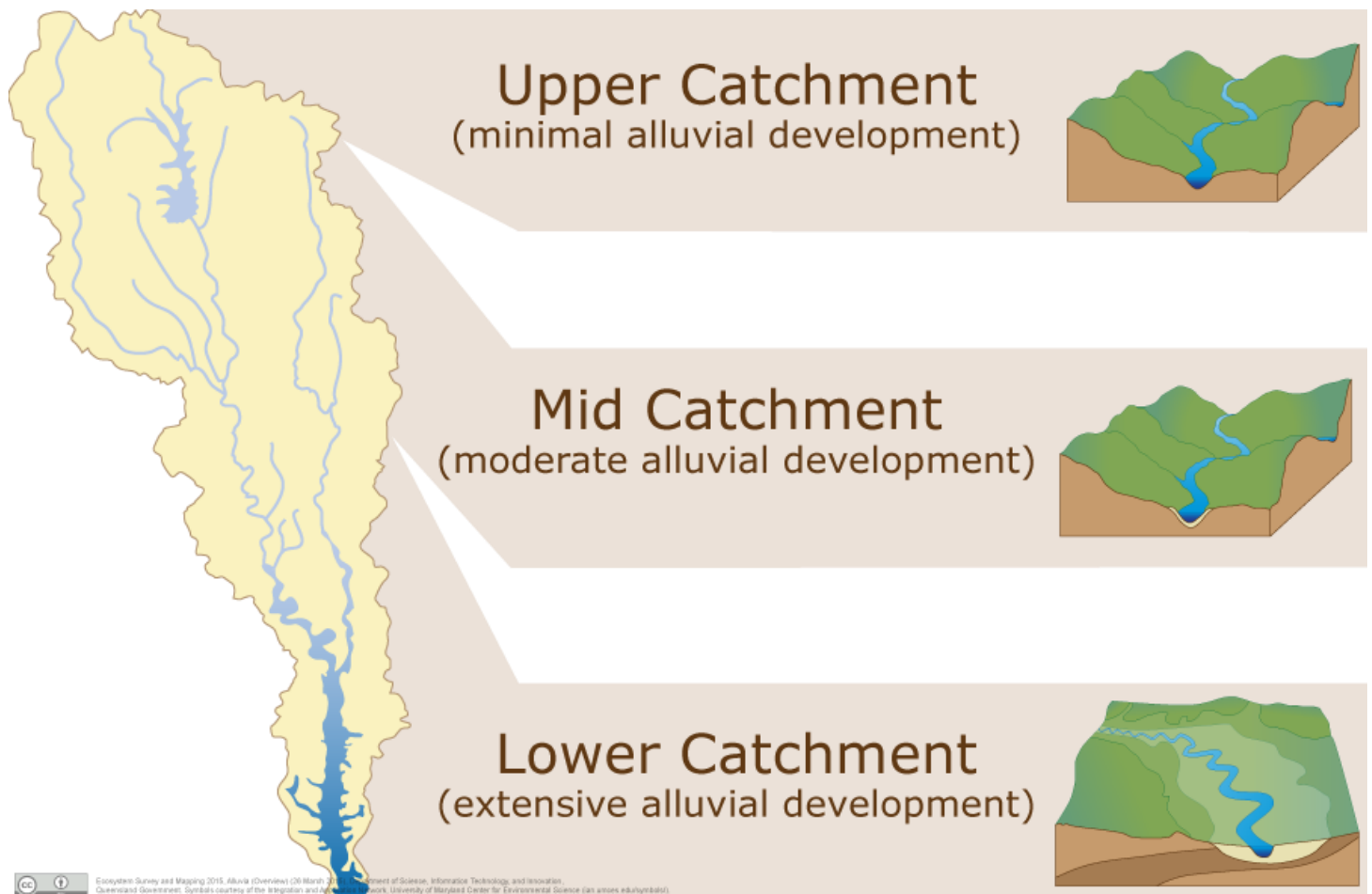


Groundwater dependent ecosystem pictorial conceptual model 'alluvia'

Version 1.5

Alluvia - overview

Alluvia is formed from particles such as gravel, sand, silt and/or clay deposited by physical processes in river channels or on floodplains. Alluvia can contain one or more unconfined, unconsolidated sedimentary aquifers, where groundwater is stored and transmitted through intergranular voids between gravel and sand particles.



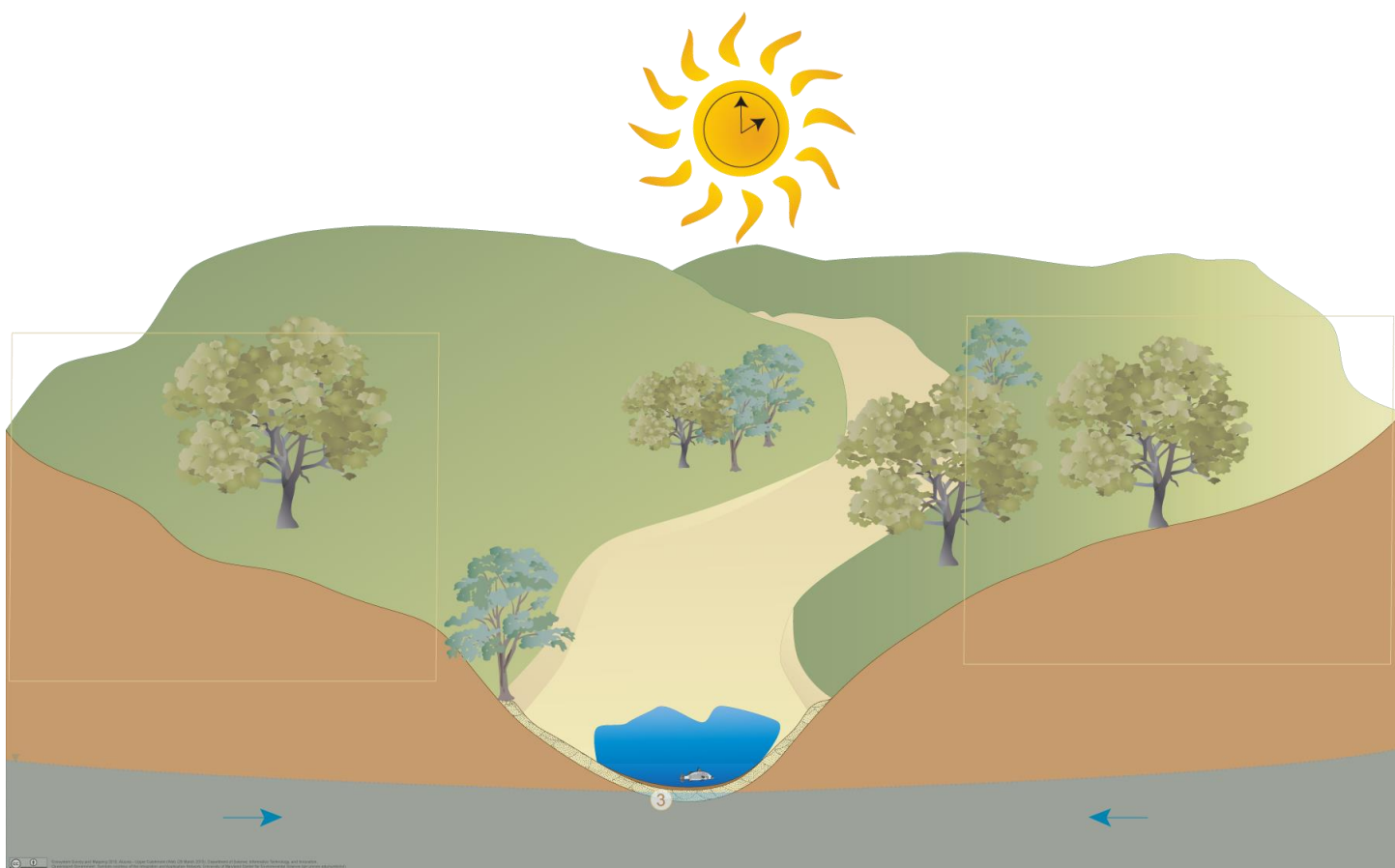
Alluvia – upper catchment (minimal alluvial development)

Alluvia – upper catchment – dry (minimal alluvial development)

In upper catchments alluvial aquifers are formed from particles such as gravel, sand and minor silt or clay deposited by physical processes in channels. Alluvia may contain unconfined, unconsolidated sedimentary aquifers, where groundwater is stored and transmitted through intergranular voids between gravel and sand particles. In upper catchments channels may have little or no alluvial development, groundwater may move through surrounding permeable rocks into the limited alluvia present and discharge into channels. In drier months the groundwater table usually drops below the surface resulting in little or no baseflow. There may be some residual pools trapped by low permeability layers beneath the channels.

