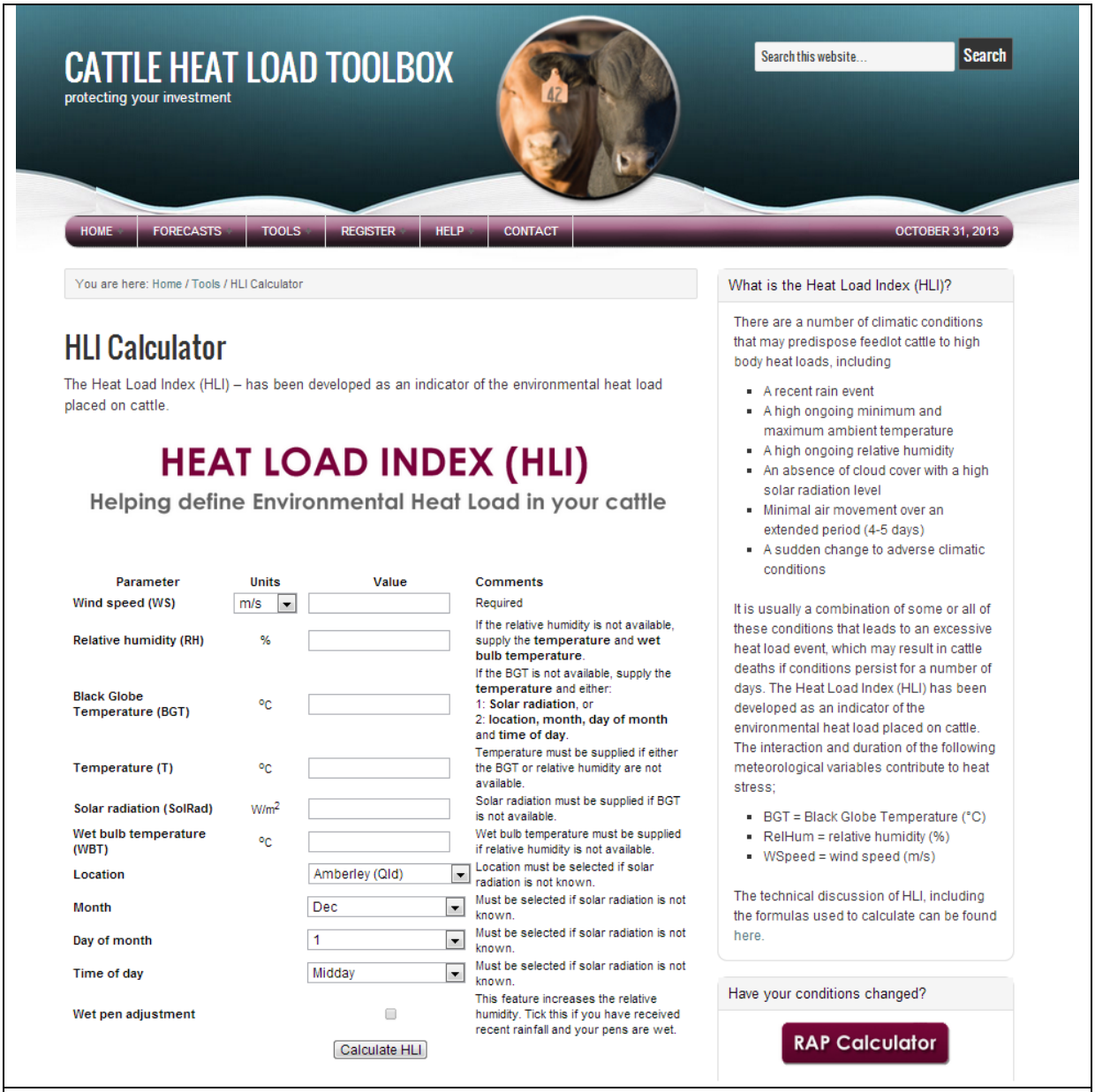


Figure 8 Heat Load Index Calculator

(http://chlt.katestone.com.au/hli-calculator/)

