TECHNICAL POSITION
EDITION 1 · 2026

BUILT TO OUTLAST THE LANDSCAPE ABOVE IT

Everything EPIC places in the ground is specified to still be doing its job in a hundred years. This paper sets out the evidence, material by material — what is buried, what could end its life, and why none of those mechanisms is switched on in the EPIC position.

100
YEARS OF IN-SERVICE LIFE DEMONSTRATED FOR BURIED POLYPROPYLENE AND POLYETHYLENE — UNDER SEWER DUTY FAR HARSHER THAN EPIC'S

446
YEARS PREDICTED FOR A COVERED HDPE GEOMEMBRANE AT 20 °C. 166 YEARS AT 30 °C, 106 AT 35 °C

1995
THE FIRST EPIC INSTALLATION. 470 SYSTEMS AND 2,093,000 SQ FT HAVE FOLLOWED IT INTO THE GROUND



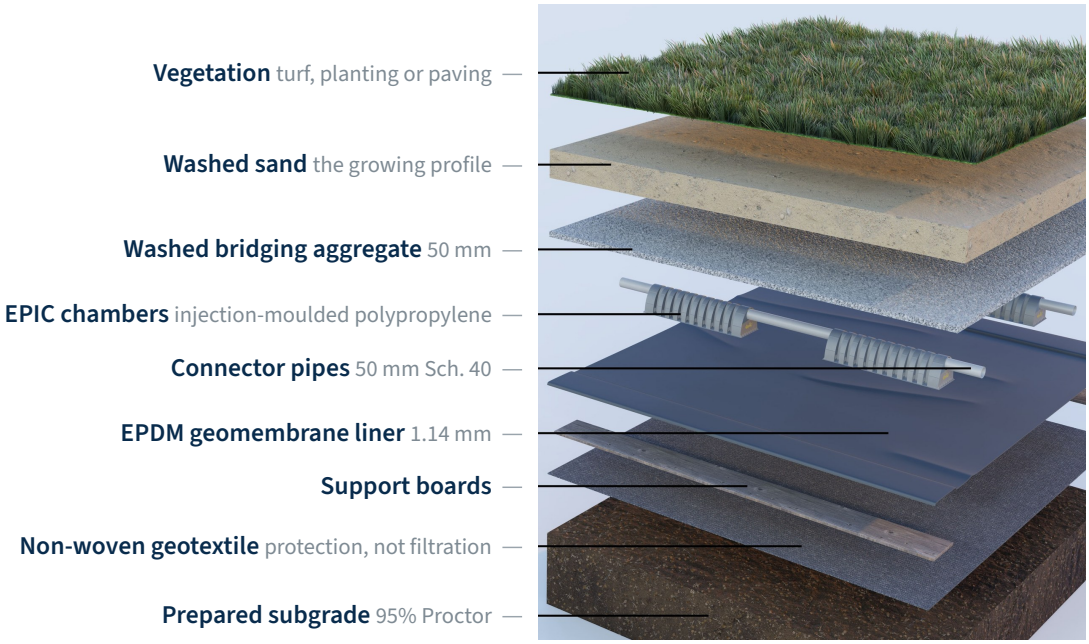
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PART ONE

NINE LAYERS. FOUR MATERIALS.

An EPIC cell is not a machine but a sequence of layers, so the question of how long it lasts is really four questions — one per class of material in the ground.



The EPIC profile, exploded. Nine layers — and the polymer ones together are under one per cent of the installed mass.

MATERIAL CLASS	WHAT IT IS	SHARE OF MASS	WHAT GOVERNS ITS LIFE
Mineral	Washed sand, bridging gravel, prepared subgrade	~99%	Nothing. Silica sand is a geological material — it does not oxidise, corrode or decompose.
Polyolefin	EPIC chambers (polypropylene) and connector pipe	under 1%	Thermo-oxidation. The rate is set by temperature and by how much oxygen reaches the polymer.
Geomembrane	EPDM or HDPE liner	under 1%	Thermo-oxidation and, when exposed, ultraviolet light. Buried, UV does not apply.

NINETY-NINE PER CENT OF THE MASS IS MINERAL

Roughly 99% of an installed EPIC system by mass is sand, gravel and water; the chambers and the liner together are well under one per cent. The durability question is therefore a question about a very small fraction of what is in the ground — and the largest fraction has no degradation mechanism at all. The only other polymer down there is the neoprene grommet at each pipe penetration, and every one is accessible and replaceable.

PART TWO

FIVE WAYS A POLYMER DIES. NONE OF THEM APPLIES HERE.

