KINGFIELD
GALVANIZING

kingfield.com.au

ENVIRONMENTAL PRODUCT DECLARATION FOR KINGFIELD GALVANIZING

In accordance with EN 15804 + A1, ISO 15025 and PCR 2011:16 V2.32
EPD Registration No. S-P-02325
Approval Date: 1st April 2021
Valid Until: 31st March 2026

AUSTRALASIA EPD®
ENVIRONMENTAL PRODUCT DECLARATION

ECO PLATFORM EPD EN 15804 VERIFIED

KINGFIELD GALVANIZING

35 O'Herns Road
Somerton Vic 3062

P: 03 9305 3902
E: sales@kingfield.com.au

kingfield.com.au

KINGFIELD GALVANIZING

ENVIRONMENTAL PRODUCT DECLARATION FOR KINGFIELD GALVANIZING

Programme:
EPD Australasia
https://epd-australasia.com/

Programme operator:
EPD Australasia Limited

Technical Rules:
Australasian General Programme Instructions

Product Category Rules (PCR):
Corrosion protection of fabricated steel products, PCR 2011:16, Version 2.32, 2020-11-23
EN 15804+A1

EPD registration number:
S-P- 02325

Approval date:
1st April 2021

Valid until:
31st March 2026

Geographical scope of EPD:
Australasia

Contents

ABOUT KINGFIELD GALVANIZING

Kingfield Galvanizing is an Australian-owned family business that was established in Melbourne's northern suburbs, in 1983. Kingfield hot dip galvanizes (HDG) steel components for use in engineering, construction and infrastructure projects throughout Australia. Hot dip galvanizing is a protective coating applied to steel. It provides three levels of corrosion protection to deliver predictable performance for steel installations with whole of life cost benefits.

In 2015, Kingfield embarked on a project to create a lower impact, commercially viable Australian benchmark for HDG. Investing in plant automation and best practice technologies to develop Australia's first state-of-the-art hot dip galvanizing facility. Our plant integrates enclosed zones, automated materials handling systems and process innovation to reduce emissions, recycle or re-use energy, waste and materials throughout the HDG process.

Our commitment is to hot dip galvanize steel in a more responsibly; to reduce, re-use and recycle our resources where possible, to minimise the environmental footprint of hot dip galvanizing for Australia's built environment.




Projects

Infrastructure Projects

Galvanized steel is specified in many infrastructure projects for its total cost benefits and extended time to first maintenance requirements, that is particularly beneficial in remote locations. Installations include road safety barriers, solar farm structures, street lighting, loading ramps at the docks, rail gantries and overpass structures.

Bolte Bridge Safety Barriers

Pedestrian Overpass

Carpark Lighting

Commercial Projects

Galvanized steel is chosen for both structural and decorative components in the commercial construction sector. From framing to facades, silos, window louvres and carpark structures, galvanized steel delivers predictable corrosion performance.

Trinity Grammar

Y3 Building

Sunshine Hospital

Social Projects

The predictable performance of galvanized steel translates well for social structures, enabling maintenance schedules to be well managed in remote and seaside installations. Galvanized steel is ideal for playground equipment, beachside cola structures, artwork, sculptures and surf lifesaving equipment.

Playground Structure

Sculpture by Damian Vick

Surf Lifesaving Club Equipment

What is HDG?

Hot dip galvanizing delivers predictable corrosion protection for fabricated steel installations. The corrosivity of any environment may vary due to local conditions, such as prevailing winds in coastal areas, atmospheric gases and chemicals in industrial areas, atmospheric moisture and micro-environments created by fertilisers in rural areas. AS/NZS 2312.2 provides a range of durability performance for steel components with an 85µm HDG coating, based on the location of an installation. HDG's performance extends from 100+ years in many capital cities to approximately 10 years in exposed surf coast locations.

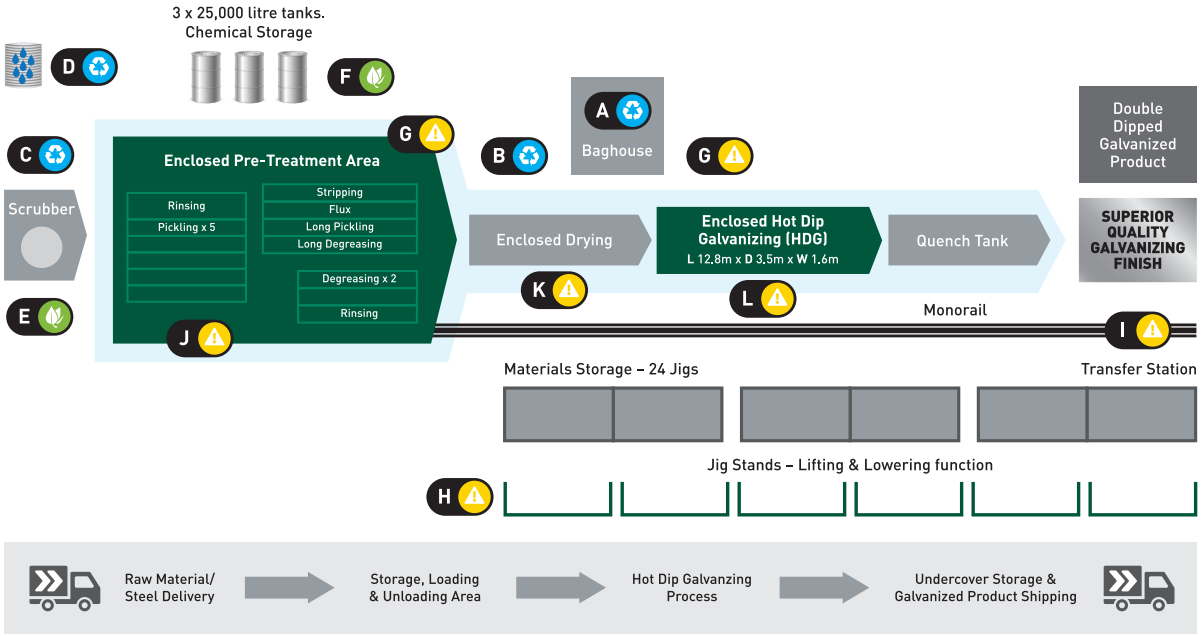
Steel is hot dip galvanized to quality standard AS/NZS4680. During the HDG process the zinc coating forms a chemical bond with the steel, to become part of the physical structure. This creates 3 layers of protection for predictable performance; barrier protection creates a physical envelope, a zinc patina reduces the exposure of the galvanizing coating to the environment, and cathodic protection safeguards small areas of exposed steel from corrosion. In addition to delivering excellent corrosion resistance, hot dip galvanized steel also holds a high tolerance to mechanical damage and is inert to the high UV levels we experience here in Australia.