Unconsolidated sedimentary aquifers in upper catchment areas may provide a range of ecosystems with water required to support their fauna and flora communities, ecological processes and delivery of ecosystem services.

- Palustrine (e.g. swamps), lacustrine (e.g. lakes) and riverine (e.g. streams and rivers) wetlands may depend on the surface expression of groundwater from these unconsolidated sedimentary aquifers which are supported by surrounding permeable rocks.
- Terrestrial vegetation fringing channels on alluvia may depend on the subsurface presence of groundwater in these unconfined, sedimentary aquifers.
- Unconsolidated sedimentary aquifers in alluvial deposits may also support ecosystems within the aquifer itself, which sometimes is indicated by the presence of stygofauna.



Geology legend



Alluvia
Unconsolidated sand, clay and gravel



Low permeability rock
In drier periods of time, clay and silt may form spatially patchy low permeability layers that disconnect surface water from groundwater in the alluvia



Moderate to high permeability rock
Stores and transmits groundwater through void spaces in the rock

Groundwater hydrology legend



Alluvia (saturated)



Alluvia (unsaturated)



Moderate to high permeability rock (saturated)



Moderate to high permeability rock (unsaturated)



Low permeability rock (unsaturated)



Groundwater table



Direction of groundwater movement



Drier periods of time

Flora legend



Eucalyptus spp.



Melaleuca spp.

Fauna legend



Fish

Groundwater dependent ecosystem legend



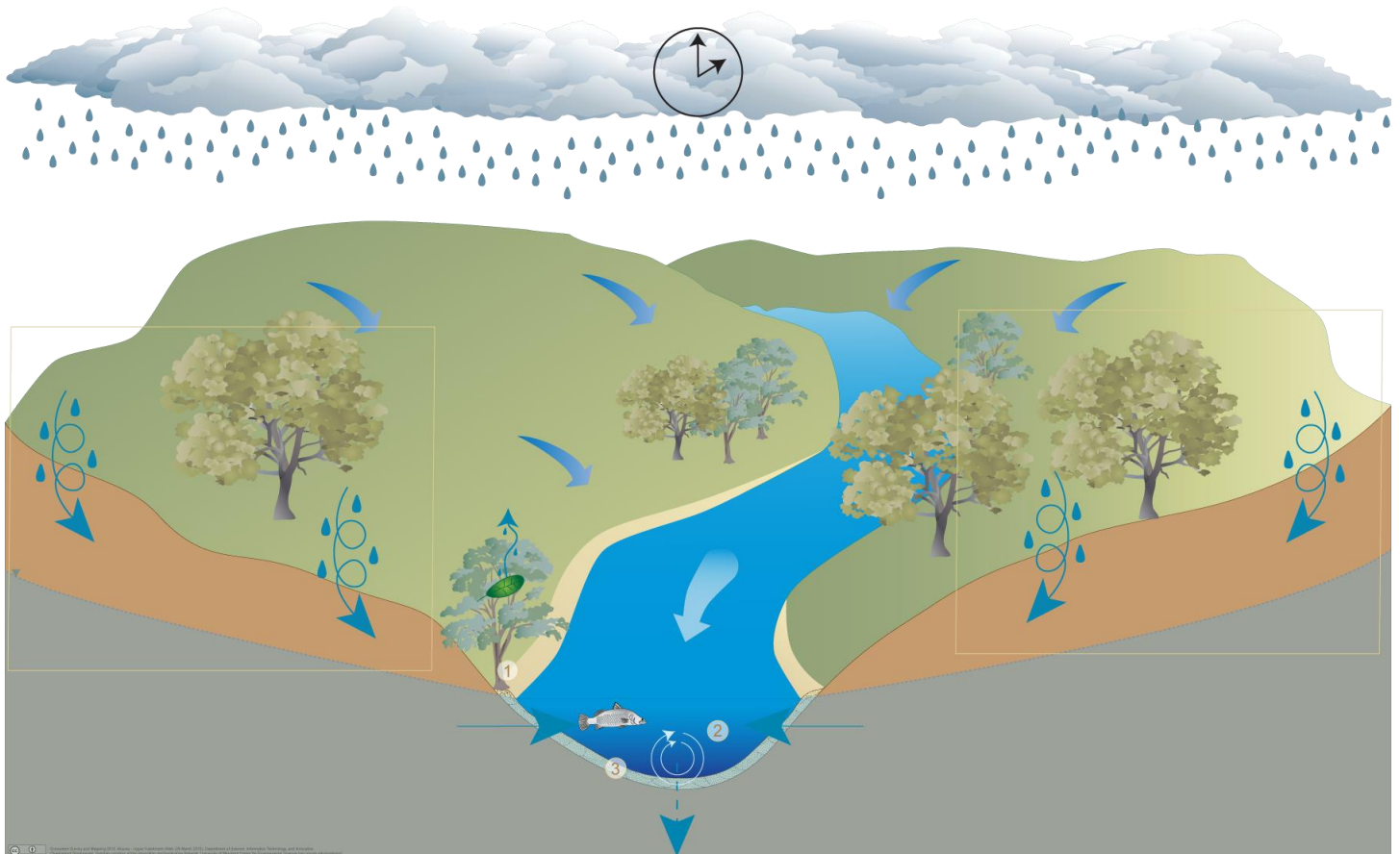
Subterranean GDEs
Aquifer and cave subterranean wetlands may depend on the subterranean presence or expression of groundwater for some or all of their water requirements.

Alluvia – upper catchment – wet (minimal alluvial development)

In upper catchments alluvial aquifers are formed from particles such as gravel, sand and minor silt or clay deposited by physical processes in channels. Alluvia may contain unconfined, unconsolidated sedimentary aquifers, where groundwater is stored and transmitted through intergranular voids between gravel and sand particles. In upper catchments channels may have little or no alluvial development, groundwater may move through surrounding permeable rocks into the limited alluvia present and discharge into channels.

Unconsolidated sedimentary aquifers in upper catchment areas may provide a range of ecosystems with water required to support their fauna and flora communities, ecological processes and delivery of ecosystem services.

- Palustrine (e.g. swamps), lacustrine (e.g. lakes) and riverine (e.g. streams and rivers) wetlands may depend on the surface expression of groundwater from these unconsolidated sedimentary aquifers which are supported by surrounding permeable rocks.
- Terrestrial vegetation fringing channels on alluvia may depend on the subsurface presence of groundwater in these unconfined, sedimentary aquifers.
- Unconsolidated sedimentary aquifers in alluvial deposits may also support ecosystems within the aquifer itself, which sometimes is indicated by the presence of stygofauna.



Geology legend



Alluvia
Unconsolidated sand, clay and gravel



Moderate to high permeability rock
Stores and transmits groundwater through void spaces in the rock

Groundwater hydrology legend



Alluvia (saturated)



Alluvia (unsaturated)



Moderate to high permeability rock (saturated)



Moderate to high permeability rock (unsaturated)



Groundwater table



Infiltration and percolation
Rain infiltrates through the soil to recharge the aquifer below



Direction of groundwater movement



Groundwater leakage



Direction of surface water movement in the channel



Direction of surface water movement outside of a channel



Mixing of groundwater and surface water



Wetter periods of time

Flora legend



Eucalyptus spp.



Melaleuca spp.



Evapotranspiration
Process whereby plants draw water up through their roots and move it out through their leaf pores

Fauna legend



Fish

Groundwater dependent ecosystem legend



1 Terrestrial GDEs
Regional ecosystems and riverine wetlands may depend on the subsurface presence of groundwater within the capillary zone for some or all of their water requirements.



