The economic cost of erosion and sediment loss from construction sites.

A summary of current data and case studies illustrating the economic costs of unmitigated erosion and sediment loss during subdivision, residential and commercial building construction and roadworks.

Bronwyn Scallan, Sediment Task Force Coordinator, Perth NRM
May 2021

 ISBN 978-0-6487012-1-7

Contents

Acknowledgements	Page	3
Executive summary	Page	3
Purpose of this document	Page	4
Approach	Page	4
Scale of the problem	Page	4
Sources and impacts of sedimentation	Page	5
Costs of sediment loss	Page	5
Examples of the costs of sediment loss (Australia and New Zealand)	Page	6
Cleaning up	Page	6
Environmental remediation/restoration	Page	9
Enforcement and compliance	Page	10
Monitoring	Page	10
Lack of adoption	Page	11
Sustained and consistent enforcement and compliance	Page	11
Prevention is cheaper	Page	12
Prevention costs (land development and building industry)	Page	13
Costs of compliance (Governments)	Page	14
Regulation	Page	15
Knowledge gaps	Page	15
Conclusions	Page	15
Recommendations	Page	16
References	Page	18
Appendices	Pages	19-25

Acknowledgements

This report was compiled on behalf of the Sediment Task Force. Funded by the Department of Biodiversity, Conservation and Attractions (DBCA), Perth NRM, the City of Canning and the City of Cockburn, the Sediment Task Force represents a multi-partisan collaborative approach to the development of solutions to prevent sediment run-off particularly, but not exclusively, from subdivision and building sites. Our appreciation goes to Healthy Land and Water in South East Queensland for their valuable support, and to the other organisations who generously contributed information for inclusion in this report.

Executive summary

Sediment runoff from urban environments is a significance source of water pollution and can cause sedimentation, particularly when soil erosion and sediment runoff is not effectively controlled on subdivision, building and roadworks sites.

Potential impacts of sedimentation include a decline in water quality, loss of critical aquatic habitat such a deep-pools, aquatic weed growth, an increase in pathogens, a decrease in the number of natural predators, altered flow regimes and implications for recreation, community health and safety.

There is evidence of financial private benefit to the land development and building industries and initially consumers when legislative requirements for erosion and sediment control on construction sites are not complied with. During and after urban development activities, expenditure is often necessary to sweep roads, repair and maintain stormwater and Water Sensitive Urban Design (WSUD) infrastructure, to remediate/restore environmental assets, and for enforcement. Costs are also incurred to retrofit poorly installed and/or maintained erosion and sediment control measures that have failed to prevent sediment loss (e.g. raingardens damaged by soil and silt and mud) or for revegetating where plants have been damaged or washed away. These costs of managing sediment loss from construction sites are primarily borne by local and state governments.

This public expenditure can be considerable as can be demonstrated by the following examples provided by different Local Government Authorities (LGAs) across Australia:

- costs borne by a single Local Government in WA in a high growth area can reach $1,663,400 per year for sediment control of new subdivisions and residential infill building in their jurisdiction;
- as a further example, a different LGA spent $642,000 per year for managing water-borne sediment discharged from new subdivisions;
- unblocking a singular pipe containing sand and rubble cost $387 per lineal metre;
- dredging costs of up to $5000 per tonne of sediment have been reported;
- $4,754 was spent to implement erosion and sediment control on a road reserve area for one location;
- removal of sediment from stormwater systems has been estimated to cost a single Local Government in Queensland $1.1 million per annum;
- $340,000 was spent on plants by a single Local Government in WA to trap sediment as one component of a wetland revegetation project;
- costs of up to $100,000 are estimated to repair or reinstate vegetated stormwater assets (e.g. bio-retention systems) per device in new housing subdivisions where assets are transferred to be Council-owned assets; and
- $100,000 was spent by a single Local Government in WA on dredging sediments to transform a sediment basin into a community recreation and wildlife habitat asset.

Further examples of expenditure can be found in this report.

Case studies have shown that the average cost to Councils in South East Queensland resulting from poorly implemented erosion and sediment control on construction sites is up to $310,000 (not including potential environmental costs, construction delays, regulatory enforcement costs or potential litigation costs). For this

same region however, a cost-benefit analysis identified there is a clear economic case for erosion and sediment control regulation and enforcement, with a conservative economic benefit of $1.20 for every $1 invested in current best practice erosion and sediment control.

This report also contains information on the scale of the problem, potential impact costs to land developers and builders that can be avoided through best practice erosion and sediment control and education and training, the need for (and cost effectiveness of) effective sentiment control regulation and enforcement, with ten recommendations.

Purpose of this document

This document compiles current data and case studies illustrating the economic costs of erosion and sediment loss during construction works (subdivision, residential/commercial building, and roadworks). It outlines economic benefits of implementing erosion and sediment controls, and likely costs to the land development and building industry.

Costings and information outlined in this report have been provided by State and Local Governments nationally and from New Zealand and the United States of America. Given resourcing and time constraints only a small number of private sector companies and civil contractors, building companies and specialist erosion and sediment control consultants in Western Australia were approached. It is recommended that future research collects data regarding the costs to the private sector.