Hot dip galvanizing can be applied to a range of steel grades in a variety of sizes and shapes; from large scale structural beams, to residential housing frames, from street furniture and lighting to sculptural pieces and components for manufacturing equipment. The role of HDG is to significantly extend the service life of steel components, steel installations and capital works in our built environment. This delivers economic benefits in lower lifecycle costs. And at the end of an asset's serviceable life, both the zinc coating and the steel substrate are recyclable into comparable or higher-grade products.

Kingfield's Hot Dip Galvanizing Process

The hot dip galvanizing process involves pre-treatment of the steel to clean its surface in preparation for the galvanizing coating. The steel moves through three processes during pre-treatment; caustic degreasing, acid pickling and fluxing. This process occurs in an enclosed zone at Kingfield, the emissions generated by the pre-treatment process are captured and 'scrubbed' of acid particulates prior to releasing air to the atmosphere. These acid particulates are then re-used in the pre-treatment tanks to reduce waste and water use.

Following pre-treatment, steel components are dried, then immersed in a bath of molten zinc, to produce the hot dip galvanized coating. The final stage of the HDG process is to quench the steel to promote passivation of the zinc surface.



Recycling Initiatives & Sustainable Operating Practices

A: Collection of Zinc Fume Emissions. Ash recycled & Zinc reclaimed.
B: Heat recycled from HDG Furnace for Heating Pre-Treatment Chemicals.
C: Acid cleaned from air in Pre-Treatment room is re-used in Pre-Treatment tanks; reducing waste & water use.
D: Water run-off captured & re-used across site

Significantly Reduced Environmental Impacts

E: Corrosive Emissions collected & treated via Scrubber, clean air then exhausted to environment.
F: Reducing chemical usage & waste by heating chemicals & using automated processes with defined recipes.

Improved Workplace Safety & State-of-the-Art Manufacturing Processes

G: Bunded areas & advanced plumbing systems minimise risk of catastrophic event & exposure to chemicals.
H: Superior materials handling with 30 jigs, 6 lifting & lowering stations.
I: Monorail enables 5 jigs to move concurrently along Galvanizing line for process efficiencies.
J: Automated system eliminates product damage & enables untreated product to be correctly vented & drained.
K: Enclosed Drying Area improves process efficiencies
L: Remote Control Galvanizing delivers greater control of angle & speed at bath; for superior galvanizing finish.

Hot Dip Galvanized Steel

Product description

The product range represented by this EPD covers steel products, such as hot-rolled structural steel sections, steel plate, and hollow structural steel sections, that are hot dip galvanized after fabrication by Kingfield Galvanizing's Victorian plant. These products are hot dip galvanized in accordance with AS/NZS 4680.

Table 1: Industry classification

Product	Classification	Code	Category
Galvanised products	UN CPC Ver.2	88731	Metal treatment and coating services
	ANZSIC 2006	2293	Metal Coating and Finishing

Commercial Building Facade

External Staircase

Wine Barrel Racks

Agricultural Shed

Multi-level Carpark

School Cola Structure

Declared Unit

The declared unit for the EPD is 1 year of protection of a 1 m^2 zinc coated 8mm thick steel plate. The product is applied to four exposure environments.

The EPD covers average values for the product category, hence, the declared unit is not available for purchase on the market. Details of average product is given in Table 2. The area of application includes commercial and residential buildings, and infrastructure, in a range of structural and non-structural components.

Galvanized products covered by EPD

This EPD covers galvanized steel product by Kingfield Galvanizing at their plant in Victoria, Australia. Changes to the steel substrate, thickness and steel type will have an impact on the results of this EPD.

Table 2: Product declaration

Substrate	Steel plate – 1 m x 1 m x 8 mm (weight 62.4 kg)			
Hot dip galvanized coating thickness	85 µm (required minimum average coating thickness on one side for steel >6mm as per AS/NZS 4680)			
Exposure environment	Category C1	Category C2	Category C3	Category C4
Corrosivity	Mildest	Mild	Moderate	High
Environment	Dry indoors	Arid & urban inland	Coastal & industrial	Calm sea-shore
Average zinc corrosion rate (ISO 9223, AS 4312 & AS/NZS 2312.2)	0.1 µm/year	0.4 µm/year	1.4 µm/year	3.15 µm/year
Predicted years of protection	Min 850 years	Min 213 years	Min 61 years	Min 27 years
Units (results)	Burdens per year of protection			