2 Surface expression GDEs
Lacustrine wetlands, palustrine wetlands and riverine water bodies may depend on the surface expression of groundwater for some or all of their water requirements.



3 Subterranean GDEs
Aquifer and cave subterranean wetlands may depend on the subterranean presence or expression of groundwater for some or all of their water requirements.

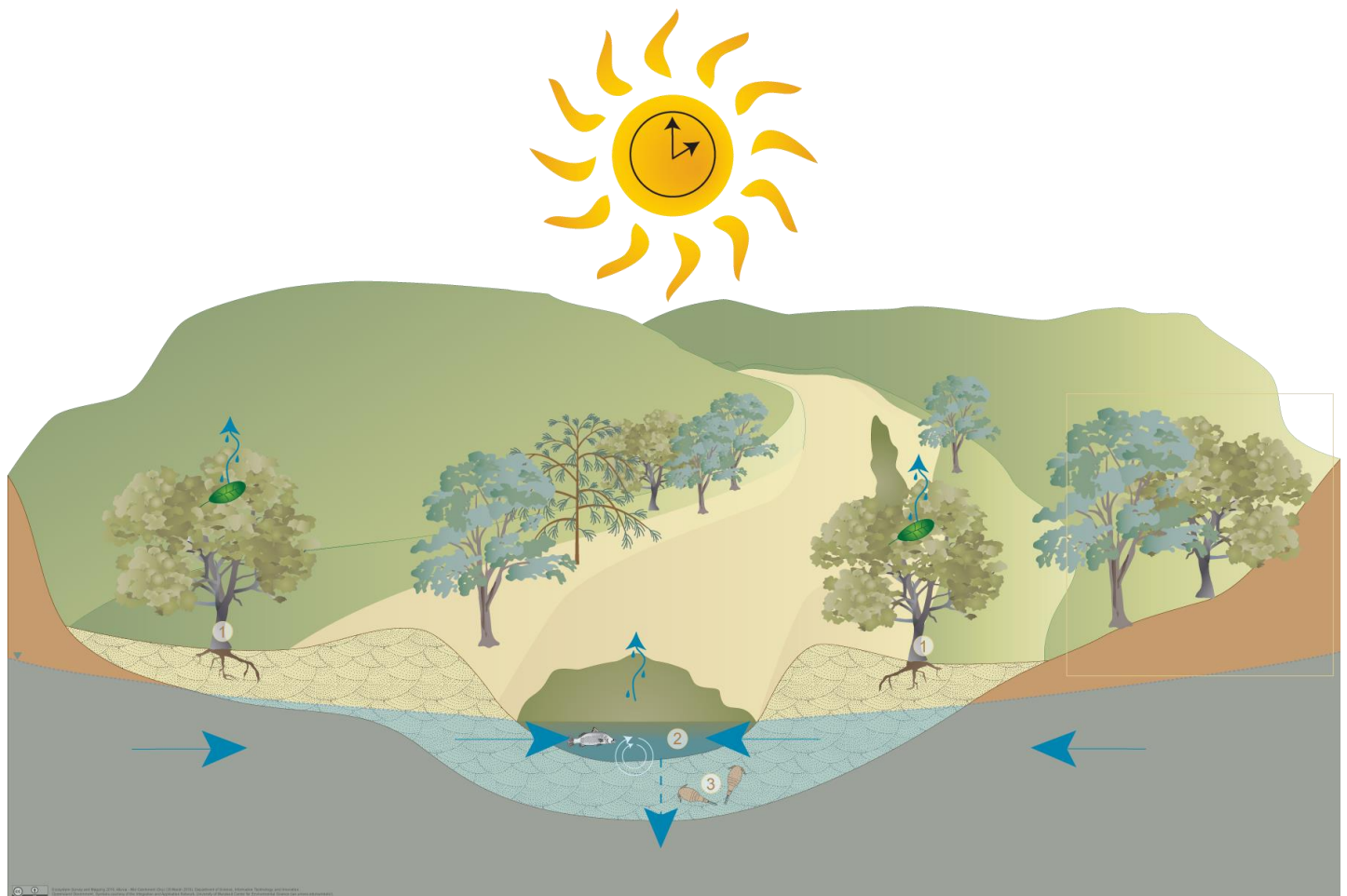
Alluvia – mid catchment (moderate alluvial development)

Alluvia – mid catchment – dry (moderate alluvial development)

Alluvial aquifers are formed from particles such as gravel, sand, silt and/or clay deposited by physical processes in river channels or on floodplains. Alluvia can contain one or more unconfined, unconsolidated sedimentary aquifers, where groundwater is stored and transmitted through intergranular voids between gravel and sand particles. The recharge of alluvia may occur directly (e.g. through infiltration of rainfall or inundation) or indirectly (e.g. through groundwater connection with surrounding permeable rock aquifers). In drier months the groundwater table may drop below the surface resulting in little or no baseflow. There may be some residual pools trapped by low permeability layers beneath the channel.

Unconsolidated sedimentary aquifers in alluvia may provide a range of ecosystems with water required to support their plant and animal communities, ecological processes and delivery of ecosystem services.

- Palustrine (e.g. swamps) and lacustrine (e.g. lakes) wetlands and riverine (e.g. streams and rivers) water bodies on alluvia may depend on the surface expression of groundwater to maintain or prolong waterholes in the channel which act as critical refugia for plants and animals.
- Terrestrial vegetation fringing channels on alluvia may depend on the subsurface presence of groundwater in these unconsolidated sedimentary aquifers where groundwater is typically accessed through the capillary zone above the water table.
- Unconsolidated sedimentary aquifers in alluvial deposits may also support ecosystems within the aquifer itself, which sometimes is indicated by the presence of stygofauna.



Geology legend



Alluvia
Unconsolidated sand, clay and gravel



Moderate to high permeability rock
Stores and transmits groundwater through void spaces in the rock

Groundwater hydrology legend



Alluvia (saturated)



Alluvia (unsaturated)



Moderate to high permeability rock (saturated)



Moderate to high permeability rock (unsaturated)



Groundwater table



Evaporation



Direction of groundwater movement



Groundwater leakage



Direction of surface water movement in the channel



Mixing of groundwater and surface water



Drier periods of time

Flora legend



Casuarina spp.



Eucalyptus spp.



Melaleuca spp.



Evapotranspiration
Process whereby plants draw water up through their roots and move it out through their leaf pores

Fauna legend



Stygofauna
Aquatic fauna that live in groundwater



Fish

Groundwater dependent ecosystem legend



1 Terrestrial GDEs
Regional ecosystems and riverine wetlands may depend on the subsurface presence of groundwater within the capillary zone for some or all of their water requirements.



3 Subterranean GDEs
Aquifer and cave subterranean wetlands may depend on the subterranean presence or expression of groundwater for some or all of their water requirements.



2 Surface expression GDEs
Lacustrine wetlands, palustrine wetlands and riverine water bodies may depend on the surface expression of groundwater for some or all of their water requirements.

Geology legend



Alluvia
Unconsolidated sand, clay and gravel



Moderate to high permeability rock
Stores and transmits groundwater through void spaces in the rock

Groundwater hydrology legend



Alluvia (saturated)



Alluvia (unsaturated)



Moderate to high permeability rock (saturated)



Moderate to high permeability rock (unsaturated)



Groundwater table



Infiltration and percolation
Rain infiltrates through the soil to recharge the aquifer below



Direction of groundwater movement



Groundwater leakage



Direction of surface water movement in the channel



Direction of surface water movement outside of a channel



Mixing of groundwater and surface water



Wetter periods of time

Flora legend



Casuarina spp.



Eucalyptus spp.



Melaleuca spp.



Evapotranspiration
Process whereby plants draw water up through their roots and move it out through their leaf pores

Fauna legend



Stygofauna
Aquatic fauna that live in groundwater



Fish

Groundwater dependent ecosystem legend



1 Terrestrial GDEs
Regional ecosystems and riverine wetlands may depend on the subsurface presence of groundwater within the capillary zone for some or all of their water requirements.