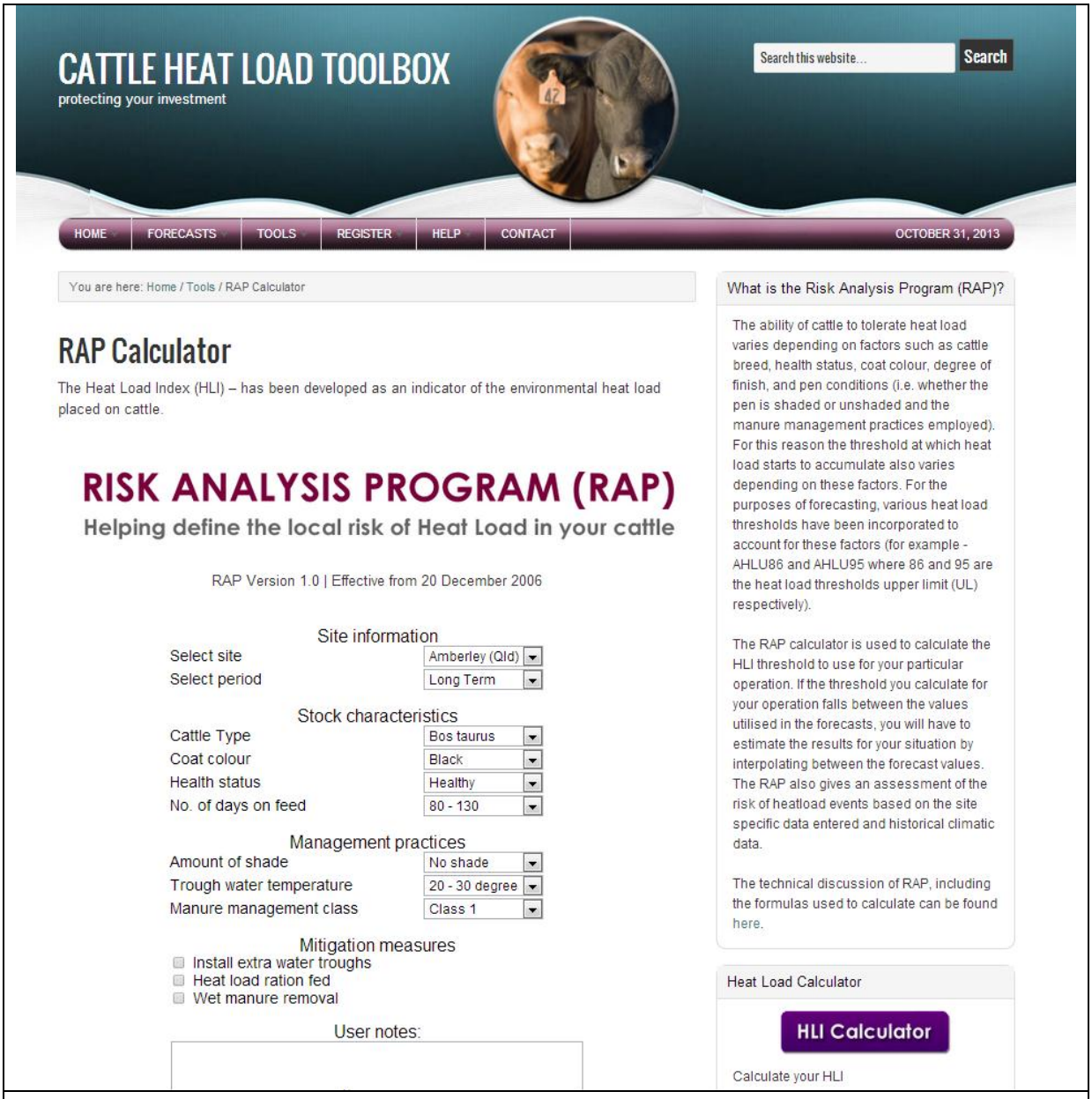


Figure 9 Risk Analysis Program Calculator

(http://chlt.katestone.com.au/rap-calculator/)