Cradle to grave plus recycling potential for hot dip galvanized product

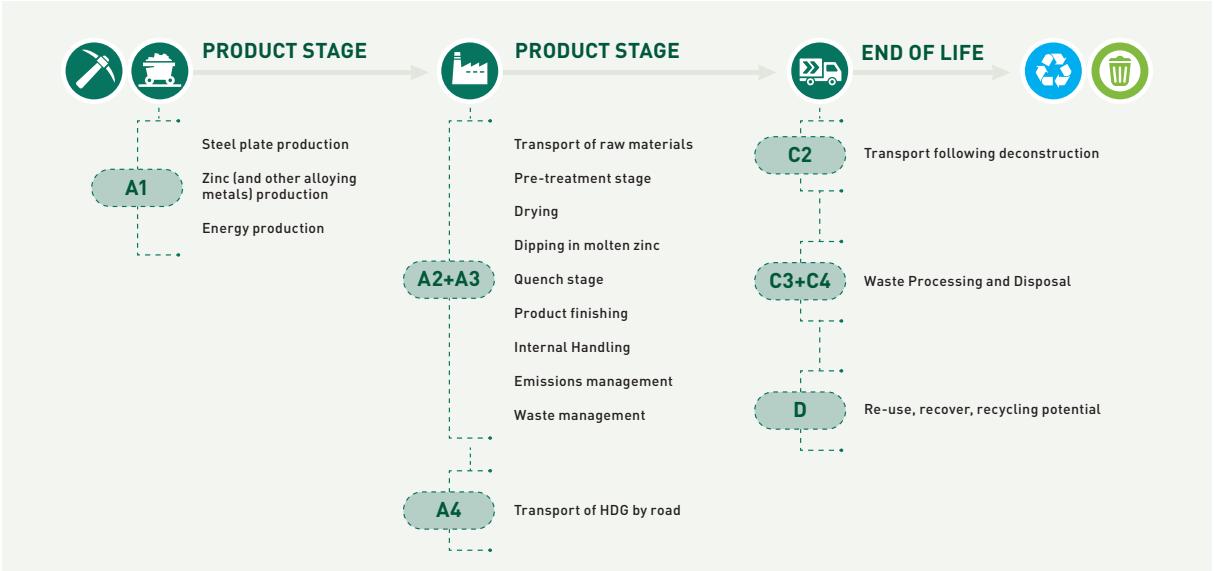
System boundaries

As shown in the table below, the scope of this EPD is of the 'cradle-to-gate' type with options. The 'cradle-to-gate' stages comprise Modules A1 to A3. The options include end-of-life processing (Modules C2-C4) and recycling potential (Module D). Other life cycle stages (Modules A5, B1-B7 and C1) are dependent on particular scenarios and best modelled at the building level.

Table 3: Modules included in the scope of the EPD

Product stage	Raw material supply	**A1**	X
	Transport of raw materials	**A2**	X
	Manufacturing	**A3**	X
Construction process stage	Transport to customer	**A4**	X
	Construction / Installation	**A5**	MND
Use stage	Use	**B1**	MND
	Maintenance	**B2**	MND
	Repair	**B3**	MND
	Replacement	**B4**	MND
	Refurbishment	**B5**	MND
	Operational energy use	**B6**	MND
	Operational water use	**B7**	MND
End of life stage	Deconstruction / demolition	**C1**	MND
	Transport to waste processing	**C2**	X
	Waste processing	**C3**	X
	Disposal	**C4**	X
Benefits and loads beyond the system boundary	Reuse / recovery / recycling potential	**D**	X

X = included in the EPD; MND = Module not declared (such a declaration shall not be regarded as an indicator result of zero)



Production (Module A)

The production stage includes the environmental impacts associated with the following modules:

A1: Environmental impacts associated with raw materials extraction and processing (primarily the steel substrate and zinc)

A2: Transport of material to the Kingfield Galvanizing site and any internal transport

A3: The galvanizing process including enclosed pre-treatment, dipping in molten zinc, followed by quench.

A4: Transport of product to the customer or end-user.

End of Life (Module C)

When an installation reaches the end of its serviceable life, steel products including galvanized steel components are removed from the site and disposed of. In Australasia, the waste materials are typically disposed of in a landfill or processed for recycling. The impact of this is measured in Module C.

C2: Environmental impacts associated with transporting material for waste processing; considering a distance of up to 100km by truck.

C3: Waste processing considers a recycling rate of 90%. The recycling rate was based on the National Waste Report (2018) which indicates that the average metals recycling rate in Australia is 90%. Of the zinc coating on the 90% of steel substrate, 75% is assumed to be recycled. This assumption was based on input from steel producers. This is considered to be a conservative estimate used in the absence of other verified recycling rates.

C4: Waste disposal to landfill for the 10% balance of galvanized steel product and 25% balance of the zinc coating that is processed.

Recovery and Recycling potential (Module D)

The potential benefits of post-consumer recycling are measured in Module D. Net scrap is calculated as the amount of secondary input (scrap steel and zinc) required for product manufacture minus the total amount of recycled steel and zinc output. If there is a net positive balance, a credit is given. This credit is calculated by comparing the impacts associated with primary product produced.

Lifecycle Inventory (LCI) Data and Assumptions

Primary data was used for all manufacturing operations up to the factory gate, including upstream data for input steel and all processes for hot dip galvanizing. The galvanizing process includes the enclosed pre-treatment of steel; caustic degreasing, rinsing, acid pickling, rinsing and fluxing, followed by enclosed drying, dipping steel into a bath of molten zinc, then quenching steel for passivation. HDG steel items then pass through a fettling process or finishing practice to remove any burrs of zinc. Items are then quality inspected, a QC tag is attached to the product, then it is packed for distribution.

Upstream data: Data for steel input is taken from InfraBuild hot rolled structural and rail products EPD (InfraBuild, 2016a). Data for steel used as process inputs (for tie wire and coil) was taken from InfraBuild EPD for reinforcing rod, bar and wire (InfraBuild, 2016b).

Primary data: Kingfield Galvanising data was collected for the period 1 July 2016 to 30 June 2017 and covers galvanized steel product including a range of heavy, medium and light products.

Background data: All data in the background system were from the GaBi Lifecycle Inventory Database 2020 (Sphera, 2020). Most datasets have a reference year between 2016 and 2019 and all fall within the 10-year limit allowable for generic data under EN 15804.

Electricity consumption

Kingfield used Green electricity for operations at the galvanizing facility. Electricity was modelled based on the green electricity mix obtained from National GreenPower™ Accreditation Program (National GreenPower™, 2018).

Table 4: Electricity mix used by Kingfield 2016/2017

Source	% generation
Electricity from hydro power	5.9%
Electricity from photovoltaic	0.2%
Electricity from solid biomass	17.2%
Electricity from wind power	76.7%

Transport

Primary transport data was used for transport of production inputs (A2), waste from the hot dip galvanizing process (A3), and for transport of galvanized product to the customer (A4). As per PCR 2011:16, transport of galvanized product to the customer is calculated based on assumed distances of 100 km. Transport is via articulated truck where distances were not available.

Cut off criteria

PCR 2011:16, v2.32 requires Life Cycle Inventory data for a minimum of 99% of total inflows to the core module. The system boundary for this EPD was defined based on relevance to the goal of the study.