3 Subterranean GDEs
Aquifer and cave subterranean wetlands may depend on the subterranean presence or expression of groundwater for some or all of their water requirements.



2 Surface expression GDEs
Lacustrine wetlands, palustrine wetlands and riverine water bodies may depend on the surface expression of groundwater for some or all of their water requirements.

Alluvia – lower catchment (extensive alluvial development)

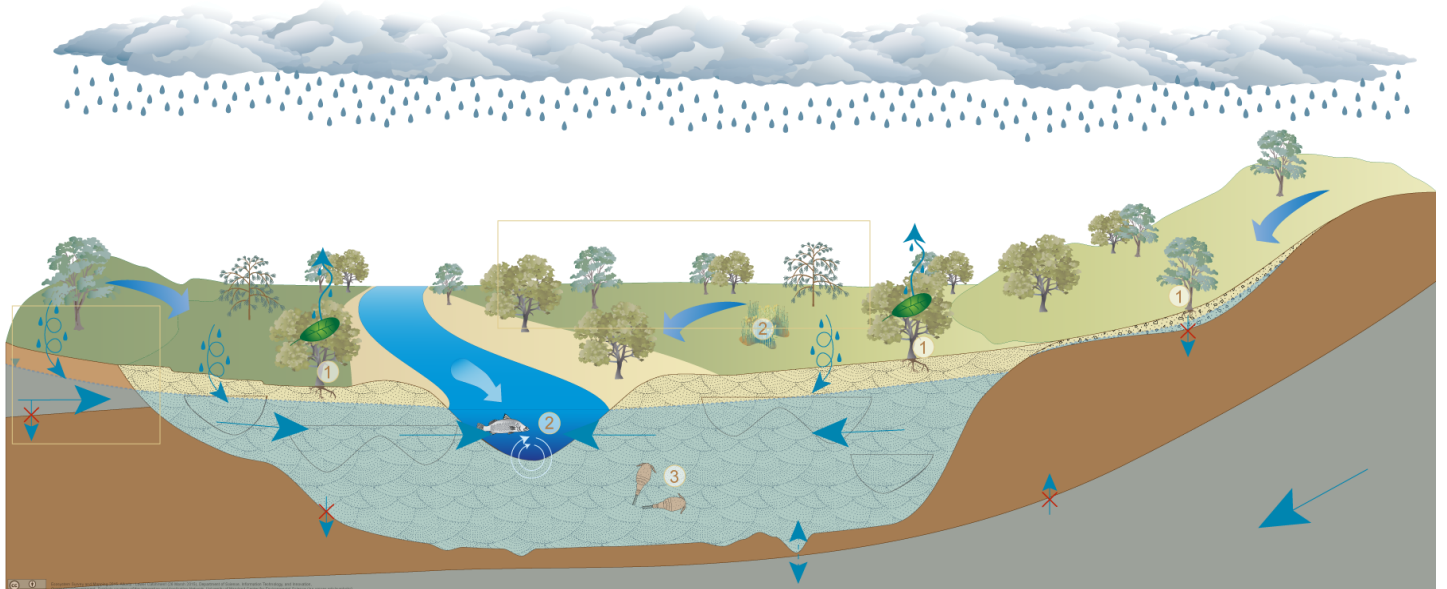
Alluvial aquifers are formed from particles such as sand, silt and/or clay deposited by physical processes in river channels or on floodplains. Alluvia can contain one or more unconfined, unconsolidated sedimentary aquifers, where groundwater is stored and transmitted through intergranular voids between gravel and sand particles. These unconsolidated sedimentary aquifers may be layered and/or discontinuous due to the presence of deposits of low permeability silt and clay within the alluvia.

Alluvia in lower catchment areas tend to be significantly wider and deeper than alluvia further up-catchment. Alluvia may also contain a number of palaeochannels, remnants of old channels and riverbeds.


Palaeochannels may transmit groundwater faster than the surrounding alluvia and may also form perched aquifers under certain conditions. Underlying the alluvia may be an impermeable rock layer which would act as a confining layer separating the unconfined sedimentary aquifer in the alluvia from other groundwater bearing geologies. Flood events provide significant recharge of alluvial aquifers (see 'Alluvia – recharge process').

Unconsolidated sedimentary aquifers in lower catchment alluvial deposits may provide a range of ecosystems with water required to support their plant and animal communities, ecological processes and delivery of ecosystem services.
















- Palustrine (e.g. swamps) and lacustrine (e.g. lakes) wetlands and riverine (e.g. streams and rivers) water bodies on alluvial deposits may depend on the surface expression of groundwater from these unconsolidated sedimentary aquifers.
- Terrestrial vegetation located on alluvial deposits may depend on the subsurface presence of groundwater in these unconsolidated sedimentary aquifers where groundwater is typically accessed through the capillary zone above the watertable.
- Unconsolidated sedimentary aquifers in alluvial deposits may also support ecosystems within the aquifer itself, which sometimes is indicated by the presence of stygofauna.



Geology legend

	Alluvia Unconsolidated sand and clay		Colluvia Unconsolidated sediment and rock fragments
	Moderate to high permeability rock Stores and transmits groundwater through void spaces in the rock		Low permeability rock
	Paleochannel Historic drainage systems filled with unconsolidated sand and clay		

Groundwater hydrology legend

	Alluvia (saturated)		Direction of groundwater movement
	Alluvia (unsaturated)		Groundwater leakage
	Colluvia (saturated)		Negligible groundwater movement
	Colluvia (unsaturated)		Direction of surface water movement in the channel
	Moderate to high permeability rock (saturated)		Direction of surface water movement outside of a channel
	Moderate to high permeability rock (unsaturated)		Mixing of groundwater and surface water
	Low permeability rock (unsaturated)		Infiltration and percolation Rain infiltrates through the soil to recharge the aquifer below
	Groundwater table		

Flora legend

	<i>Casuarina</i> spp.		<i>Melaleuca</i> spp.
	<i>Eucalyptus</i> spp.		Evapotranspiration Process whereby plants draw water up through their roots and move it out through their leaf pores
	Wetland		

Fauna legend

	Stygofauna Aquatic fauna that live in groundwater		Fish
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Groundwater dependent ecosystem legend



1 Terrestrial GDEs
Regional ecosystems and riverine wetlands may depend on the subsurface presence of groundwater within the capillary zone for some or all of their water requirements.



2 Surface expression GDEs
Lacustrine wetlands, palustrine wetlands and riverine water bodies may depend on the surface expression of groundwater for some or all of their water requirements.



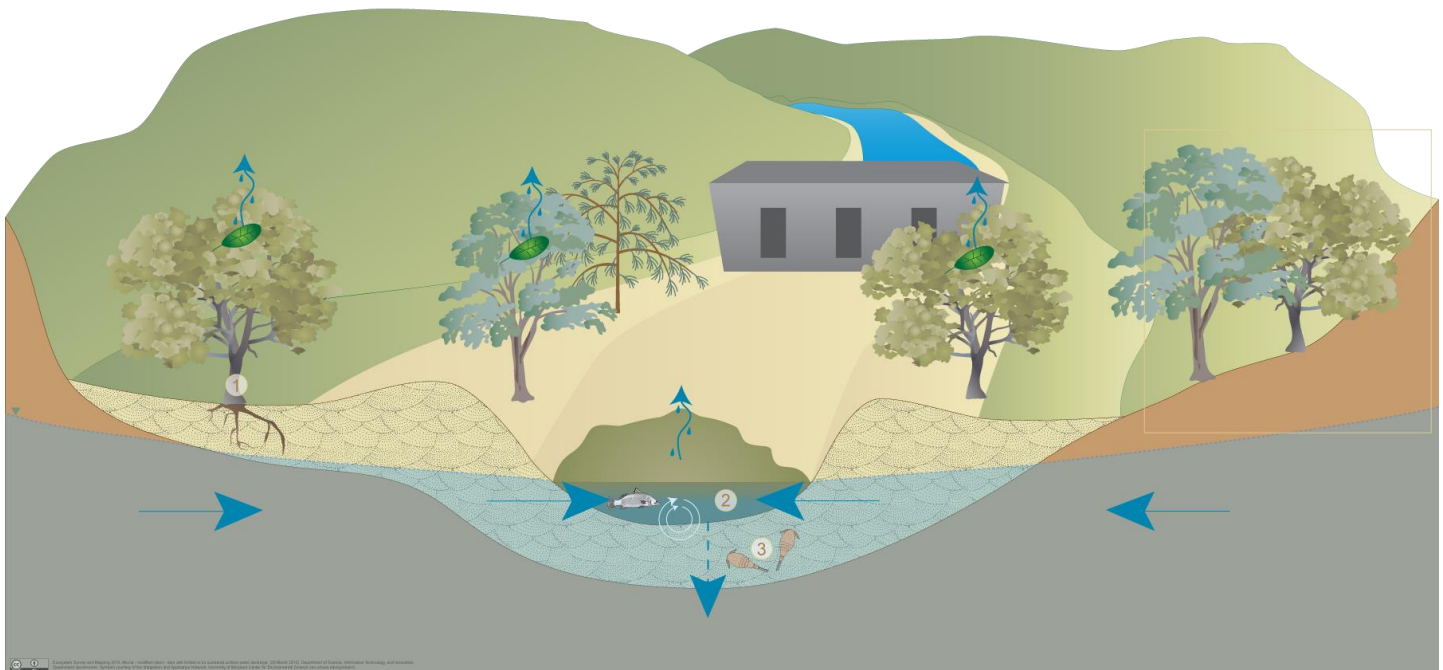
3 Subterranean GDEs
Aquifer and cave subterranean wetlands may depend on the subterranean presence or expression of groundwater for some or all of their water requirements.

