PRODUCTIVE SALTLAND PASTURES

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Salinity Manual

Module 2
Extent, Hazard, Risk

Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

natural resource management program

All photos from SGSL DAFWA team

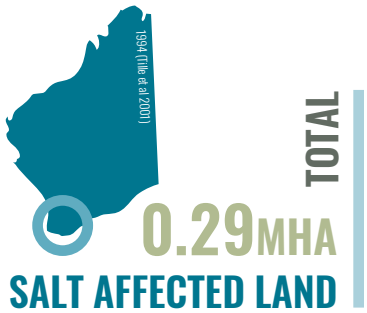
EXTENT OF SALINITY

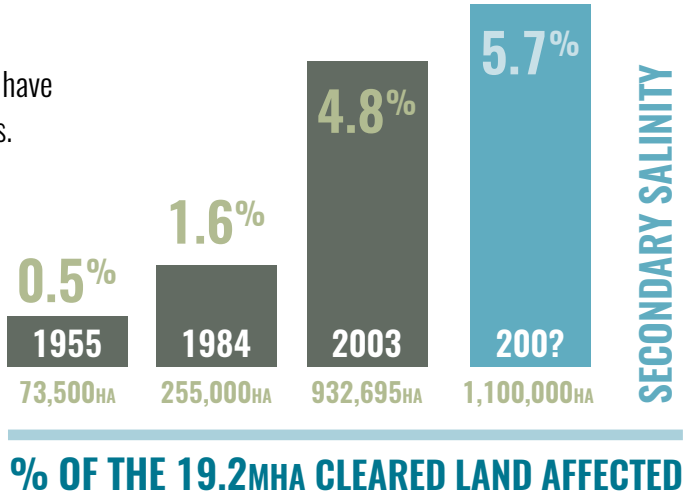
INTRODUCTION

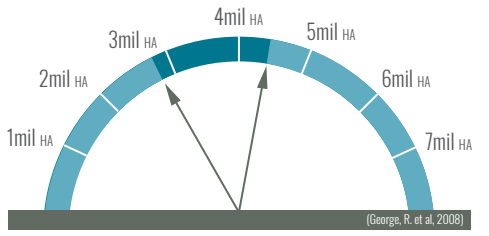
Developing an understanding of the current extent and the potential expansion of salinity will assist with answering the question of "why" salinity is an issue. This module covers the extent of salinity, its hazard and risk in agriculture.

EXTENT OF SALINITY

Secondary salinity has been increasing since land clearing. The earliest statistics for extent of salinity have been collected by the Australian Bureau of Statistics.

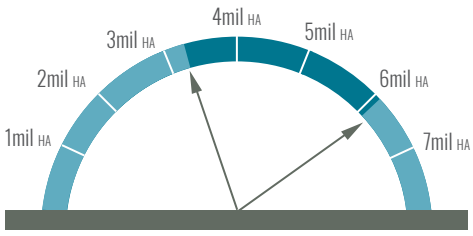






DETERMINED AREA OF LAND OF HAZARD

(area which potentially could have a shallow water table within 2m of the soil surface)



POTENTIAL AREA OF LAND OF HAZARD

(likelihood of the soil becoming saline given current land use patterns and practices)