For the processes within the system boundary, all available energy and material flow data have been included. Raw materials such as steel substrate and zinc do not require significant quantities of packaging. As such, production of packaging for inbound raw materials is excluded. Packaging for process inputs (e.g. chemicals) are also considered to be insignificant and are excluded from the LCI. Galvanized product packaging is included in the inventory.

Environmental impacts relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary as per PCR 2011:16, v2.32. All other reported data was incorporated and modelled using the best available life cycle inventory data.

Allocation

Allocation rules for foreground processes as well as upstream data used within this project complies with the allocation principles outlined in the PCR 2011:16, v2.32. Allocation of co-products and waste from the galvanizing process is based on the mass of zinc in each co-product. Allocation of recycling at end-of-life follows EN 15804 and the PCR. Allocation rules for secondary data (upstream/ downstream processes) are documented on the GaBi website (Sphera, 2020).

The role of **hot dip galvanizing** is to significantly extend the service life of steel components, steel installations & capital works in our built environment.

Environmental Impact Indicators

The following indicators describe potential environmental impacts for each product per declared unit.

Table 5: Impact indicators used in this EPD

Acronym	Unit	Indicator
Environmental impact indicators		
GWPT	kg CO_2-eq.	Global warming potential (Total)
GWPF	kg CO_2-eq.	Global warming potential (Fossil)
GWPB	kg CO_2-eq.	Global warming potential (Biogenic)
GWPL	kg CO_2-eq.	Global warming potential (Land use and transformation)
ODP	kg CFC11-eq.	Depletion potential of the stratospheric ozone layer
AP	kg SO_2-eq.	Acidification potential of land and water
EP	kg PO_4^{3-}-eq.	Eutrophication potential
POCP	kg C_2H_4-eq.	Formation potential of tropospheric ozone photochemical oxidants
ADPE	kg Sb-eq.	Abiotic depletion potential for elemental (non-fossil) resources
ADPF	MJ	Abiotic depletion potential for fossil resources
WSP	m^3 equiv.	Water scarcity potential
Resource use indicators		
PERE	MJ	Renewable primary energy as energy carrier
PERM	MJ	Renewable primary energy resources as embodied materials
PERT	MJ	Total use of renewable primary energy resources
PENRE	MJ	Non-renewable primary energy as energy carrier
PENRM	MJ	Non-renewable primary energy as embodied materials
PENRT	MJ	Total use of non-renewable primary energy resources
SM	kg	Use of secondary material
RSF	MJ	Use of renewable secondary fuels
NRSF	MJ	Use of non-renewable secondary fuels
FW	m^3	Use of net fresh water
Waste and output flow indicators		
HWD	kg	Hazardous waste disposed
NHWD	kg	Non-hazardous waste disposed
RWD	kg	Radioactive waste disposed
CRU	kg	Components for re-use
MFR	kg	Materials for recycling
MER	kg	Materials for energy recovery
EEE	MJ	Exported electrical energy
EET	MJ	Exported thermal energy
Greenstar indicators*		
HTc	CTUh	Human Toxicity cancer effects
HTnc	CTUh	Human Toxicity non-cancer effects
LU	kg C deficit eq.	Land use
RDw	m^3 eq.	Resource depletion - water
IR	kBq U235 eq.	Ionising Radiation
PM	kg PM2,5-eq.	Particulate Matter

* Greenstar indicators are only provided for the galvanizing process, and do not include upstream steel impact

Results of Assessment

The declared unit for the EPD is 1 year of protection of a 1 m^2 zinc coated 8mm thick steel plate. The zinc coating has a minimum average thickness requirement of 85 µm to comply with AS/NZS 4680. The declared unit assumes exposure across four corrosion zones; C1 – C4 as defined in ISO 9223 and AS/NZS 2312.2. The EPD represents average values for the product category, hence, the declared unit is not available for purchase on the market. Details of average product are given in Table 2. The area of application includes commercial and residential buildings, and infrastructure, in a range of structural and non-structural components. See How to use this EPD (page 23) for more information.

Environmental impact indicators

The galvanizing contribution to the manufacturing phase (A1-A3) is reported separately in the last column of the following tables, according to the same declared unit.

Table 6: 1 year of protection for a 1 m² of hot dip galvanized 8mm steel plate in C1 environment

Indicator	Unit	A1-A3	A4	C2	C3	C4	D	Galvanizing A1-A3
EN15804 Environmental impact indicators								
GWPT	kg CO_2-eq.	0.244	6.48E-04	6.47E-04	0.00284	3.11E-04	-0.0919	0.0109
GWPF	kg CO_2-eq.	0.243	6.22E-04	6.22E-04	0.00284	3.26E-04	-0.0916	0.0106
GWPB	kg CO_2-eq.	4.92E-04	2.58E-05	2.58E-05	-5.46E-07	-1.49E-05	-2.79E-04	3.27E-04
GWPL	kg CO_2-eq.	3.21E-05	1.17E-08	1.17E-08	6.86E-07	2.30E-07	2.66E-06	5.32E-06
ODP	kg CFC11-eq.	1.18E-12	1.16E-19	1.16E-19	1.75E-17	1.06E-18	2.69E-16	7.02E-15
AP	kg SO_2-eq.	5.56E-04	1.23E-06	1.23E-06	1.13E-05	1.31E-06	-1.02E-04	3.57E-05
EP	kg PO_4^{3-}- eq.	7.38E-05	2.54E-07	2.54E-07	1.01E-06	3.00E-07	-4.25E-06	6.92E-06
POCP	kg C_2H_4-eq.	1.48E-04	-3.12E-07	-3.12E-07	6.07E-07	1.79E-08	-3.94E-05	2.73E-06
ADPE	kg Sb-eq.	5.73E-08	8.06E-12	8.05E-12	1.92E-10	6.58E-11	-1.01E-08	3.11E-08
ADPF	MJ	2.68	0.00871	0.00870	0.0317	0.00493	-0.838	0.120
WSP	m^3 equiv.	0.0637	4.11E-06	4.11E-06	0.00109	1.87E-05	-0.0272	0.0339
EN15804 Resource use indicators								
PERE	MJ	0.178	5.69E-05	5.69E-05	0.00483	4.08E-04	0.0563	0.0313
PERM	MJ	0	0	0	0	0	0	0
PERT	MJ	0.178	5.69E-05	5.69E-05	0.00483	4.08E-04	0.0563	0.0313
PENRE	MJ	2.70	0.00871	0.00871	0.0317	0.00504	-0.811	0.129
PENRM	MJ	0	0	0	0	0	0	0
PENRT	MJ	2.70	0.00871	0.00871	0.0317	0.00504	-0.811	0.129
SM	kg	0.0322	0	0	0	0	0	0.0110
RSF	MJ	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0
FW	m^3	0.00185	8.14E-08	8.13E-08	1.53E-05	7.16E-07	-8.08E-04	9.85E-04
EN15804 Waste categories and output flows								
HWD	kg	4.18E-08	5.30E-13	5.30E-13	5.14E-12	3.37E-11	-1.14E-07	1.21E-08
NHWD	kg	0.0486	2.02E-07	2.02E-07	8.18E-06	0.00755	0.0101	0.00130
RWD	kg	8.26E-06	9.23E-10	9.23E-10	5.43E-09	4.27E-08	-2.10E-06	3.61E-06
CRU	kg	0	0	0	0	0	0	0
MFR	kg	2.61E-05	0	0	0.0571	0	0	4.08E-06
MER	kg	4.86E-05	0	0	0	0	0	2.85E-07
EEE	MJ	0	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0	0
Green Star*								
HTc	CTUh							1.06E-12
HTnc	CTUh							2.37E-14
LU	kg C deficit eq.							0.00558
RDw	m^3 eq.							5.58E-04
IR	kBq U235 eq.							4.28E-04
PM	kg PM2,5-eq.							4.17E-06