Alluvia – modified (dam)

Alluvia – modified (dam) - dam with limited or no sustained surface water discharge

Alluvial aquifers are formed from particles such as gravel, sand, silt and/or clay deposited by fluvial processes in river channels or on floodplains. These deposits store and transmit water to varying degrees through inter-granular voids. These aquifers may have structures, such as dams, that modify the flow of surface water and groundwater. Where dams restrict the discharge of surface water, there is less recharge of downstream alluvial aquifers from channels reducing their saturation over time. This can also occur in dry or drought conditions. Both stream and alluvial aquifers may then be recharged from other adjacent aquifers (e.g. permeable rock aquifers).

- Palustrine (e.g. swamps), lacustrine (e.g. lakes) and riverine (e.g. streams and rivers) wetlands on alluvial aquifers below or down-gradient of a dam may depend on the surface expression of groundwater from these underlying alluvial aquifers.
- Terrestrial vegetation on alluvial aquifers down-gradient of a dam may depend on the subsurface presence of groundwater, typically accessed through the capillary zone above the water table.



Geology legend













Alluvia
Unconsolidated sand, clay and gravel



Moderate to high permeability rock
Stores and transmits groundwater through void spaces in the rock

Groundwater hydrology legend

	Alluvia (saturated)		Direction of groundwater movement
	Alluvia (unsaturated)		Groundwater leakage
	Moderate to high permeability rock (saturated)		Direction of surface water movement in the channel
	Moderate to high permeability rock (unsaturated)		Mixing of groundwater and surface water
	Groundwater table		Evaporation

Flora legend

	<i>Casuarina</i> spp.		<i>Melaleuca</i> spp.
	<i>Eucalyptus</i> spp.		Evapotranspiration Process whereby plants drew water up through their roots and move it out through their leaf pores

Fauna legend

	Stygofauna Aquatic fauna that live in groundwater		Fish
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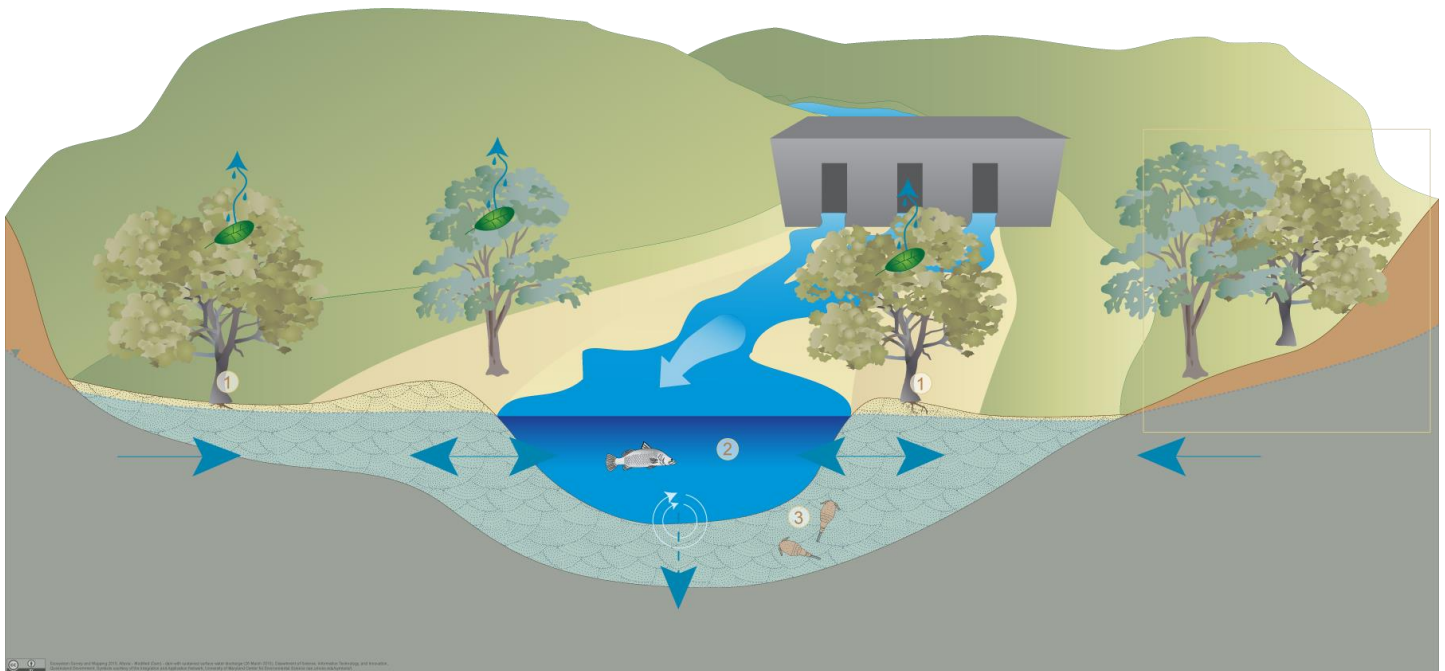
Groundwater dependent ecosystem legend

	1 Terrestrial GDEs Regional ecosystems and riverine wetlands may depend on the subsurface presence of groundwater within the capillary zone for some or all of their water requirements.		2 Surface expression GDEs Lacustrine wetlands, palustrine wetlands and riverine water bodies may depend on the surface expression of groundwater for some or all of their water requirements.
	3 Subterranean GDEs Aquifer and cave subterranean wetlands may depend on the subterranean presence or expression of groundwater for some or all of their water requirements.		

Alluvia – modified (dam) - dam with sustained surface water discharge

Alluvial aquifers are formed from particles such as gravel, sand, silt and/or clay deposited by fluvial processes in river channels or on floodplains. These deposits store and transmit water to varying degrees through inter-granular voids. These aquifers may have structures, such as dams, that modify the flow of both surface water and groundwater. Dams that provide a sustained release of surface water may increase recharge from the downstream channel into the alluvial aquifers, resulting in their saturation.

- Palustrine (e.g. swamps), lacustrine (e.g. lakes) and riverine (e.g. streams and rivers) wetlands on alluvial aquifers with sustained flow from dams may depend on the surface expression of groundwater from these underlying alluvial aquifers.
- Terrestrial vegetation on alluvial aquifers with sustained flow from dams may depend on the subsurface presence of groundwater, typically using deep roots to access groundwater in the capillary zone above the water table.