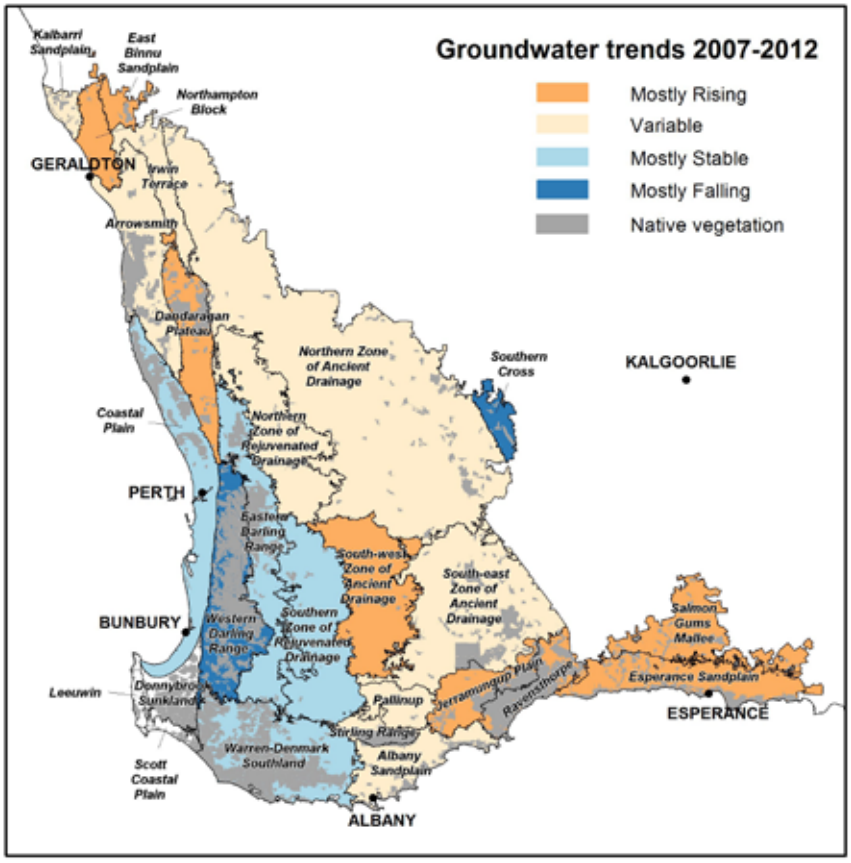
Whatever the final figure is, the amount will reflect the new hydrological equilibrium post clearing.

More Information:

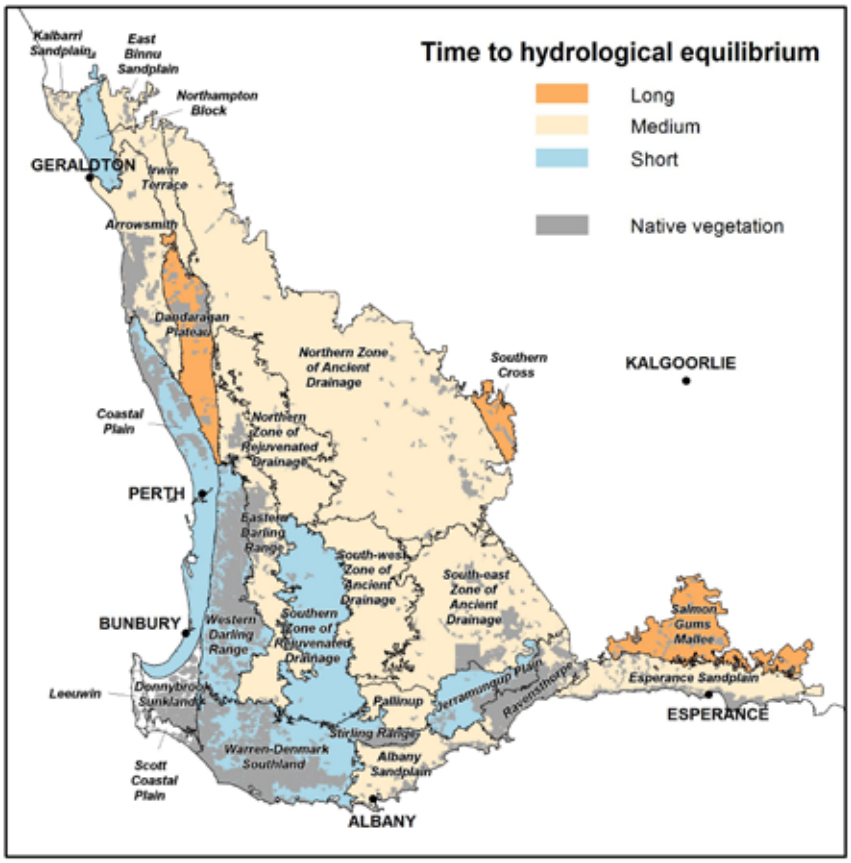
https://www.agric.wa.gov.au/report-card-conditions-and-trends/report-card-sustainable-natural-resource-use-agriculture-western

https://www.agric.wa.gov.au/report-card-conditions-and-trends/groundwater-trends-agricultural-areas-western-australia

Hydrological zones of the agricultural area of Western Australia showing:



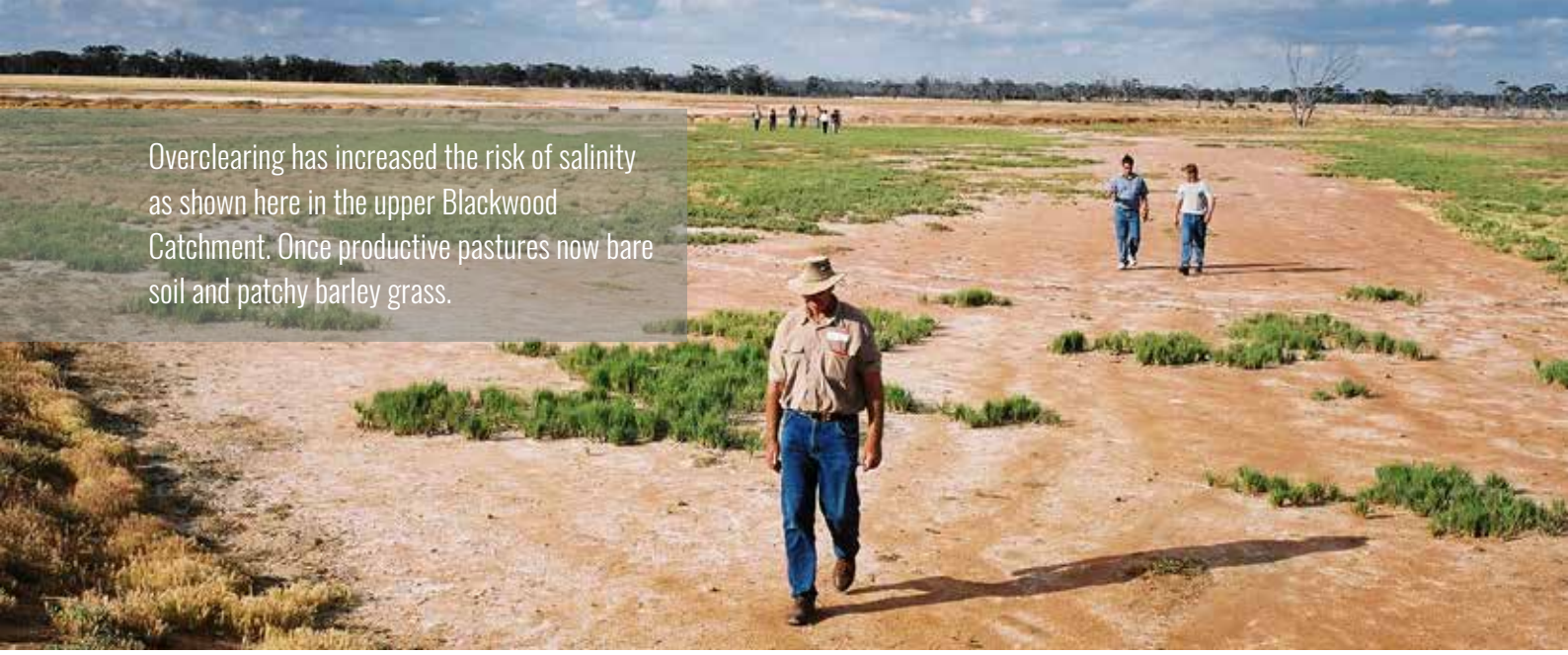
(a). groundwater trends;



(b). time to hydrological equilibrium.

0 100 200
Kilometres

Compiled by: Geographic Information Services, DAFWA
Date: June 2013
Projection: Transverse Mercator
Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia 1994 Zone 50



Overclearing has increased the risk of salinity as shown here in the upper Blackwood Catchment. Once productive pastures now bare soil and patchy barley grass.