Polymers do not wear out with time. They fail through identifiable mechanisms, and every one of those mechanisms needs a driver. Remove the drivers and the clock effectively stops.

MECHANISM	WHAT DRIVES IT	POSITION IN AN EPIC PROFILE
Photo-oxidation	Direct sunlight. The dominant cause of failure in exposed plastics and geomembranes.	Absent. In a standard profile the chambers carry 175–200 mm of sand over the crown, and the liner sits deeper still. 150 mm of soil cover alone stops UV entirely.
Thermo-oxidation	Heat together with available oxygen. The rate rises exponentially with temperature.	Strongly suppressed. Buried components sit at damped ground temperature, not air temperature, and oxygen supply inside a backfilled, largely saturated profile is limited.
Sustained stress	Continuous load or deflection held over decades, leading to slow crack growth.	Low. The chamber is an arch bedded in confined sand, not a ring held in permanent deflection. The compacted sand and gravel around it carry the load past it.
Chemical attack	Strong oxidising acids, aromatic and chlorinated solvents, hydrocarbons.	Not present. EPIC carries irrigation water, treated effluent, stormwater, brackish and saline water. Polypropylene is rated excellent against neutral salts, fertiliser solutions and alkalis.
Biological attack	Metabolism of the polymer itself by soil bacteria or fungi.	Does not occur. Untreated polyolefins are not metabolised by soil organisms; published work finds fungal attack only after deliberate UV or thermal pre-oxidation of the sample.

ONCE UV IS REMOVED, TEMPERATURE IS THE ONLY VARIABLE LEFT

Every remaining mechanism is temperature-driven and follows an Arrhenius relationship: as a rule of thumb the rate doubles for each 10 °C. This is exactly why the same geomembrane is modelled at **446 years at 20 °C** and **69 years at 40 °C** — and why depth of cover is a durability decision, not a constructability one.

In a Gulf profile the chambers sit under 175–200 mm of sand that is damp or wet for most of the year, and the saturated zone at the base of the cell is cooler still. Even taken at the model's 30 °C line — a deliberately conservative reading of Gulf ground temperature at that depth — the covered geomembrane is predicted at **166 years**.

The same logic runs the other way and is worth stating plainly: an EPIC component left exposed on site before backfill is in the worst position it will ever occupy. Cover it on the day it is laid, and it never sees those conditions again.

PART THREE

POLYPROPYLENE, AND THE HUNDRED-YEAR FINDING

The definitive work on how long buried polypropylene and polyethylene last was not done for irrigation. It was done for sewers — a far harder duty than EPIC's.

In December 2014 TEPPFA, the European Plastic Pipes and Fittings Association, published a three-year study with the resin producers Borealis and LyondellBasell, independently validated by Prof. Dr Heinz Dragaun of the Austrian Federal Institute of Technology in Vienna. Its conclusion, in its own words: polyolefin sewer systems will have an in-service life of **at least one hundred years** when materials, products and installation practices meet the appropriate requirements. It did not rest on modelling — pipe was excavated from five European sites and tested against the requirements applied to new product.

SITE	MATERIAL	YRS	RESULT ON EXCAVATION
Finland	PE solid wall, 200 mm	38	Physical characteristics in the range of the original data sheets; heat-ageing gave a residual life of more than 50 further years.
Germany	PE solid wall, 280 / 355 mm	16–18	No reduction in quality.
Norway	PP solid wall, 110 mm	23	No significant loss of mechanical properties; pressure tests ran 1,260 h and over 2,800 h against a 1,000 h requirement.
Norway	PP structured wall, 160 mm	20	Meets today's ring flexibility and impact requirements.
Denmark	PP structured wall, 200 mm	12	No accelerated polymer degradation.

WHY EPIC'S DUTY IS THE EASIER ONE

- **Temperature.** EN 476 permits continuous discharge at 45 °C and the study evaluated the polymer there. An EPIC chamber carries irrigation water at ground temperature.
- **Sustained deflection.** A sewer pipe is a ring held in permanent deflection, limited to 8% at commissioning and relaxation-tested at 15%. The EPIC chamber is an open-bottomed arch bedded in compacted sand and gravel.
- **Chemistry.** The study had to allow for sewage. EPIC carries irrigation water, treated effluent, stormwater and saline water, none at concentrations that affect polyolefin life.

INDEPENDENT LOAD TESTING, 2009

American Engineering Testing Inc. (project 20-08900) loaded installed EPIC chambers through the finished profile. Under 305 mm of sand — 140 mm of it over the chamber crown, shallower than the specification requires, so the result is conservative — **6,200 lb on a 100 in² plate** gave 1.16 in; under 406 mm, **10,000 lb on a 10 × 14 in plate** gave 3.345 in.