Geology legend

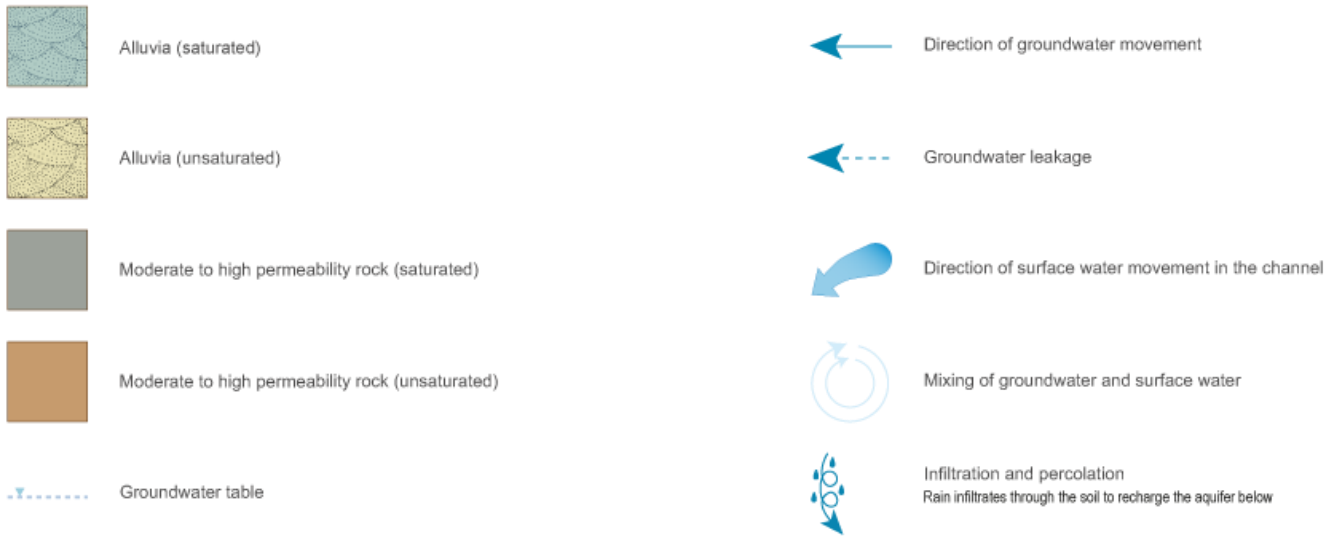


Alluvia
Unconsolidated sand, clay and gravel



Moderate to high permeability rock
Stores and transmits groundwater through void spaces in the rock

Groundwater hydrology legend



Flora legend



Fauna legend



Groundwater dependent ecosystem legend

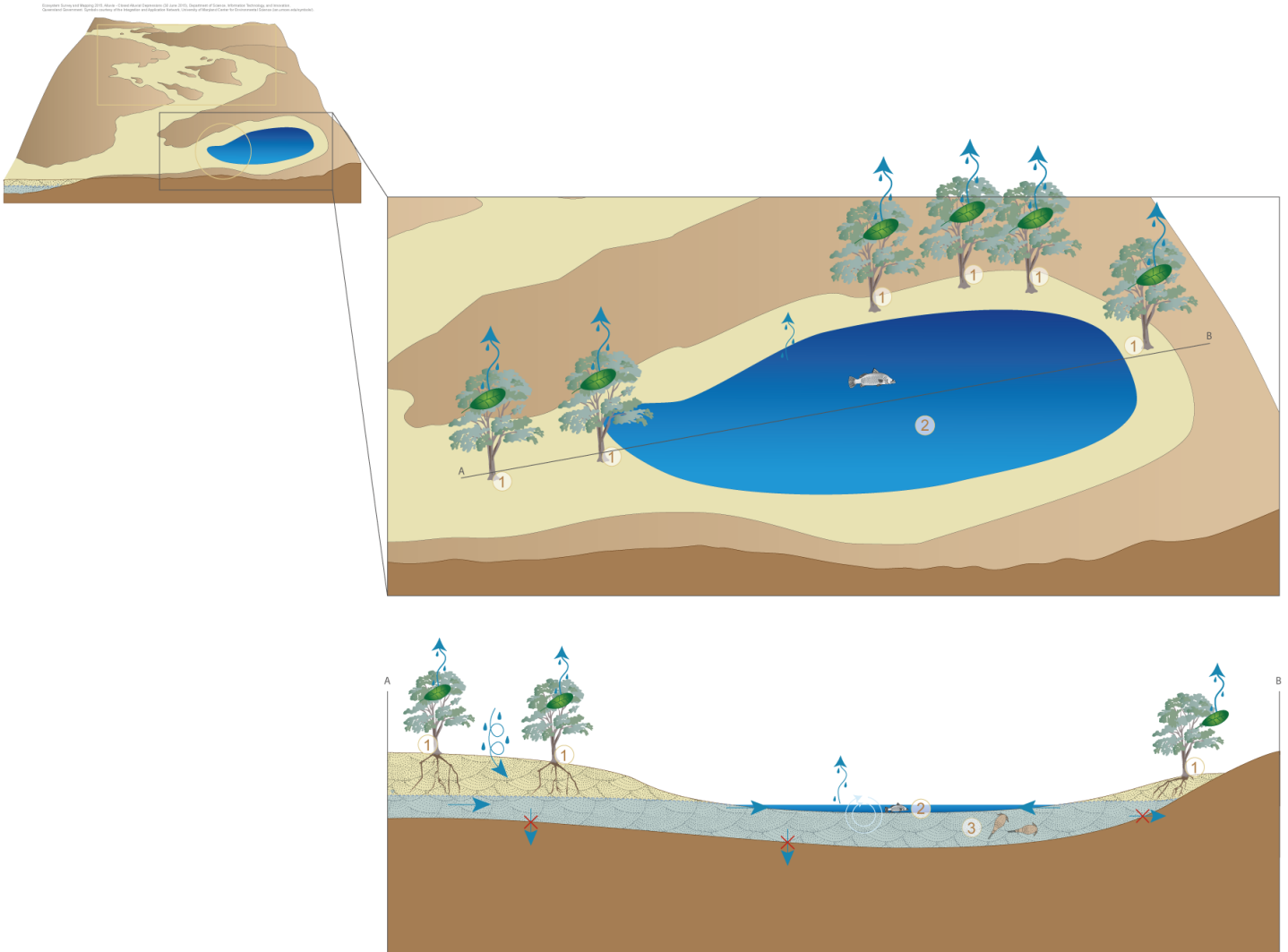


Alluvia – closed drainage systems

Alluvial aquifers are formed from particles such as gravel, sand, silt and/or clay deposited by fluvial processes in river channels or on floodplains. These deposits store and transmit water to varying degrees through inter-granular voids. Alluvial aquifers can develop in areas where groundwater flow is constrained by the surrounding lower permeability material. In closed drainage systems alluvial aquifers are completely constrained by local geology and topography, combined with high evaporation. Therefore, groundwater and surface water is unable to continue flowing and are stored in these areas.

Unconsolidated sedimentary aquifers in closed drainage systems may provide a range of ecosystems with water required to support their fauna and flora communities, ecological processes and delivery of ecosystem services.

- Palustrine (e.g. swamps), lacustrine (e.g. lakes) and riverine (e.g. streams and rivers) wetlands may depend on the surface expression of groundwater from these unconsolidated sedimentary aquifers.
- Terrestrial vegetation on alluvia in closed drainage systems may depend on the subsurface presence of groundwater in these unconsolidated sedimentary aquifers.
- Unconsolidated sedimentary aquifers in alluvial deposits may also support ecosystems within the aquifer itself, which sometimes is indicated by the presence of stygofauna.



Geology legend



Alluvia
Unconsolidated sand and clay



Low permeability rock or clay

Groundwater hydrology legend



Alluvia (saturated)



Alluvia (unsaturated)



Low permeability rock or clay (unsaturated)



Groundwater table



Evaporation



Direction of groundwater movement



Negligible groundwater movement



Mixing of groundwater and surface water



Infiltration and percolation
Rain infiltrates through the soil to recharge the aquifer below

Flora legend



Eucalyptus spp.



Evapotranspiration
Process whereby plants draw water up through their roots and move it out through their leaf pores

Fauna legend



Stygofauna
Aquatic fauna that live in groundwater



Fish

Focal elements legend



Closed alluvial depression
Groundwater and surface water move down-stream through alluvial plains before entering a closed alluvial depression where alluvia is constrained by low permeability rock or clay.