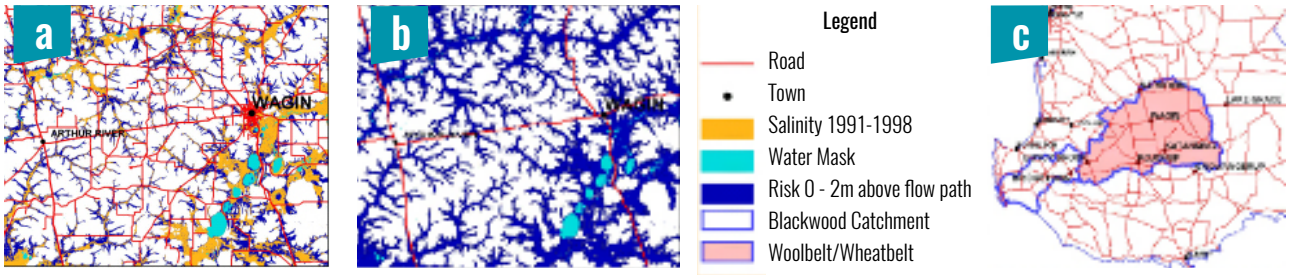
HAZARD

Salinity hazard is defined as land that may develop a shallow water table within 2m of the soil surface and salt is also a hazard as it leads to salinity where it has the potential to be moved to where it can threaten assets such as agriculture, infrastructure, water resources and biodiversity. Salt stored in the ground may be mobilized by water and transported vertically and horizontally. To assess the hazard area, a map of current saline areas is overlain with surface contours and water table trend data.

These maps are available from the DPIRD salinity webpages and include definitions and relating to the impact on salinity of a drying climate:

https://www.agric.wa.gov.au/resource-assessment/interactive-groundwater-and-salinity-map-south-west-agricultural-region

They provide a spatial context of current and hazard areas of salinity.
Land monitor maps showing areas of current salt affected land (Map 1a) and hazard (Map 1b) as well as the legend for these maps. Map 1c shows the wheatbelt and woolbelt study area.



Land monitor maps showing areas of current salt affected land (a) and valley hazard (b). Map (c) shows the Wheatbelt and Woolbelt study area.

RISK

Areas with a high salinity risk are defined as those with a likelihood of soil becoming saline given the current landuse, trends in water table rise and management practices. It is different from "hazard' in the sense that landuse can increase or decrease the risk while hazard will always remain as hazard areas. Understandably, many factors influence this. Some are the depth, quality and trend of groundwater, as well as landuse and management of the landscape. Groundwater monitoring of some 1,300 bores across the SW agriculture area has shown that prior to 2000 almost all had a rising trend. However since then rates of rise have varied and in some cases groundwater levels have fallen in response to a drier climatic variation. (George, R., 2009)

MAPPING SALINITY

METHODS OF MAPPING SALINITY

Mapping salinity can be a difficult task. When looking at maps of salinity, it should be related back to the interpretation of salinity and/or the method which will help determine its accuracy and at what scale it can be applied. There are a number of methods which have been used to map or estimate salinity in WA.

AUSTRALIAN BUREAU OF STATISTICS

Since 1955 – 2002 the ABS has included a question in their survey asking landholders to estimate the area of salt affected land on their property. The accuracy of this data is dependant on what each landholder perceives as salinity. Over time this reported pattern by landholders made sense when compared to the mapped data.

More information on DPIRD interactive salinity mapping webpage:

https://www.agric.wa.gov.au/resource-assessment/interactive-groundwater-and-salinity-map-south-west-agricultural-region

AERIAL PHOTOGRAPHY

Areas of salt affected land are marked out on air photos after interpretation by hydrologists and ground truthing in the field. This is useful for reasonably detailed information at a small scale but is too extensive if large areas need to be mapped and is dependant on the amount of experience/knowledge of the individual.

SOIL SURVEYS

Surveying and mapping soils by digging numerous hole, taking soil samples and looking at soil-vegetation relationships has been completed in most regions and have resulted in maps which can show current saline soils based on actual and interpreted data.

GEOPHYSICAL INSTRUMENTS

Instruments such as EM38 (electromagnetic) or EM31 can be used to measure the bulk amount of salt stored in a certain depth of soil. The accuracy and resolution of the survey is dependant on whether the survey is carried out on the ground (good accuracy and resolution for paddock scale) or by air (useful for catchment and regional studies). In most cases a contour map is produced of the area with different colours representing the various salt content. This type of mapping is commonly used to help with land management planning as well as assessment of a site before and after treatment.