Approach

The key methods of this research were a literature review, internet research and direct communication with relevant State and Local Government Departments and other key stakeholders and practitioners involved in working to improve water quality outcomes. Details of expenditure associated with managing the impacts of poor erosion and sediment control practices during urban development were requested. Our appreciation goes to those organisations and individuals who provided information.

Scale of the problem

Recent research conducted by Healthy Land and Water (HLW) in South East Queensland (SEQ) estimated that annual sediment contribution (unmitigated loads) from construction activities can be up to 202,000 tonnes of mobilised sediment per annum (up to 40% of the total sediment load entering waterways per annum). This volume is equal to 50,000+ dump trucks worth of sediment per annum.

Using this estimate and possible urban growth scenarios for SEQ, unmitigated sediment loads could be as high as 310,000t/pa by 2036 (i.e. a further 30% increase in sediment discharge to waterways a year). It is also estimated that over 40,000 hectares of urban expansion is required for the construction of 740,000 new homes in south-east Queensland by 2031 (HLW, 2019).

During storm events at the Heron Park Estate subdivision site in Perth in Western Australia, sediment was discharged at a rate of 0.005 kg/day/m² sand. When baseflow intersected with seasonally high groundwater this rose to 0.014 kg/day/m² sand. The measured rates of sediment discharge amounted to approximately 17,000 kg/ha of exposed sand/year (Oldham C.E., Eynon F. and Ocampo, C.J, 2020).

The United States of Americas' (USA) Environmental Protection Agency (EPA) lists sediment as the most common pollutant in USA's rivers, streams, lakes and reservoirs. It has determined that while natural erosion produces nearly 30% of the total sediment in the USA, accelerated erosion from human use of land accounts for the remaining 70%, and that the concentrated sediment releases come from construction activities, including relatively minor home-building projects such as room additions and swimming pools (USA EPA, 2012).

Sources and impacts of sedimentation

In Western Australia, the main water quality issues in waterways are salinisation, acidification and eutrophication (nutrient enrichment), low dissolved oxygen, shallow groundwater, and erosion and sedimentation (DWER, 2020).

Sediment runoff from urban environments is a significance source of water pollution and can cause sedimentation. Impacts of sedimentation can include a decline in water quality, loss of critical aquatic habitat such a deep pools, aquatic weed growth, an increase in pathogens, a decrease in the number of natural predators and altered flow regimes.

Sediment washed off from urban impervious areas can provide a substantial percentage of the sediment load in the stormwater drainage network. Stormwater is a particularly important source of contaminants that can be adsorbed to and transported by suspended sediment. Suspended sediment and the contaminants associated with it can also be transported with groundwater (Gellis et al. 2020).

Sediment accumulation can decrease oxygen availability and habitat diversity (Campbell and Doeg, 1989); alter species composition (Lemly 1982, Doeg et. al., 1987); leaf processing rates (Webster and Waide, 1982); decrease primary production through diminution of light to stream-bed (Henley et al 2000); loss of drought refuge for fishes (Bond et al. 2008); and cause infilling (Pen, 1999) and (K. Trayler, pers. comm., 2020).

Refer to Appendix 1 for details of the main pollutants in urban run-off and their impacts, Appendix 2 for details of sources and impacts of sedimentation, Appendix 3 for the conceptual pattern of sediment yield with varying land use and Appendix 4 for general phases of urbanisation with associated process changes, channel conditions and morphological adjustment.

Cost of sediment loss

The economic costs of sediment loss during construction works are not only for “cleaning-up” sediment run-off or sand drift from sites and associated sediment (waste) disposal costs; they are also incurred during remediation and restoration of drainage pits (e.g. repairing washout and scouring of swales or basins post construction), during remediation and restoration of waterways, and for enforcement. Costs are also incurred to retrofit poorly installed and/or maintained erosion and sediment control measures that have failed to prevent sediment loss (e.g. raingardens damaged by soil and silt and mud) or for revegetating where plants have been damaged or washed away.

Further economic costs are related to the loss of storage capacity and reduced design life for reservoirs, dredging costs to maintain navigable channels, increased water treatment costs, reduced flood capacity (bridges, culverts), bank erosion, reduced lifespan of stormwater infrastructure and increased maintenance costs. Economic costs resulting from declining tourism, recreation and cultural and heritage values are also evident, and further costs are predicted (HLW, 2019). (Refer to Appendix 5 for an example of a holistic analysis of the economic costs of sediment for Moreton Bay).

The University of Western Australia (UWA) Cooperative Research Centre Water Sensitive Cities (CRCWSC)’s report *Quantifying sediment export from an urban development construction site: Heron Park, Western Australia* concludes that the economic cost of expensive on-going management of water borne sediment arising from urban development is predominantly borne by local and state governments, and therefore rate payers. UWA found that the cost to the land developer of importing (and therefore losing) 200 - 300 m^3 of building sand per year is up to $7,500. Local Governments in WA have reported dredging costs up to $80 per tonne of sediment, depending on the ease of access to the site and difficulty of the dredge. Using this costing, if all the sediment discharged along the Heron Park drain in 2017 and 2019 (estimated at 766 tonnes) were released to waterways, it would cost up to $60,000 to remove/dredge (Oldham C.E., Eynon F. and Ocampo, C.J., 2020).