Refer to page 15 for explanation of each Indicator.

Table 7: Results for 1 year of protection for a 1 m² of hot dip galvanized 8mm steel plate in C2 environment

Indicator	Unit	A1-A3	A4	C2	C3	C4	D	Galvanizing A1-A3
EN15804 Environmental impact indicators								
GWPT	kg CO_2-eq.	0.976	0.00259	0.00259	0.0113	0.00124	-0.368	0.0435
GWPF	kg CO_2-eq.	0.974	0.00249	0.00249	0.0113	0.00130	-0.367	0.0422
GWPB	kg CO_2-eq.	0.00197	1.03E-04	1.03E-04	-2.18E-06	-5.95E-05	-0.00112	0.00131
GWPL	kg CO_2-eq.	1.28E-04	4.66E-08	4.66E-08	2.75E-06	9.22E-07	1.06E-05	2.13E-05
ODP	kg CFC11-eq.	4.70E-12	4.65E-19	4.65E-19	6.99E-17	4.23E-18	1.08E-15	2.81E-14
AP	kg SO_2-eq.	0.00222	4.90E-06	4.90E-06	4.51E-05	5.23E-06	-4.09E-04	1.43E-04
EP	kg PO_4^{3-}- eq.	2.95E-04	1.01E-06	1.01E-06	4.05E-06	1.20E-06	-1.70E-05	2.77E-05
POCP	kg C_2H_4-eq.	5.93E-04	-1.25E-06	-1.25E-06	2.43E-06	7.16E-08	-1.58E-04	1.09E-05
ADPE	kg Sb-eq.	2.29E-07	3.22E-11	3.22E-11	7.69E-10	2.63E-10	-4.05E-08	1.24E-07
ADPF	MJ	10.7	0.0348	0.0348	0.127	0.0197	-3.35	0.481
WSP	m^3 equiv.	0.255	1.64E-05	1.64E-05	0.00435	7.49E-05	-0.109	0.136
EN15804 Resource use indicators								
PERE	MJ	0.710	2.28E-04	2.28E-04	0.0193	0.00163	0.225	0.125
PERM	MJ	0	0	0	0	0	0	0
PERT	MJ	0.710	2.28E-04	2.28E-04	0.0193	0.00163	0.225	0.125
PENRE	MJ	10.8	0.0348	0.0348	0.127	0.0202	-3.24	0.518
PENRM	MJ	0	0	0	0	0	0	0
PENRT	MJ	10.8	0.0348	0.0348	0.127	0.0202	-3.24	0.518
SM	kg	0.129	0	0	0	0	0	0.0442
RSF	MJ	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0
FW	m^3	0.00741	3.25E-07	3.25E-07	6.11E-05	2.86E-06	-0.00323	0.00394
EN15804 Waste categories and output flows								
HWD	kg	1.67E-07	2.12E-12	2.12E-12	2.06E-11	1.35E-10	-4.55E-07	4.83E-08
NHWD	kg	0.194	8.09E-07	8.09E-07	3.27E-05	0.0302	0.0406	0.00520
RWD	kg	3.30E-05	3.69E-09	3.69E-09	2.17E-08	1.71E-07	-8.39E-06	1.44E-05
CRU	kg	0	0	0	0	0	0	0
MFR	kg	1.04E-04	0	0	0.228	0	0	1.63E-05
MER	kg	1.94E-04	0	0	0	0	0	1.14E-06
EEE	MJ	0	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0	0
Green Star*								
HTc	CTUh							4.22E-12
HTnc	CTUh							9.48E-14
LU	kg C deficit eq.							0.0223
RDw	m^3 eq.							0.00223
IR	kBq U235 eq.							0.00171
PM	kg PM2,5-eq.							1.67E-05

Refer to page 15 for explanation of each Indicator.