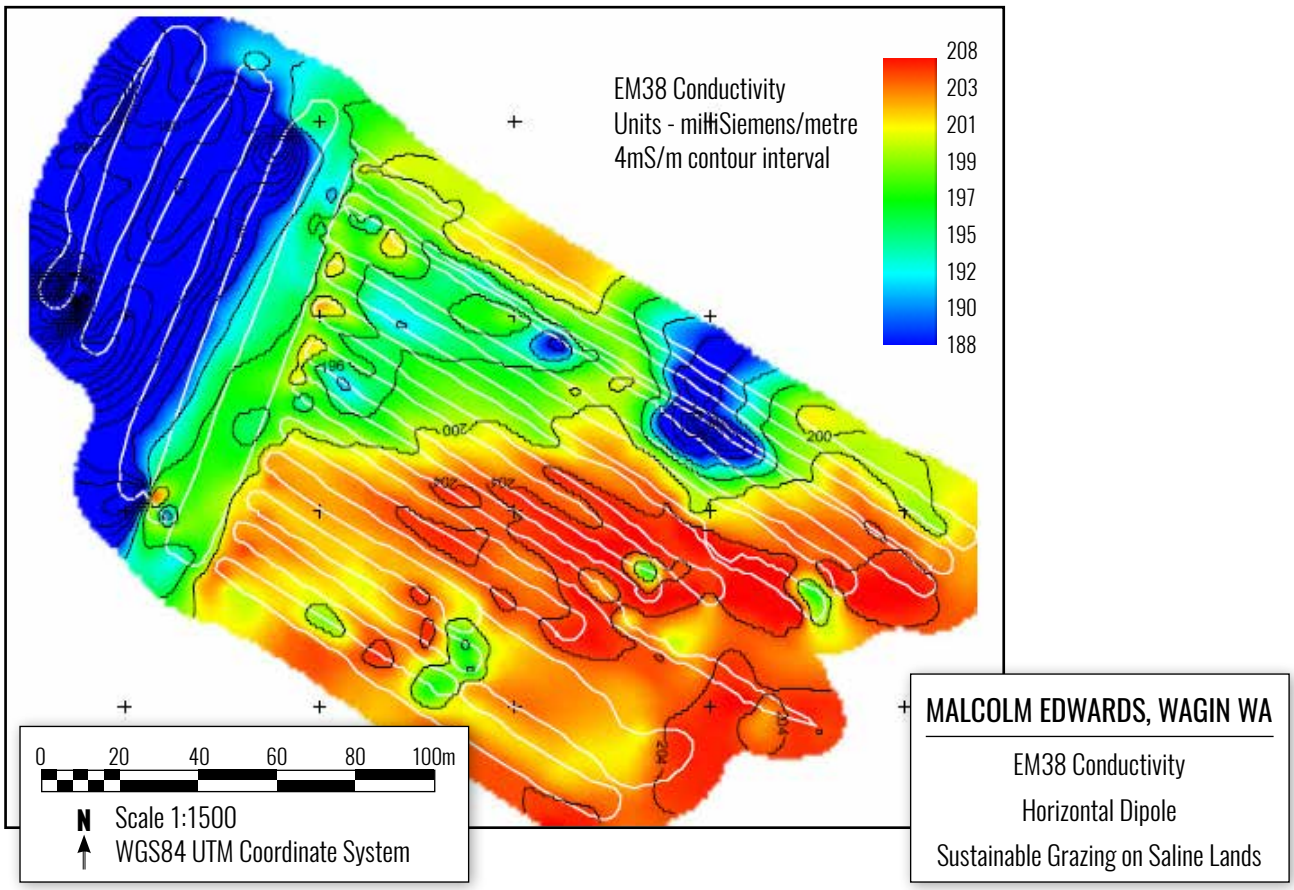


Figure 2. Ground based EM38 survey contour map survey shows the variation of salt store in a paddock, white lines are the tracks of the GPS on the quad bike dragging the EM38 instrument.

SATELLITE REMOTE SENSING

Landsat thematic mapping images are used to map areas of current and hazard areas. The technique is complex but involves using multiple scenes of the same region which are then overlain identifying areas which consistently show up as low producing areas. Research using groundtruthing has enabled these areas to be classified as saline. Confidence that current areas of saline land are being mapped correctly has improved with further fine tuning. This method has been accepted and is used for the mapping of current salinity and changes at a farm scale with a reasonable accuracy.