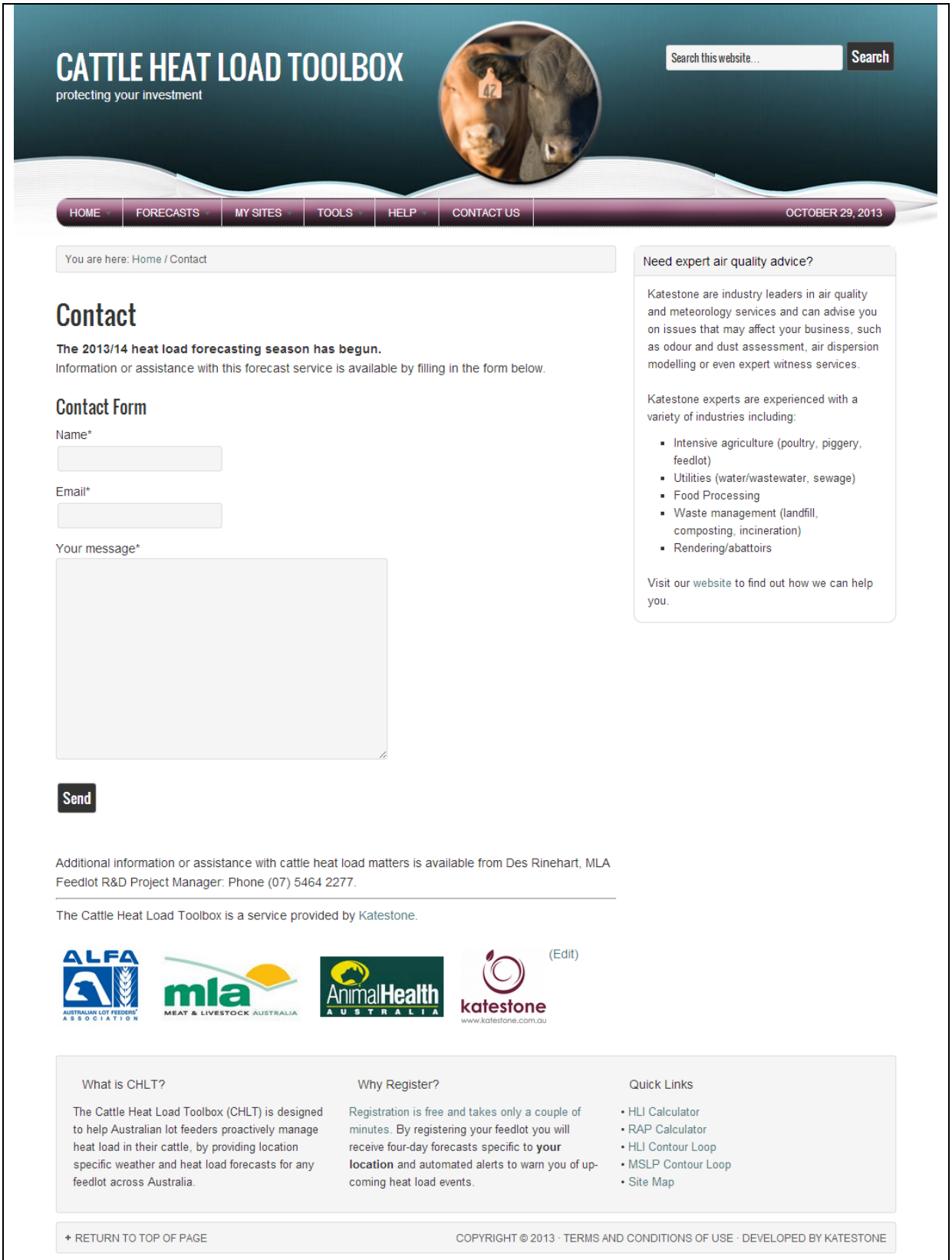


Figure 10 Contact page

(http://chlt.katestone.com.au/contact/)