Table 8: 1 year of protection for a 1 m² of hot dip galvanized 8mm steel plate in C3 environment

Indicator	Unit	A1-A3	A4	C2	C3	C4	D	Galvanizing A1-A3
EN15804 Environmental impact indicators								
GWPT	kg CO_2-eq.	3.41	0.00907	0.00906	0.0397	0.00435	-1.29	0.152
GWPF	kg CO_2-eq.	3.41	0.00870	0.00870	0.0397	0.00456	-1.28	0.148
GWPB	kg CO_2-eq.	0.00689	3.61E-04	3.61E-04	-7.64E-06	-2.08E-04	-0.00391	0.00458
GWPL	kg CO_2-eq.	4.49E-04	1.63E-07	1.63E-07	9.61E-06	3.23E-06	3.73E-05	7.45E-05
ODP	kg CFC11-eq.	1.65E-11	1.63E-18	1.63E-18	2.45E-16	1.48E-17	3.77E-15	9.82E-14
AP	kg SO_2-eq.	0.00778	1.72E-05	1.72E-05	1.58E-04	1.83E-05	-0.00143	4.99E-04
EP	kg PO_4^{3-}- eq.	0.00103	3.55E-06	3.55E-06	1.42E-05	4.20E-06	-5.95E-05	9.68E-05
POCP	kg C_2H_4-eq.	0.00208	-4.37E-06	-4.37E-06	8.50E-06	2.51E-07	-5.51E-04	3.82E-05
ADPE	kg Sb-eq.	8.02E-07	1.13E-10	1.13E-10	2.69E-09	9.21E-10	-1.42E-07	4.36E-07
ADPF	MJ	37.5	0.122	0.122	0.444	0.0691	-11.7	1.68
WSP	m^3 equiv.	0.891	5.75E-05	5.75E-05	0.0152	2.62E-04	-0.381	0.475
EN15804 Resource use indicators								
PERE	MJ	2.49	7.97E-04	7.97E-04	0.0676	0.00571	0.789	0.439
PERM	MJ	0	0	0	0	0	0	0
PERT	MJ	2.49	7.97E-04	7.97E-04	0.0676	0.00571	0.789	0.439
PENRE	MJ	37.8	0.122	0.122	0.444	0.0706	-11.3	1.81
PENRM	MJ	0	0	0	0	0	0	0
PENRT	MJ	37.8	0.122	0.122	0.444	0.0706	-11.3	1.81
SM	kg	0.451	0	0	0	0	0	0.155
RSF	MJ	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0
FW	m^3	0.0259	1.14E-06	1.14E-06	2.14E-04	1.00E-05	-0.0113	0.0138
EN15804 Waste categories and output flows								
HWD	kg	5.85E-07	7.42E-12	7.42E-12	7.19E-11	4.72E-10	-1.59E-06	1.69E-07
NHWD	kg	0.680	2.83E-06	2.83E-06	1.15E-04	0.106	0.142	0.0182
RWD	kg	1.16E-04	1.29E-08	1.29E-08	7.60E-08	5.98E-07	-2.94E-05	5.05E-05
CRU	kg	0	0	0	0	0	0	0
MFR	kg	3.65E-04	0	0	0.799	0	0	5.71E-05
MER	kg	6.80E-04	0	0	0	0	0	4.00E-06
EEE	MJ	0	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0	0
Green Star*								
HTc	CTUh							1.48E-11
HTnc	CTUh							3.32E-13
LU	kg C deficit eq.							0.0781
RDw	m^3 eq.							0.00781
IR	kBq U235 eq.							0.00599
PM	kg PM2,5-eq.							5.84E-05

Refer to page 15 for explanation of each Indicator.

Table 9: 1 year of protection for a 1 m² of hot dip galvanized 8mm steel plate in C4 environment

Indicator	Unit	A1-A3	A4	C2	C3	C4	D	Galvanizing A1-A3
EN15804 Environmental impact indicators								
GWPT	kg CO_2-eq.	7.68	0.0204	0.0204	0.0894	0.00980	-2.90	0.343
GWPF	kg CO_2-eq.	7.67	0.0196	0.0196	0.0894	0.0103	-2.89	0.332
GWPB	kg CO_2-eq.	0.0155	8.13E-04	8.13E-04	-1.72E-05	-4.69E-04	-0.00879	0.0103
GWPL	kg CO_2-eq.	0.00101	3.67E-07	3.67E-07	2.16E-05	7.26E-06	8.38E-05	1.68E-04
ODP	kg CFC11-eq.	3.70E-11	3.66E-18	3.66E-18	5.50E-16	3.33E-17	8.48E-15	2.21E-13
AP	kg SO_2-eq.	0.0175	3.86E-05	3.86E-05	3.55E-04	4.12E-05	-0.00322	0.00112
EP	kg PO_4^{3-}- eq.	0.00233	7.99E-06	7.99E-06	3.19E-05	9.46E-06	-1.34E-04	2.18E-04
POCP	kg C_2H_4-eq.	0.00467	-9.83E-06	-9.82E-06	1.91E-05	5.64E-07	-0.00124	8.60E-05
ADPE	kg Sb-eq.	1.80E-06	2.54E-10	2.54E-10	6.06E-09	2.07E-09	-3.19E-07	9.80E-07
ADPF	MJ	84.3	0.274	0.274	1.000	0.155	-26.4	3.79
WSP	m^3 equiv.	2.01	1.29E-04	1.29E-04	0.0343	5.89E-04	-0.857	1.07
EN15804 Resource use indicators								
PERE	MJ	5.59	0.00179	0.00179	0.152	0.0129	1.77	0.987
PERM	MJ	0	0	0	0	0	0	0
PERT	MJ	5.59	0.00179	0.00179	0.152	0.0129	1.77	0.987
PENRE	MJ	85.0	0.274	0.274	1.000	0.159	-25.5	4.08
PENRM	MJ	0	0	0	0	0	0	0
PENRT	MJ	85.0	0.274	0.274	1.000	0.159	-25.5	4.08
SM	kg	1.01	0	0	0	0	0	0.348
RSF	MJ	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0
FW	m^3	0.0584	2.56E-06	2.56E-06	4.81E-04	2.26E-05	-0.0254	0.0310
EN15804 Waste categories and output flows								
HWD	kg	1.32E-06	1.67E-11	1.67E-11	1.62E-10	1.06E-09	-3.58E-06	3.81E-07
NHWD	kg	1.53	6.37E-06	6.37E-06	2.58E-04	0.238	0.319	0.0410
RWD	kg	2.60E-04	2.91E-08	2.91E-08	1.71E-07	1.35E-06	-6.61E-05	1.14E-04
CRU	kg	0	0	0	0	0	0	0
MFR	kg	8.21E-04	0	0	1.80	0	0	1.28E-04
MER	kg	0.00153	0	0	0	0	0	8.99E-06
EEE	MJ	0	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0	0
Green Star*								
HTc	CTUh							3.33E-11
HTnc	CTUh							7.46E-13
LU	kg C deficit eq.							0.176
RDw	m^3 eq.							0.0176
IR	kBq U235 eq.							0.0135
PM	kg PM2,5-eq.							1.31E-04

Refer to page 15 for explanation of each Indicator.