IMPACTS

Salinity is one of the greatest environmental threats facing Western Australia's agricultural land, water, biodiversity and infrastructure.

INFRASTRUCTURE

Infrastructure can be affected by damage resulting from rising groundwater levels or excessive waterlogging. Examples include cellars of hotels needing to be pumped out weekly due to the seepage of groundwater. Brickwork on old homes with out damp course showing signs of crumbling. Roads with excessive crumbling of the bitumen or folds and pit holes developing on the surface.

Roads are impacted when they cut across valley floors affected by high and saline water levels. Typified by this photo from the central Wheatbelt.

Many rail networks constructed in the lowest parts of the landscape with low gradient making railways particularly vulnerable. Likewise, many rural towns are located next to these rail networks and are at risk. During the mid-2000s, the State Government instigated a Rural Town Program, which, over a number of years assisted 38 towns and shires in dealing and managing with the impacts of salinity.

A frequent issue in many of the towns of the upper Blackwood catchment is the corrosive effect of rising saline groundwater on brickwork, cement and render such this photo (from Katanning).

WATER RESOURCES

The major threat to water resources is to river health with its impact being felt further than just the source of salinity. Irrigation, stock and domestic, industry and the environment all depend on a reliable supply of good quality water from river systems. As salinity within catchments worsens, there is a greater potential for increasing the salinity level of waterways. High salinity levels limit the use of the water for domestic, irrigation and industrial users and threaten the health of river ecosystems. Most river systems with large cleared catchments in the agricultural regions of Western Australia are already too saline for human consumption. Catchments with water quality suitable for human consumption are generally within the higher rainfall zone and have a lower percentage of cleared area.

Both west of Katanning; (a) Carlecatup River, fenced and managed semi permanent water body; (b) Carrolup River, fenced, managed and regenerating, includes local native salt tolerant species

BIODIVERSITY

The impacts on biodiversity is investigated by Department of Biodiversity, Conservation and Attractions (DPCA), which undertake biological surveys in agricultural areas as part programs such as of the Salinity Action Plan (1996). The agricultural zones cover all, or significant parts of six of the eight biogeography zones recognised in temperate south-western Australia (DBCA 1999). Threatened Ecosystems (TEC), as defined by English and Blyth (1999), are also being examined by DPCA. Examples of impacts include tree and shrub death, change in plant species as plants sensitive to salt die and those more tolerant become dominant, loss of habitat and protection for particular fauna species, a reduction in food and or type for native fauna.

AGRICULTURE

Agriculture has the largest impact in terms of area affected. Examples include loss of arable land, bores and dams becoming unusable as they become saline, increased erosion and surface runoff from bare saline areas, broad valley floors which were once the most productive land turn saline as catchments become fully cleared, farms with large areas of salt become unviable and hence need to buy more land or sell.

The statewide loss of annual production due to salinity was estimated to be $557 mil).

A previously productive valley turned saline that is sparsley covered by sea barley grass and puccinellia enabling it to provide cover and some grazing.

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QUESTIONS

1. What is salinity "Hazard"?
    - ❑ A hazardous bare area of land to look out for.
    - ❑ A area of land that may develop a shallow water table within 2m of the soil surface.
    - ❑ A radioactive area of soil.

2. When will salinity reach its final extent?
    - ❑ Never
    - ❑ When annual rainfall decreases by 10%.
    - ❑ When a new hydrological equilibrium is established post clearing.

3. Which method is widely used to estimate current and hazard areas of salinity?
    - ❑ Satellite remote sensing with ground contours.
    - ❑ Soil surveys.
    - ❑ EM38.

4. Can an EM38 instrument provide you all the information you need to determine the hazard and risk of salinity?
    - ❑ No
    - ❑ Yes

5. Agriculture suffers the largest impact in terms of area affected by salinity?
    - ❑ True
    - ❑ False
    - ❑ Maybe

6. What is the estimated loss of annual production from agricultural land due to salinity.
    - ❑ 102.6mil
    - ❑ 44.2mil
    - ❑ 14.8mil

NOTES

PRODUCTIVE SALTLAND PASTURES

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