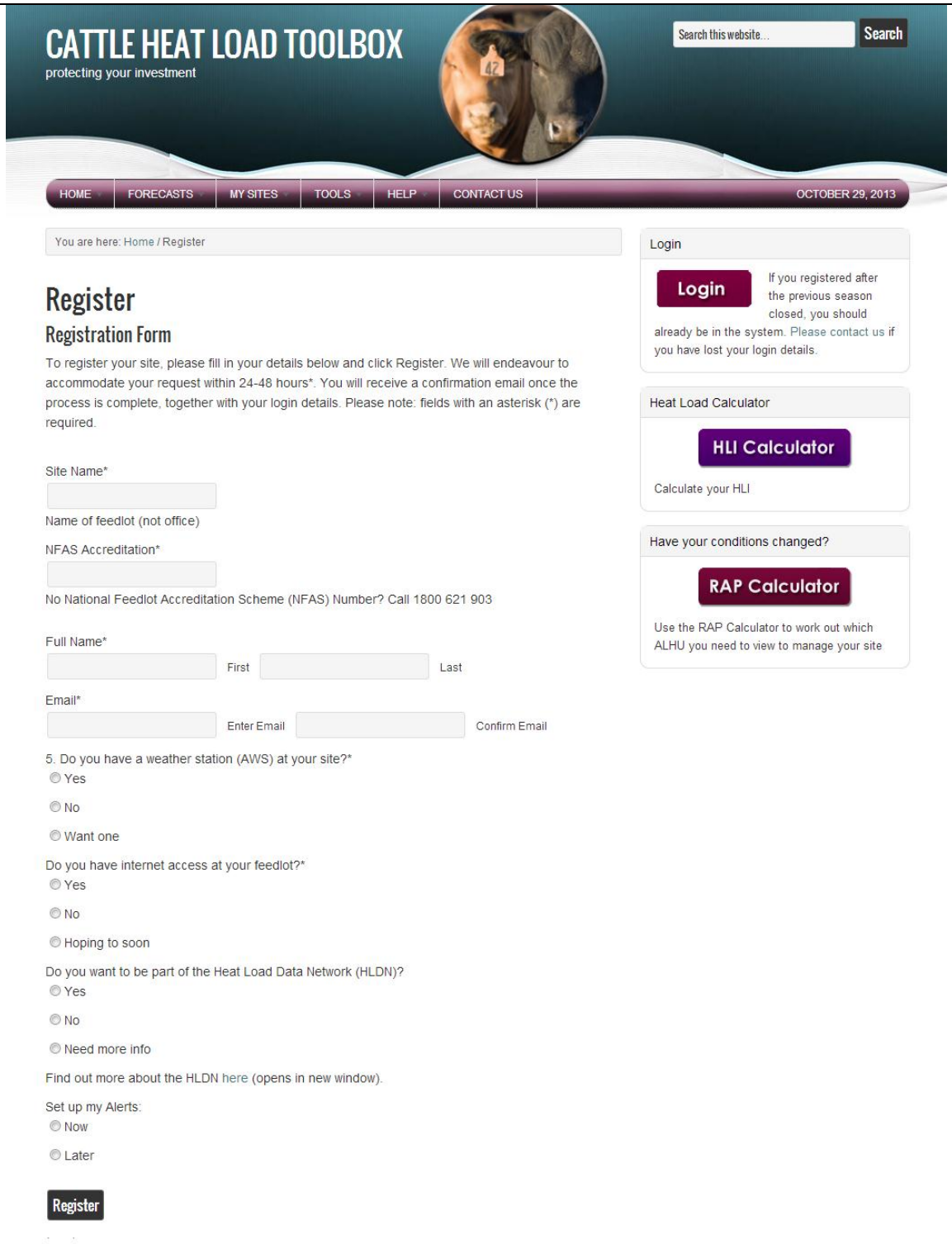


Figure 11 Registration page

(http://chlt.katestone.com.au/register/)