Groundwater dependent ecosystem legend



1 Terrestrial GDEs
Regional ecosystems and riverine wetlands may depend on the subsurface presence of groundwater within the capillary zone for some or all of their water requirements.



3 Subterranean GDEs
Aquifer and cave subterranean wetlands may depend on the subterranean presence or expression of groundwater for some or all of their water requirements.



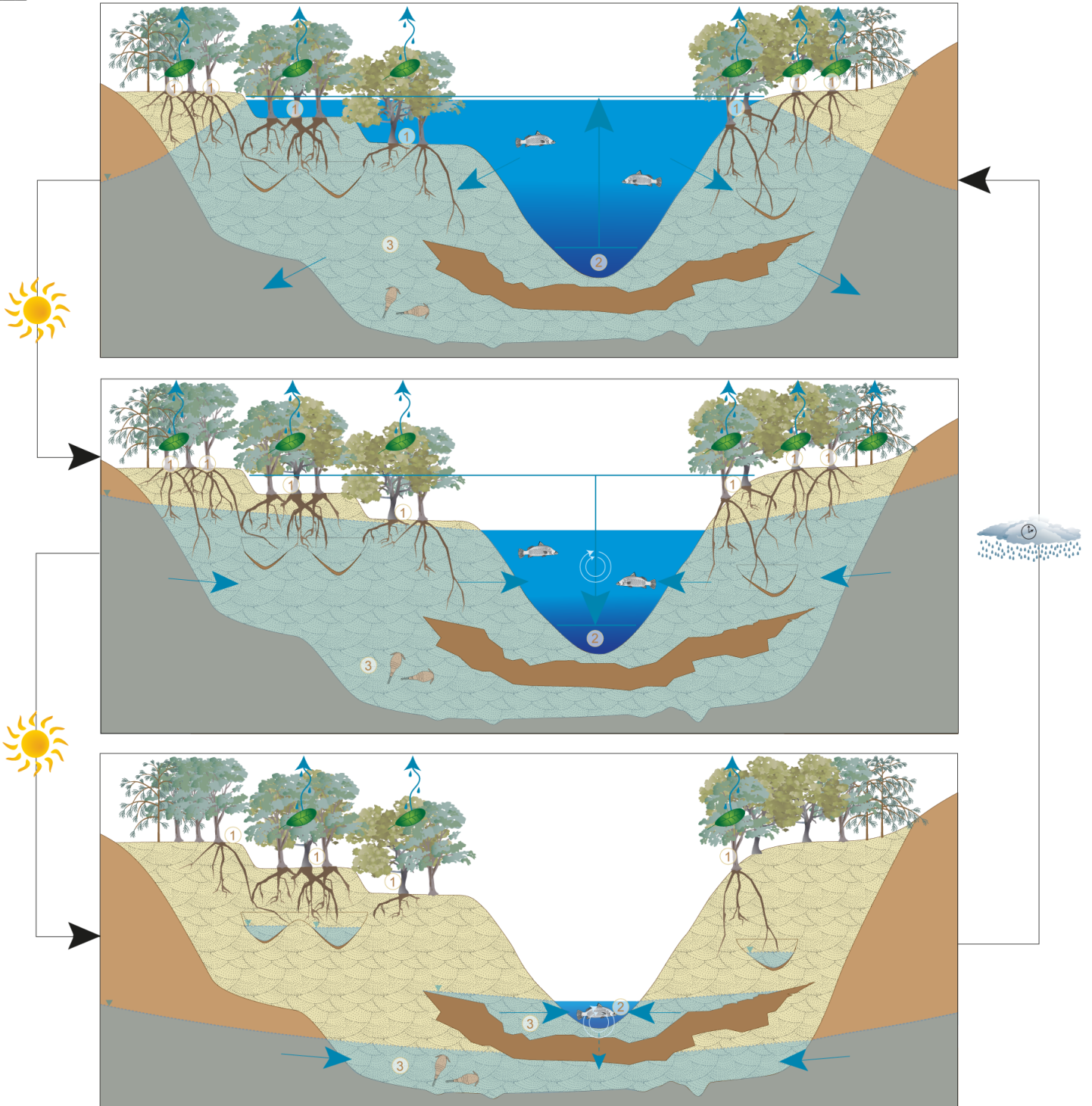
2 Surface expression GDEs
Lacustrine wetlands, palustrine wetlands and riverine water bodies may depend on the surface expression of groundwater for some or all of their water requirements.

Alluvia – recharge process (inundation)

There are several processes that may occur individually or in conjunction with other processes to recharge groundwater in the alluvia: infiltration, discharge from surrounding water bearing geologies, and inundation. This conceptual model illustrates the recharge process of alluvial aquifers during inundation events (e.g. flooding).

- During a flood event channel flow increases and water levels rise. This may result in groundwater in the alluvia and surrounding geologies being recharged from the channel (see top box).
- After a flood event channel flow decreases and water levels drop. The additional groundwater stored in the alluvia and surrounding geologies will slowly discharge to the channel over time. During this period vegetation on terraces surrounding the channel may depend on the sub-surface presence of groundwater to meet some or all of their water requirements provided the vegetation can access the capillary zone (see middle box).
- Recharge from surrounding fractured hard rock or porous sedimentary rock may assist in maintaining groundwater levels in the alluvia and supporting specialised aquatic fauna, stygofauna, which are groundwater dependent (see bottom box).

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Geology legend

- | | | | |
|---|--|--|--|
|  | Alluvia
Unconsolidated sand and clay |  | Low permeability rock |
|  | Moderate to high permeability rock
Stores and transmits groundwater through void spaces in the rock |  | Paleochannel
Historic drainage systems filled with unconsolidated sand and clay |

Groundwater hydrology legend

	Alluvia (saturated)		Groundwater table
	Alluvia (unsaturated)		Direction of groundwater movement
	Moderate to high permeability rock (saturated)		Groundwater leakage
	Moderate to high permeability rock (unsaturated)		Mixing of groundwater and surface water
	Low permeability rock (unsaturated)		

Flora legend

	<i>Casuarina</i> spp.		<i>Melaleuca</i> spp.
	<i>Eucalyptus</i> spp.		Evapotranspiration Process whereby plants draw water up through their roots and move it out through their leaf pores

Fauna legend

	Stygofauna Aquatic fauna that live in groundwater		Fish
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Groundwater dependent ecosystem legend