Galvanizing only impact per kg of zinc

Table 10: A1-A3 galvanizing only impact for 1 year of protection for a 1 m² of hot dip galvanized 8mm steel plate per 1kg of zinc coating for C1, C2, C3 and C4 corrosion environments

Indicator	Unit	C1 Environment	C2 Environment	C3 Environment	C4 Environment
EN15804 Environmental impact indicators					
GWPT	kg CO2-eq.	8.97E-03	3.58E-02	1.25E-01	2.82E-01
GWPF	kg CO2-eq.	8.72E-03	3.47E-02	1.22E-01	2.73E-01
GWPB	kg CO2-eq.	2.69E-04	1.08E-03	3.77E-03	8.47E-03
GWPL	kg CO2-eq.	4.38E-06	1.75E-05	6.13E-05	1.38E-04
ODP	kg CFC11-eq.	5.78E-15	2.31E-14	8.08E-14	1.82E-13
AP	kg SO2-eq.	2.94E-05	1.18E-04	4.11E-04	9.21E-04
EP	kg PO43-- eq.	5.69E-06	2.28E-05	7.96E-05	1.79E-04
POCP	kg C2H4-eq.	2.25E-06	8.97E-06	3.14E-05	7.08E-05
ADPE	kg Sb-eq.	2.56E-08	1.02E-07	3.59E-07	8.06E-07
ADPF	MJ	0.10	0.40	1.38	3.12
WSP	m^3 equiv.	0.03	0.11	0.39	0.88
EN15804 Resource use indicators					
PERE	MJ	0.206	0.026	0.103	0.361
PERM	MJ	0	0	0	0
PERT	MJ	0.206	0.026	0.103	0.361
PENRE	MJ	1.61	0.11	0.43	1.49
PENRM	MJ	8.52E-05	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.61	0.11	0.43	1.49
SM	kg	0.123	0.009	0.036	0.128
RSF	MJ	2.69E-08	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	1.09E-04	0.00E+00	0.00E+00	0.00E+00
FW	m^3	0.138	0.001	0.003	0.011
EN15804 Waste categories and output flows					
HWD	kg	9.95E-09	3.97E-08	1.39E-07	3.13E-07
NHWD	kg	0.0011	0.0043	0.0150	0.0337
RWD	kg	2.97E-06	1.18E-05	4.15E-05	9.38E-05
CRU	kg	0	0	0	0
MFR	kg	0.00000	0.00001	0.00005	0.00011
MER	kg	2.34E-07	9.38E-07	3.29E-06	7.40E-06
EEE	MJ	0	0	0	0
EET	MJ	0	0	0	0
Green Star*					
HTc	CTUh	8.72E-13	3.47E-12	1.22E-11	2.74E-11
HTnc	CTUh	1.95E-14	7.80E-14	2.73E-13	6.14E-13
LU	kg C deficit eq.	0.0046	0.0183	0.0643	0.1448
RDw	m3 eq.	0.0005	0.0018	0.0064	0.0145
IR	kBq U235 eq.	0.00035	0.00141	0.00493	0.01111
PM	kg PM2,5-eq.	3.43E-06	1.37E-05	4.80E-05	1.08E-04

Refer to page 14 for explanation of each Indicator.

Hot dip galvanizing provides three levels of **corrosion protection** to deliver predictable performance and whole of life cost benefits for steel installations.

How to use this EPD

This Environmental Product Declaration (EPD) covers the environmental impacts of hot dip galvanized steel, typically used in commercial construction, infrastructure projects and residential housing. This is a product EPD for Kingfield hot dip galvanized steel, produced to meet the quality standards of AS/NZS4680 and is not an industry average EPD.

This EPD is a third party verified, EN15804 compliant document that includes information about the environmental impact of HDG steel throughout its life cycle. EPDs require the completion of Life Cycle Inventory (LCI) or the collection of data on the inputs, processes and outputs within a defined system boundary, along with Life Cycle Assessment (LCA), the modelling of LCI in accordance with ISO 14040 and ISO 14044 standards.

EPDs are not always comparable due to product category rules applied, the EPD programme used or industry EPDs compared to product EPDs. When attempting to compare EPD outputs, we recommend seeking expert advice to avoid confusion.

Benefits of using this EPD

This EPD provides an independently verified representation of the environmental impact of Kingfield hot dip galvanized steel going into a project.

This EPD can also support projects to gain points in the Green Building Council of Australia's Green Star rating tool, and the Infrastructure Sustainability Council of Australia's IS® rating scheme.

Green Star

Green Star projects can score points under the Sustainable Products credit for using products with EPDs that comply with the following criteria:

- EN 15804 and ISO 14025 compliant
- Verified by an independent third party
- Cradle-to-gate scope.

This EPD meets these requirements as a product-specific EPD.

IS Rating Tool

IS® projects can claim points for using products with EPDs that comply with the criteria below, for either ISv1.2 Mat-2 Environmentally labelled products and supply chains, or ISv2.0 Rso 7 Sustainability Labelled Products and Supply Chains:

- Compliant with ISO 14025
- Compliant with EN15804
- Verified by a third party

This EPD meets these requirements as a product-specific EPD.

EPD results can also be included in the ISv2.0 Materials Calculator used in Rso 6 Material Life Cycle Impact Measurement and Reduction, and may help the project to achieve reductions compared to a Base Case footprint.

Glossary

Allocation

"Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems" (ISO 14040:2006, section 3.17)

AS/NZS 2213.1

Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings

AS/NZS 4680

The Australian and New Zealand standard that defines the minimum requirements for coating mass (thickness) of hot dip galvanizing for various steel sections, including methods of test and repairs, information on design for galvanizing, surface preparation and metallurgical information.

Barrier Protection

The physical envelope that hot dip galvanizing forms around the steel substrate. In hollow sections, i.e. pipes, this envelope protects the internal & external facings of the steel.