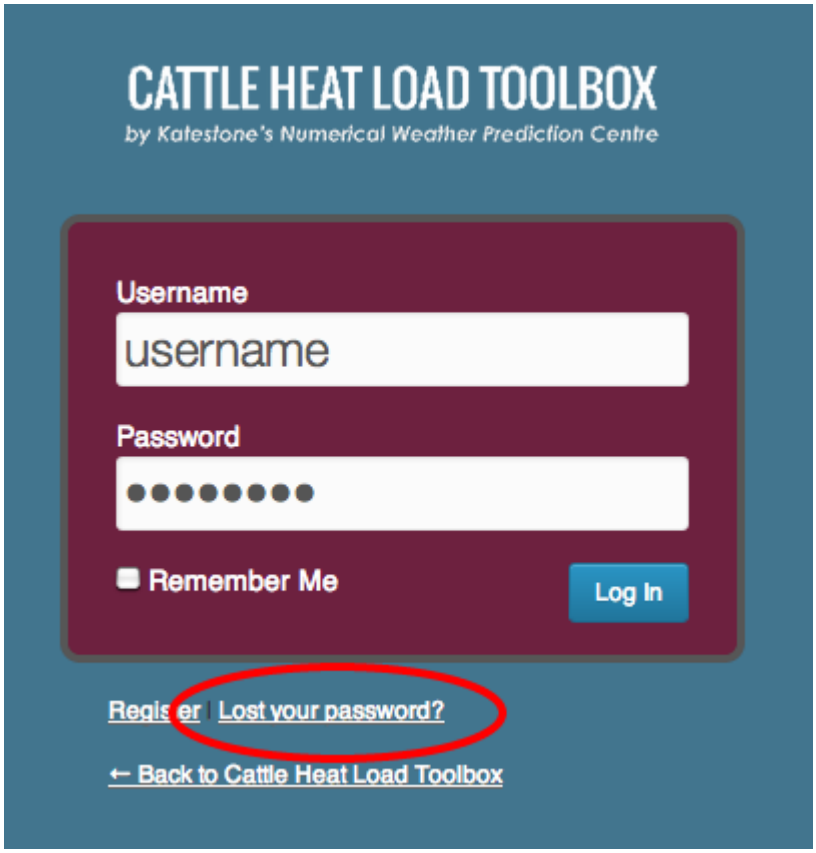


Figure 12 Login page

(http://chlt.katestone.com.au/login/)