PART FOUR

COVERED, NOT EXPOSED. THAT IS THE WHOLE ARGUMENT.

Geomembrane service life is not a property of the sheet but of where the sheet sits. The models and the exhumed samples agree on that.

The Geosynthetic Institute's lifetime prediction for a covered HDPE geomembrane, by field temperature (Koerner, Hsuan & Koerner, GRI White Paper #6, 2005, updated 2011):

TEMP.	DEPLETION	INDUCTION	TO HALF-LIFE	TOTAL PREDICTED
20 °C	208 yr	30 yr	208 yr	**446 years**
25 °C	140 yr	25 yr	100 yr	**265 years**
30 °C	97 yr	20 yr	49 yr	**166 years**
35 °C	66 yr	15 yr	25 yr	**106 years**
40 °C	46 yr	10 yr	13 yr	**69 years**

Independent work at Queen's University agrees from a different direction: a seventeen-year elevated-temperature incubation programme projects 660–1,700 years at 20 °C, and over 550 years at 35 °C under a protective cover (Ewais, Rowe, Rimal & Sangam, 2018).

EXHUMED, NOT MODELLED

- A **22-year-old** HDPE liner from a waste landfill, in leachate at up to 65 °C: all physical, mechanical and endurance properties essentially unchanged and above current specification (Koerner, Youngblood & Rafter, 2018).
- A **20-year-old** HDPE geomembrane exhumed from a mine reclamation cover: tensile properties above requirement, hydraulic conductivity unaffected (Rarison et al., 2023).
- **The counter-case proves the rule.** An unprotected liner exhumed from an exposed leachate lagoon after fourteen years had effectively ceased to function within four of them (Rowe, Sangam & Lake, 2003). Same polymer. No cover.

WHY EPDM, NOT PVC

EPDM is a cured synthetic rubber with a saturated main chain — no double bonds in the backbone for ozone or ultraviolet light to attack — and a minimum 300% elongation, so it conforms to an imperfect substrate instead of tearing on it. EPIC specifies 1.14 mm (45 mil) to ASTM D7465. Roofing membrane of the same base polymer, pulled from five roofs after thirty years of full exposure, met or exceeded the physical minimums of membrane in production today.

PVC is not specified and should not be accepted as an equal: its flexibility depends on a plasticiser that migrates out of the sheet into the soil and water around it, so it stiffens, embrittles and becomes impractical to repair. In the GSI exposed-lifetime comparison it was the shortest-lived material.

PART FIVE

SAND DOES NOT DECOMPOSE. NEITHER DOES THE RECORD.

Ninety-nine per cent of an EPIC profile is mineral, and mineral has no service life to run down. The remaining one per cent is evidenced by systems that have been in the ground for a quarter of a century.

Washed silica sand is a geological material. It does not oxidise, corrode, decompose or lose strength, and because the particles do not break down the profile does not compact — it remains stable indefinitely. There is exactly one long-term degradation mechanism in an EPIC profile and it acts at the surface, not in the depth: plugging by clays or silts brought in from above through inappropriate top-dressing, contaminated sand or windblown fines. Regular aeration with the cores raked up and removed resolves it.



Reno, first season, 2000



The same field, second season



The same field in 2022 — twenty-two years on

University of Nevada, Reno — athletic practice fields, installed 2000. The system beneath the grass has not been opened.

THIRTY-ONE YEARS OF INSTALLATIONS

The first EPIC installation went into the ground in May 1995. Four hundred and seventy systems and 2,093,000 square feet have followed it. At Sonoma Golf Club in California all seventy-two bunkers were rebuilt on EPIC drainage in 2003; five and a half years on, the club's general manager recorded that every one of them drained with no standing water within an hour of the heaviest rains, while two bunkers built at the same time on conventional perforated pipe had to be pumped. The bunkers were photographed again in 2011.



Sonoma Golf Club, California — bunkers rebuilt on EPIC drainage in 2003, photographed in 2011.

PART SIX

WHAT IS NOT A HUNDRED YEARS — AND WHY THAT IS BY DESIGN

A claim is only useful if it says where it stops. EPIC is a passive system: the parts that can wear are the parts that move, and they are deliberately not buried.

COMPONENT	INDICATIVE LIFE	WHERE IT SITS	REPLACEMENT
Pumps and low-lift circulation	10–15 years	Above ground, or in an accessible vault	Like for like. No excavation of the profile.
Control valves and float switches	5–10 years	In the outlet or supply vault	Through the vault cover.
Controllers, timers, sensors	5–10 years	In the control enclosure	Bench replacement.
Surface vegetation and top-dressing	Per landscape practice	At the surface	Normal grounds maintenance.