Cathodic Protection

The surrounding galvanizing coating protects small areas of exposed steel from corrosion. The zinc coating corrodes preferentially to the cathodic steel base, preventing corrosion of small areas which may be exposed, such as cut edges or drilled holes. This cathodic protection continues for as long as some of the galvanized coating remains.

Cradle to gate

Scope of study extends from mining of natural resources to the completed product ready for shipping from the manufacturing dispatch "gate", known as Modules A1-A3.

Cradle to grave

Scope of study extends from mining of natural resources to manufacture, use and disposal of products at End of Life, including all Modules A-D.

End of life (EoL)

Post-use phase life cycle stages involving collection and processing of materials (e.g. scrap) and recycling or disposal, known as Modules C and D.

EPD – Environmental Product Declaration

An independently verified and registered document that communicates transparent and comparable information about the life-cycle environmental impact of products.

HDG – Hot dip galvanizing

Is the process of coating fabricated steel by immersing in a bath of molten zinc, to form a zinc carbonate alloy with the surface of the steel, to protect the steel substrate from corrosion.

Life Cycle Inventory (LCI)

"Phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle" (ISO 14040:2006, section 3.3)

Passivation

Passivation **protects steel** by providing both cathodic and barrier protection. The naturally occurring formation of a tenacious, abrasion-resistant zinc carbonate patina protects steel substrates from corrosion.

Whole of life cost

The **total expense of owning an asset over its entire life**, from purchase to disposal, also known as a "life-cycle" cost, which includes purchase and installation, design and building costs, operating costs, maintenance, associated financing costs, depreciation and disposal costs.

Zinc Patina

Zinc patina begins to form with exposure to oxygen in the atmosphere. Forming a layer of zinc oxide on the surface of the galvanized steel. Once this patina stabilises, it reduces exposure of the galvanized coating to the environment and slows the corrosion process.

General information

An Environmental Product Declaration, or EPD, is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as a PCR (Product Category Rules).

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804.

Declaration owner:	**Kingfield Galvanizing** Web: https://www.kingfield.com.au/ Email: sales@kingfield.com.au Post: 35 Oherns Road, Somerton, VIC 3062
EPD produced by:	**thinkstep-anz** Web: https://www.thinkstep-anz.com Email: anz@thinkstep-anz.com Post: 25 Jubilee Street, Perth, Western Australia 6151
EPD programme operator:	**EPD Australasia Limited** Web: http://www.epd-australasia.com Email: info@epd-australasia.com Post: EPD Australasia Limited, 315a Hardy Street Nelson 7010, New Zealand
CEN standard EN 15804 +A1 served as the core PCR	
PCR:	PCR 2011:16 Corrosion protection of fabricated steel products, Version 2.32, 2020-11-23 EN: 15804+A1:2013
PCR review was conducted by:	The Technical Committee of the International EPD® System
Chair:	Massimo Marino. Contact via info@environdec.com
Independent verification of the declaration and data, according to ISO 14025:	☐ EPD process certification (Internal) ☑ EPD verification (External)
Third party verifier:	**Kimberly Robertson, Catalyst Ltd** Email: kimberly.robertson@catalystnz.co.nz
Approved by:	EPD Australasia

References

AS 4312:2019; Atmospheric corrosivity zones in Australia, Standards Australia

AS/NZS 2312.2:2014; Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings - Part 2: Hot dip galvanizing, Standards New Zealand, Standards Australia

AS/NZS 4680:2006 (Reconfirmed 2017) Hot-dip galvanized (zinc) coatings on fabricated ferrous articles. Standards New Zealand, Standards Australia

Department of the Environment and Energy; Blue EnvironmentPty Ltd (2018) National Waste Report 2018, Retrieved from: https://www.environment.gov.au/system/files/resources/7381c1de-31d0-429b-912c-91a6dbc83af7/files/national-waste-report-2018.pdf

EPD Australasia (2018) Instructions of the Australasian EPD Programme V3.0 - A Regional Annex to the General Programme Instructions of the International EPD System.

EN 15804:2012+A1:2013; Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products . Brussels: European Committee for Standardization.

IEPDS (2019) General Programme Instructions for the International EPD® System v3.01. Stockholm: International EPD®

IEPDS (2020) PCR 2011:16 Corrosion protection of fabricated steel products of the International EPD® System, Version 2.32: 2020-11-23

InfraBuild (2016a) Environmental Product Declaration for hot rolled structural and rail products, Version 1 of 08/11/2016. EPD registration number no. S-P-00854. EPD Australasia.

InfraBuild (2016b) Environmental Product Declaration for reinforcing rod, bar and wire, Version 1 of 08/11/2016. EPD registration number S-P-00855. EPD Australasia.

ISO 14040:2006; Environmental management – Life cycle assessment – Principles and framework. Geneva: International Organization for Standardization.

ISO 14044:2006; Environmental management – Life cycle assessment – Requirements and guidelines. Geneva: International Organization for Standardization.

ISO 14025:2006; Environmental labels and declarations — Type III environmental declarations — Principles and procedures. Geneva: International Organization for Standardization.

ISO 9223:2012; Corrosion of metals and alloys — Corrosivity of atmospheres — Classification, determination and estimation. International Organization for Standardization, Geneva.

National GreenPowerTM Accreditation Program (2018) Annual Compliance Audit for 1 January 2017 to 31 December 2017. Retrieved from: https://www.greenpower.gov.au/sites/default/files/2020-09/GreenPower%202017%20Annual%20Audit%20Report%20FINAL.pdf

Sphera (2020) GaBi Lifecycle Inventory Database 2020 Documentation. United States of America. Retrieved from: http://www.gabi-software.com/international/support/gabi/gabi-database-2020-lci-documentation

Our commitment is to hot dip galvanize steel in a more sustainable manner; to reduce, re-use & recycle, to **minimise the environmental footprint** of HDG for Australia's built environment.

KINGFIELD
GALVANIZING

PH: 9305 3902 FAX: 9305 3016 WEBSITE: kingfield.com.au EMAIL: sales@kingfield.com.au
ADDRESS: 35 O'Herns Road, Somerton Vic 3062 – P.O Box 501, Somerton VIC 3062