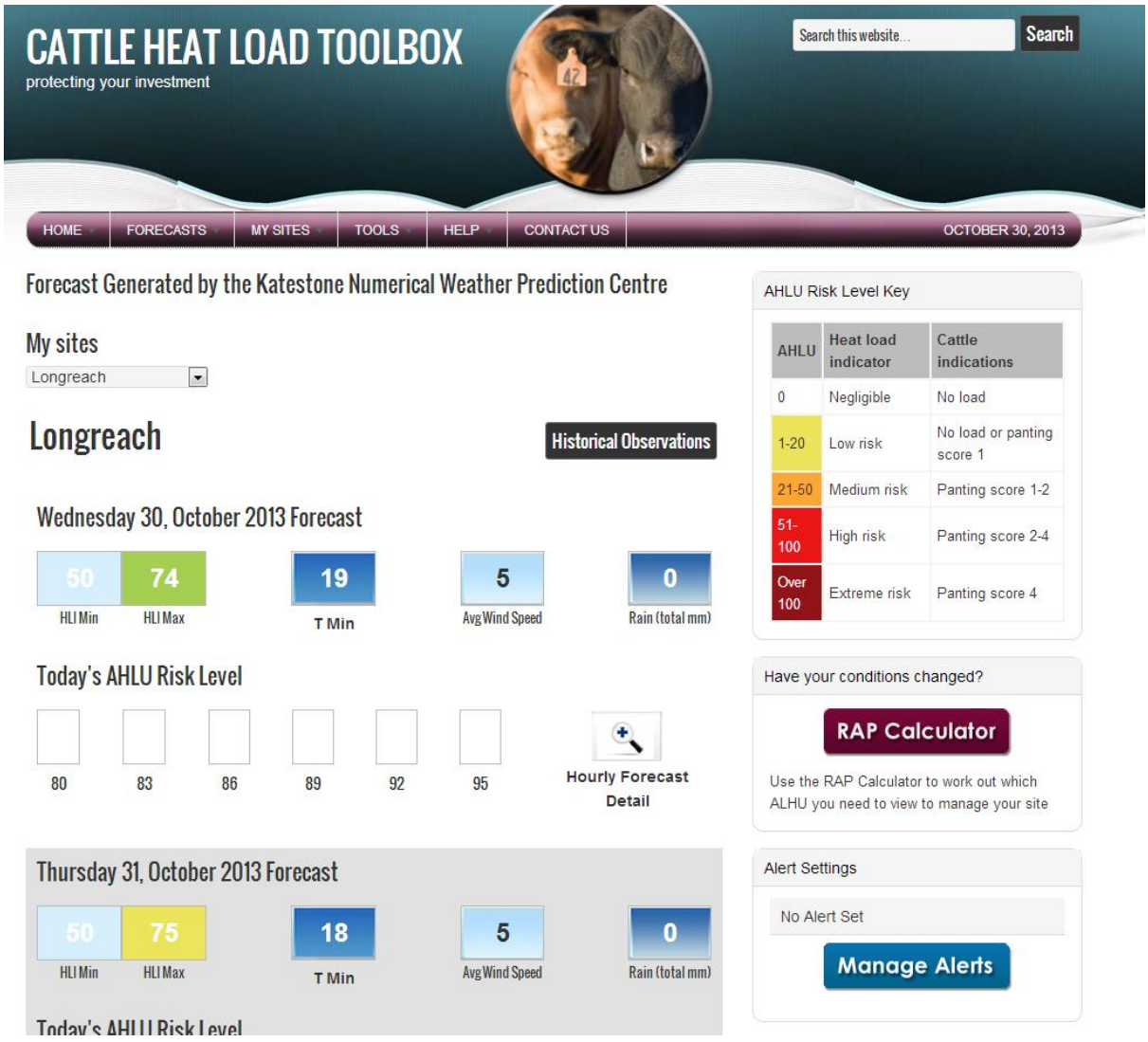


Figure 13 My sites summary

(http://chlt.katestone.com.au/my-site-summary/)