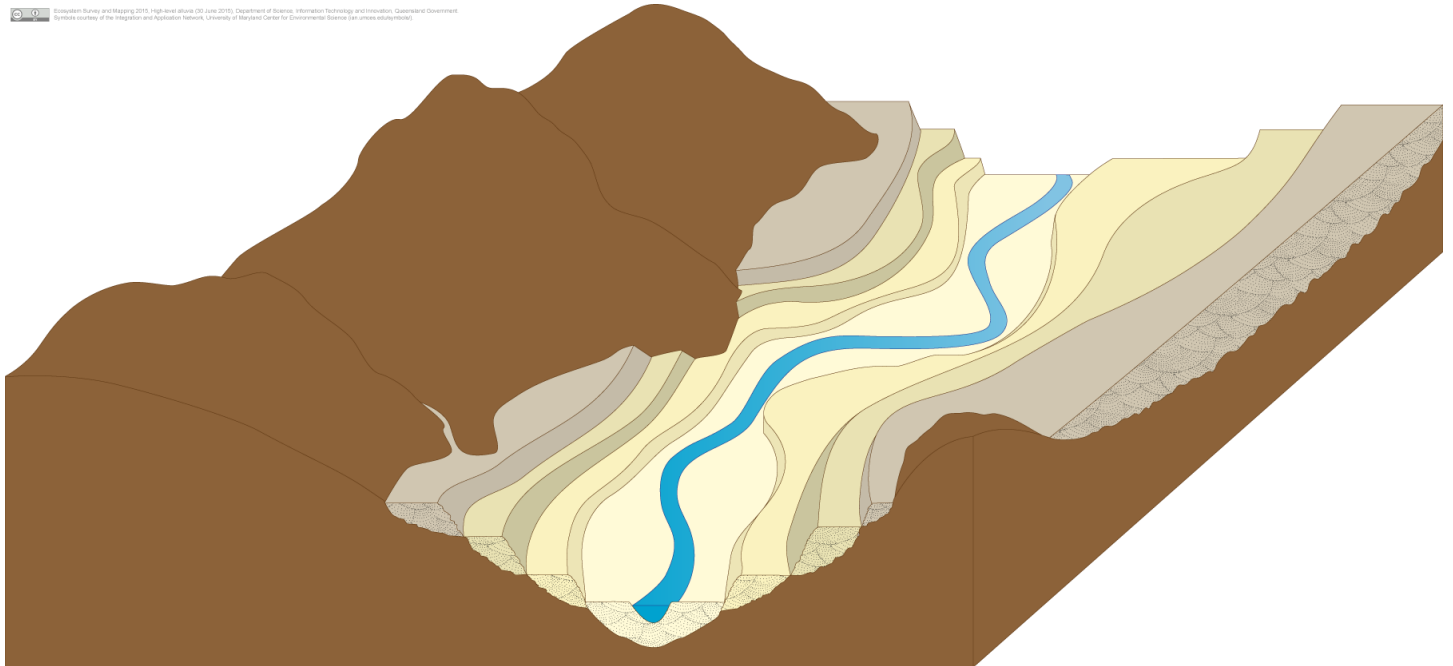
	1 Terrestrial GDEs Regional ecosystems and riverine wetlands may depend on the subsurface presence of groundwater within the capillary zone for some or all of their water requirements.		2 Surface expression GDEs Lacustrine wetlands, palustrine wetlands and riverine water bodies may depend on the surface expression of groundwater for some or all of their water requirements.
	3 Subterranean GDEs Aquifer and cave subterranean wetlands may depend on the subterranean presence or expression of groundwater for some or all of their water requirements.		

High-level alluvia

The term 'high-level' alluvia refer to alluvia deposited in ancestral valleys which are located above the channels in the current landscape in a form of inverted relief. Over time a channel will erode through older alluvial deposits resulting in older alluvia appearing in the banks above the channel. This model shows the process of terrace development and does not show groundwater.

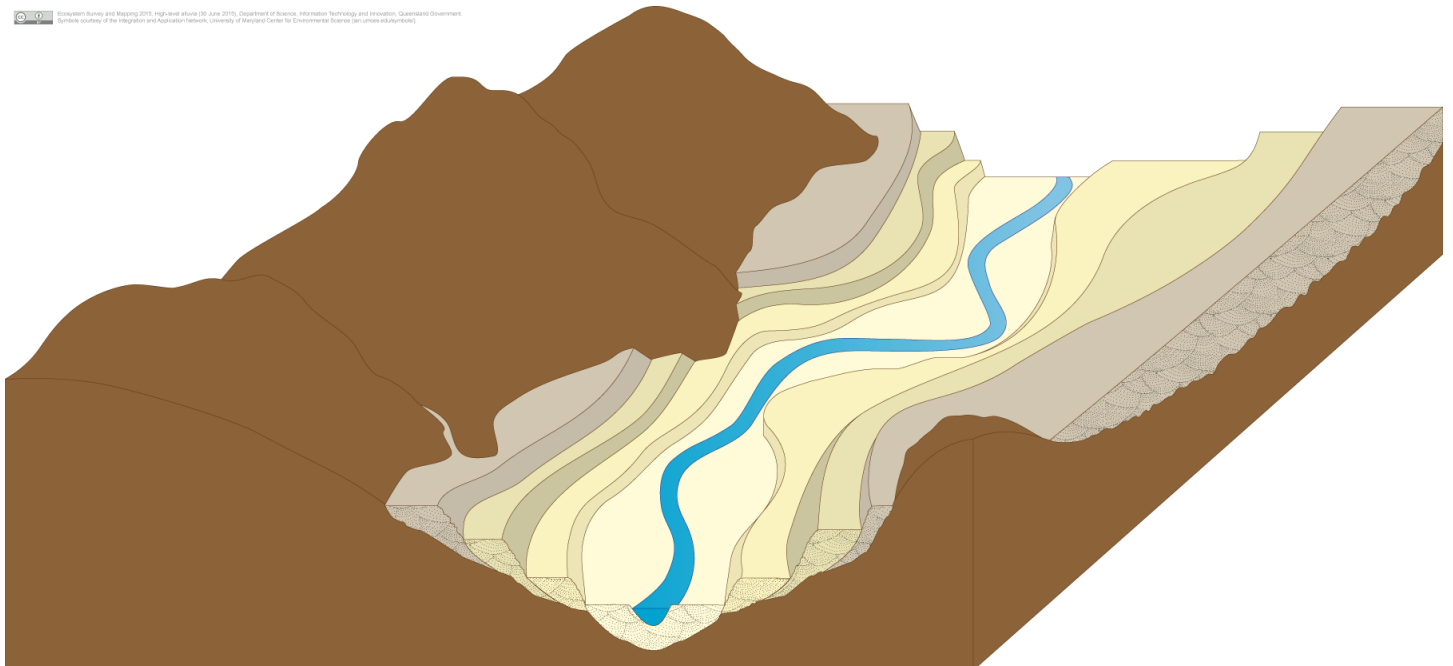
High-level alluvia overlying bedrock

© Crown Copyright and Geoscience Australia 2015. High-level alluvia (20 June 2015). Department of Science, Information Technology and Innovation, Queensland Government. Symbols courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (see www.ianigdc.org).

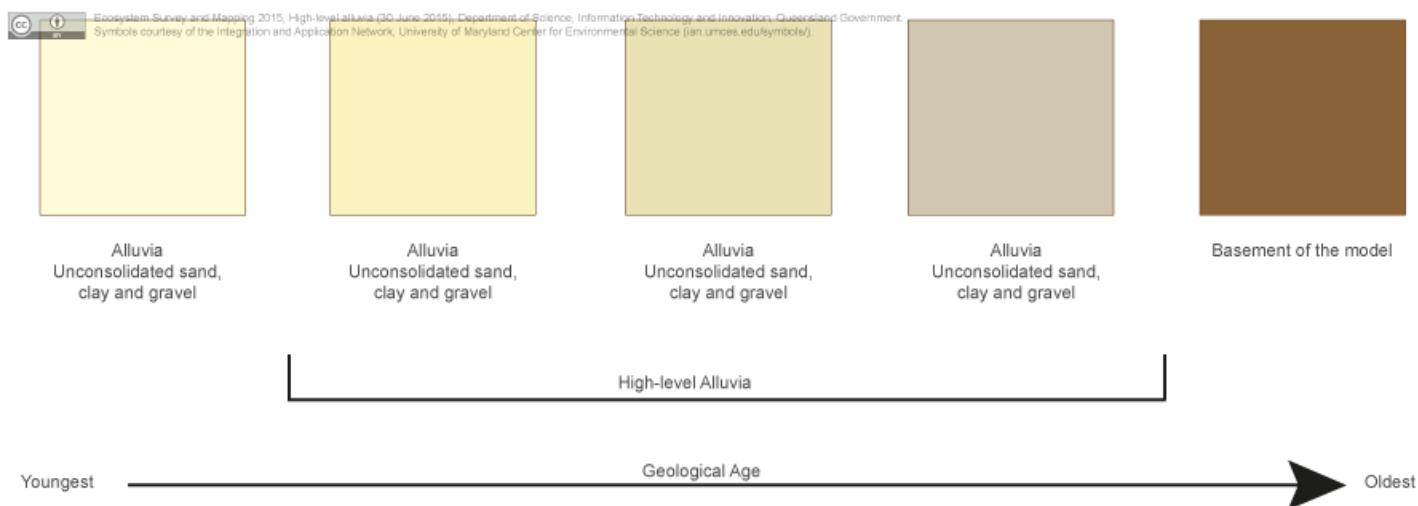


High-level alluvia overlying bedrock or older alluvial deposits

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Geology legend



Citation

Queensland Government (2017) *Groundwater dependent ecosystem pictorial conceptual model 'alluvia': version 1.5*, Queensland Government, Brisbane.