THE ONE THING THAT NEEDS DOING

Aeration, with the cores collected. Tines of 75–100 mm are recommended; a 150 mm tine would still not reach the chambers under a standard profile, which leaves 175–200 mm of sand over the crown. Rake up and remove the plugs rather than leaving them to break down at the surface — that is how clay and silt contamination accumulates in the first place. It is the single maintenance item where neglect has a cumulative, physical consequence. Everything else about an EPIC system is either automatic or cosmetic.

A WARRANTY IS NOT A SERVICE LIFE

The two are different instruments and should not be read against each other. EPIC's commercial warranty is **twenty years pro rata** on manufactured parts and the EPDM liner and **ten years** on system operation, conditional on design review before the bid date. That is a commercial term, set by what a manufacturer will underwrite. The service life set out in this paper is an engineering estimate of how long the material will perform, and it is longer — as it is for every buried infrastructure product, from concrete pipe to cable duct.



Chambers laid and connected, immediately before the sand goes over them. Once covered, nothing in this photograph is scheduled to be touched again.

PART SEVEN

THE LIFE IS SPECIFIED, NOT ASSUMED

Every long-life finding in this paper is conditional. TEPPFA's hundred years holds "when materials, products and installation practices meet the appropriate requirements." Seven clauses carry that condition onto a project.

	CLAUSE	WHAT IT MUST SAY
1	Virgin polymer	The hundred-year analyses cover virgin material only — modified and mineral-filled compounds sit outside them. Specify injection-moulded virgin polypropylene chambers from the manufacturer, with no regrind.
2	The liner to a named standard	1.14 mm (45 mil) EPDM to ASTM D7465, or a heavy HDPE where welded seams or chemical resistance govern. Do not accept PVC as an equal.
3	Geotextile as protection, never filtration	4.5 oz/yd^2 non-woven beneath the liner, lapped 300 mm, to shield it from sharp material. It has no filtration role anywhere in an EPIC profile.
4	Cover depth maintained	Not less than 175 mm of sand over the chamber crown — 175–200 mm in a standard profile — held on the drawings. Cover is what removes UV and damps temperature: the most valuable durability measure on the drawings.
5	Sand and gravel tested	Washed, negligible silt and clay, near-neutral pH; the diameter of the larger aggregate less than eight times that of the smaller. Capillary rise measured on the proposed source before the profile depth is fixed.
6	Hydrocarbons kept off the liner	Petroleum products, greases, oils and animal fats isolated from the geomembrane; asphalt, coal tar pitch and plastic cements not used in contact with it.
7	Design review before the bid date	Every EPIC design is reviewed by the manufacturer or an appointed design firm before the bid date. The warranty depends on it — and it is what keeps the six clauses above from being value-engineered out of the package after award.

Sources. TEPPFA / Borealis / LyondellBasell, 100 Year Service Life of Polypropylene and Polyethylene Gravity Sewer Pipes, Summary Technical Report, December 2014; validated by Prof. Dr H. Dragaun, TGM Vienna. · R. M. Koerner, Y. G. Hsuan & G. R. Koerner, Geomembrane Lifetime Prediction: Unexposed and Exposed Conditions, GRI White Paper #6, Geosynthetic Institute, 2005, updated 2011 — Table 2. · R. K. Rowe & H. P. Sangam, Durability of HDPE geomembranes, Geotextiles and Geomembranes 20(2), 2002. · A. Ewais, R. K. Rowe, S. Rimal & H. P. Sangam, 17-year elevated temperature study of HDPE geomembrane longevity, Geosynthetics International 25(5), 2018. · G. Koerner, J. Youngblood & T. Rafter, Case history of a 22-year old geomembrane liner, ICG 11, 2018. · R. Rarison, M. Mbonimpa, B. Bussière & S. Pouliot, Properties of HDPE geomembrane exhumed 20 years after installation, Int. J. Geosynthetics and Ground Engineering, 2023. · R. K. Rowe, H. P. Sangam & C. B. Lake, Evaluation of an HDPE geomembrane after 14 years as a leachate lagoon liner, Canadian Geotechnical Journal 40(3), 2003. · American Engineering Testing Inc., Epic Chamber Testing, project 20-08900, 2009. · ASTM D7465 · EN 1852 · EN 12666 · EN 13476 · EN 476 · ISO 9080 · ISO 15494 · ISO 1167. · US Patents 5,921,711 · 7,517,172 B2 · 10,472,813 B1.

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