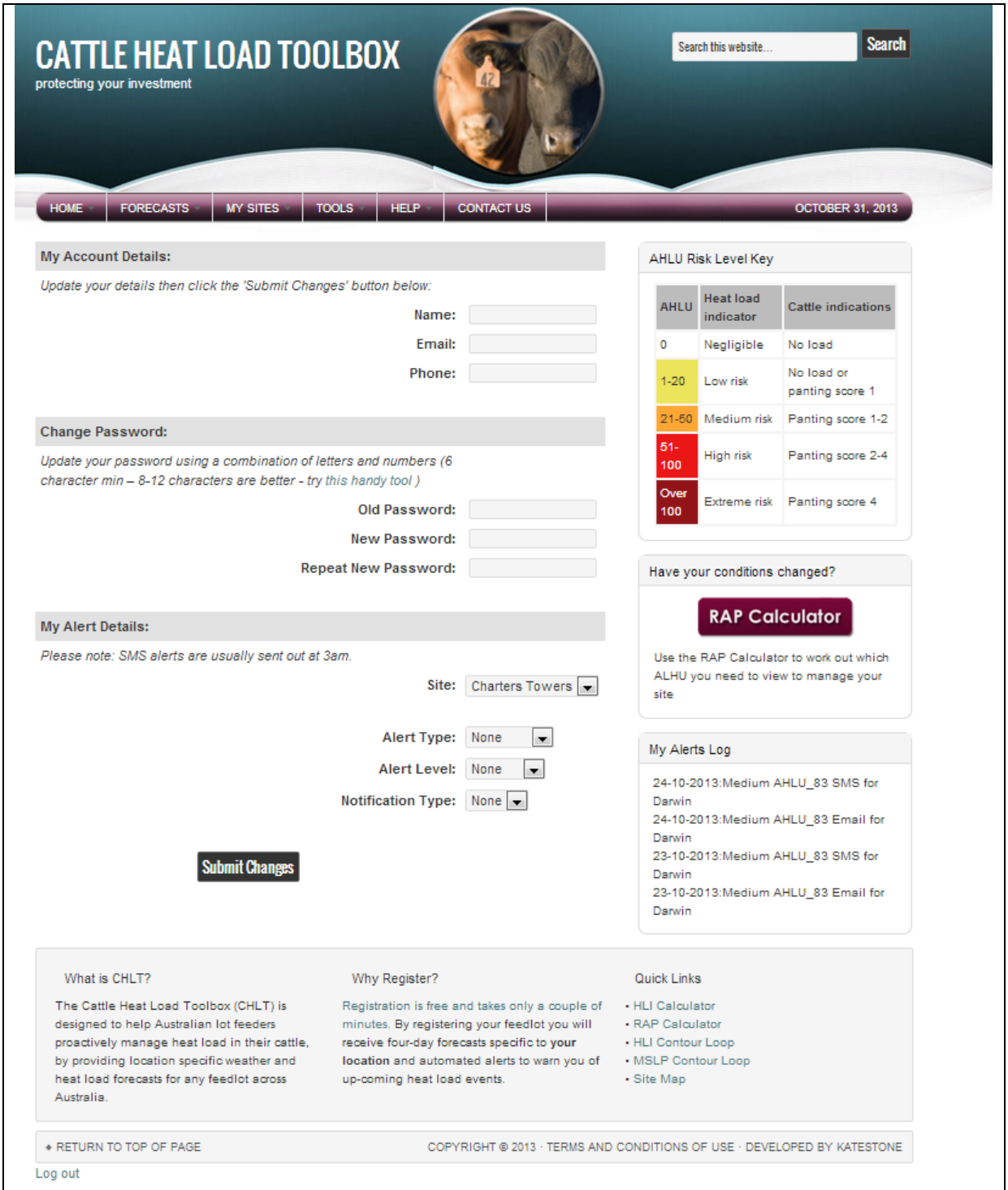


Figure 14 Account management

(http://chlt.katestone.com.au/my-site-summary/my-account/)

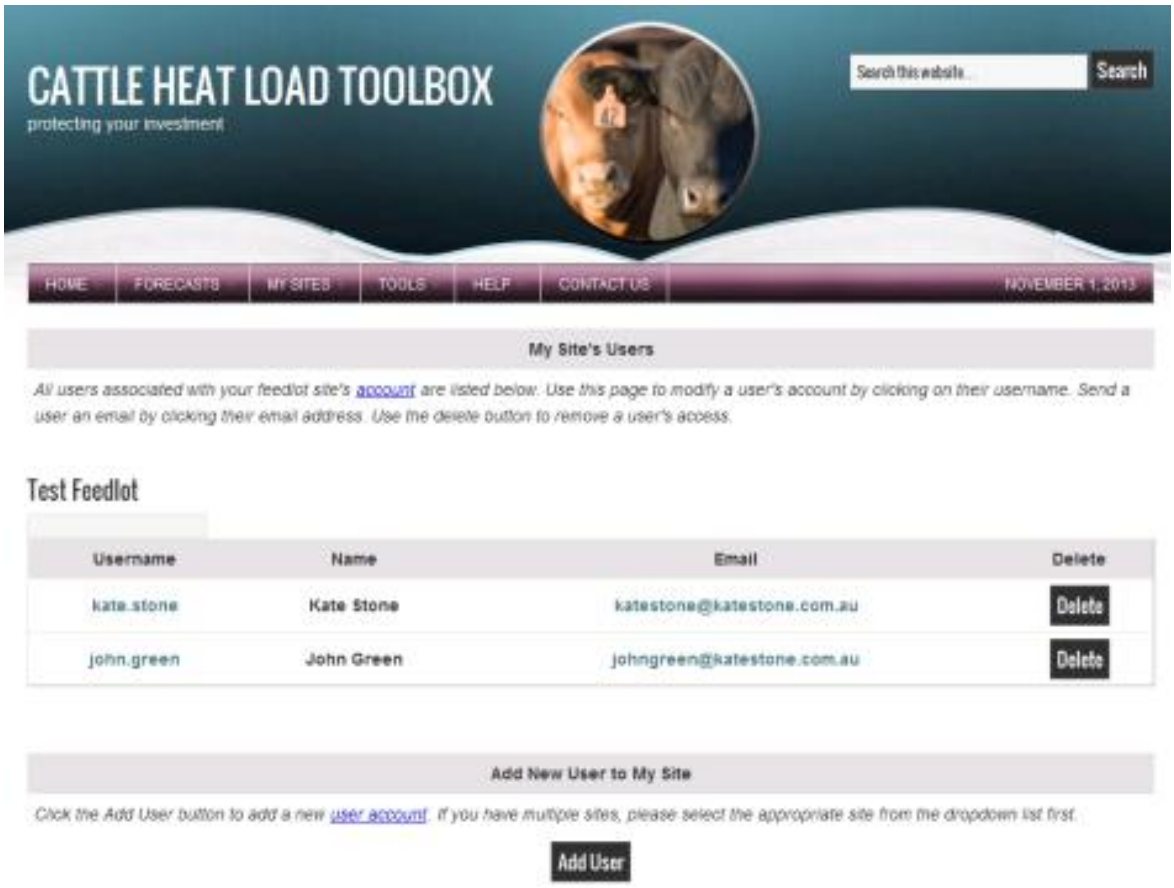


Figure 15 User management

(http://chlt.katestone.com.au/my-site-summary/manage-users/)

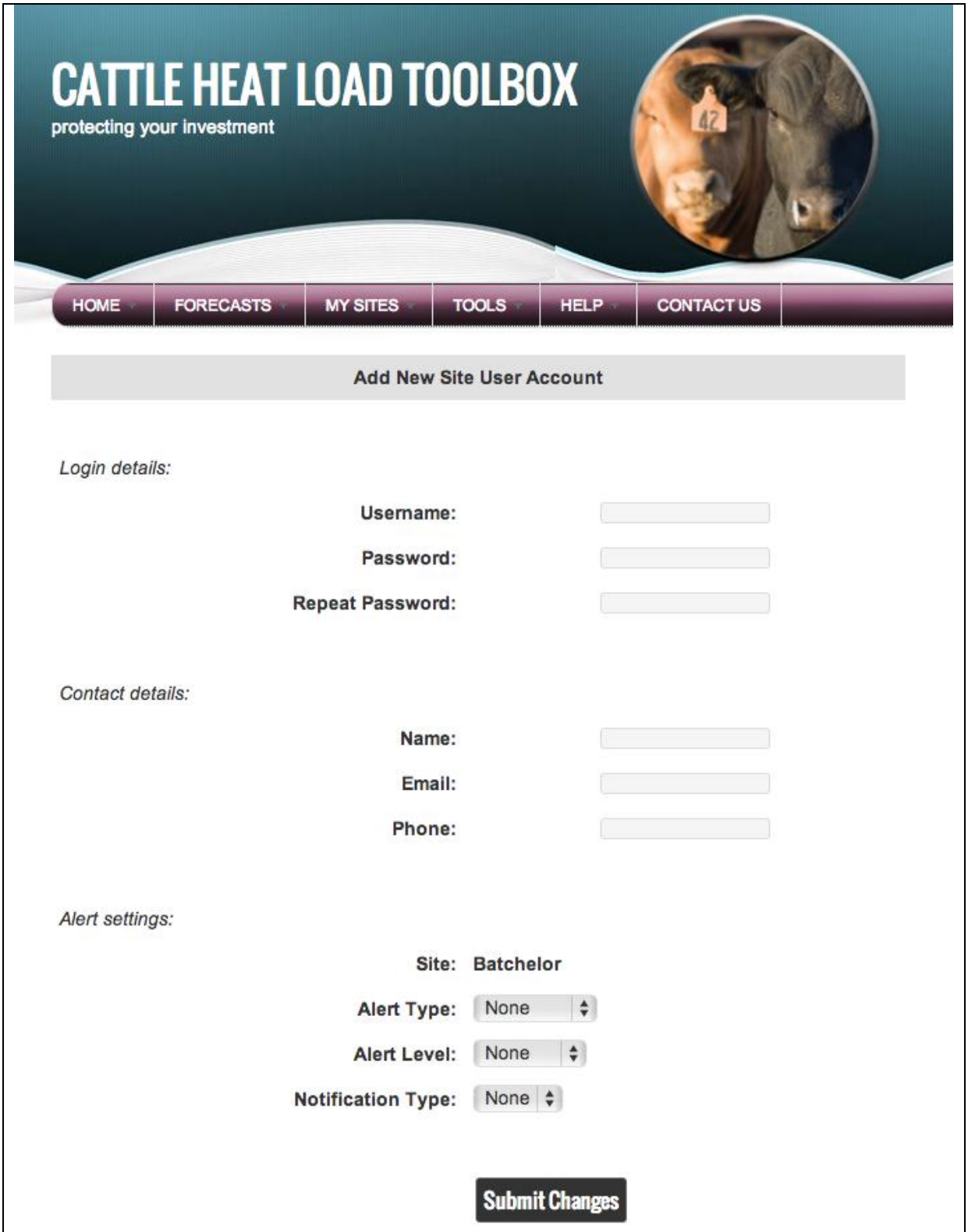


Figure 16 Add users

(http://chlt.katestone.com.au/my-site-summary/add-new/)