The costs borne by a single Local Government in WA in a high growth area can reach $1,663,400 per year for sediment control of new subdivisions and residential infill building in their jurisdiction.

As a further example of the significant cost borne by a single Local Government in WA in a high growth area, a different LGA spent $642,000 per year for managing water-borne sediment discharged from new subdivisions.

These costings, along with UWA's research, validates the current high level of private financial benefit to land developers, the building industry and initially consumers (rate payers) in WA when legislative requirements for erosion and sediment control on construction sites are not compiled with.

The USAEPA acknowledges the private financial benefit of sediment pollution is $16 billion in environmental damage annually (2012).

A cost benefit analysis conducted in South East Queensland* by Healthy Land and Water (2014; updated 2019) estimates that:

- Over the next 20 years, Local Governments would avoid costs of $160 billion for waterway management if sediment and erosion controls are in place.
- SEQ council's collective expenditure to manage the direct impacts of sediment upon Council infrastructure assets costs $31 million per annum as of 2019. This is an average cost of $310,000 per SEQ council and represents the direct avoidable impact costs resulting from poorly implemented erosion and sediment control across three case studies in SEQ. It does not include potential environmental costs, construction delays, regulatory enforcement costs or potential litigation costs.

* The South East Queensland region comprises ten councils (Brisbane, Ipswich, Lockyer Valley, Logan, Moreton Bay, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba). South East Queensland's regional area is 22,420km² and its regional population is 3.6 million (Wikipedia 2018). Savings of avoided waterway management derived from annual costs (2014 calendar year) and supporting data provided by participating Councils and Healthy Waterways analysis. Urban footprint data was used to extrapolate expenditure estimates across all SEQ Councils where specific data was unavailable.

Examples of the costs of sediment loss (Australia and New Zealand)

Note that the major cost of sediment removal from drains or during environmental remediation of wetlands and other waterways (e.g. river pools) is the "logistics" or practical requirements required to extract sediment, as opposed to the costs of sediment disposal. Inert materials, such as uncontaminated soil (as confirmed by soil testing) and builders sand may be recycled. Whilst tipping costs do not vary considerably, disposal of contaminated soil (sediment, silt, mud) is much more expensive and highly variable, and is based on contamination status.

Cost of extraction of sediment is variable and will depend on:

1. Method of removal (e.g. machinery, manual labour).

2. Location and distance to disposal site i.e.;
   a) difficulty of extracting soil/sediment/sand from site due to access, topography, slope etc;
   b) size and depth of lakes and wetlands or river pool; and
   c) ease of access.

Cleaning up

During and after urban development activities, expenditure is often necessary to sweep roads, repair and maintain stormwater and Water Sensitive Urban Design (WSUD) infrastructure and remediate/restore environmental assets. This expenditure can be significant, as illustrated below.

Table 1- Examples of cleaning-up costs (street sweeping)

Street Sweeping	**Cost ($)**	**Source/Reference**
Cost of sweeping program for internal roads and paths (associated with sediment control).	$1,310,400 per annum	City of Cockburn (WA) 2020
Street sweeping activities which can potentially be avoided by one SEQ Council.	$660,000 per annum (estimated cost)	Healthy Land and Water (QLD) 2019
LGA budget for street sweeping of new subdivision stages after residential building.	$267,000 per annum (estimated cost)	City of Swan (WA) 2019
Works within a road reserve on multiple occasions to implement some erosion and sediment control and sweeper trucks engaged on multiple occasions to remove sediment from road.	$4,754 (total estimated cost for road reserve area)	City of Launceston (TAS) 2020
Erosion and sediment control onsite failed, resulting in significant spills of sediment onto public road. Sweeper trucks cleaned road on 5 occasions.	$805 ($161 per sweeper truck visit)	City of Launceston (TAS) 2020
Average cost for road sweeping (includes but not limited to costs of sweeping up sediment runoff from subdivision/ building sites).	$80/km	City of Kwinana (WA) 2021

Table 2 - Examples of cleaning-up costs (unblocking pipes)

Unblocking pipes	**Cost ($)**	**Source/Reference**
Council budget for cleaning drainage pits and lines full of sand within new subdivisions. (462 work requests related to drainage were received by the City of Swan's Assets Management Department during 2018).	$375,000 per annum (estimated cost)	City of Swan (WA) 2019
Cleaning of drainage infrastructure – singular pipe blocked by sand & rubble.	$5,400 ($387 per lineal metre)	City of Armadale (WA) 2018
Cost of waste disposal for sweeping and educting (associated with sediment control).	$103,000 per annum	City of Cockburn (WA) 2020

Table 3 - Examples of cleaning-up costs (rectifying vegetated stormwater assets)

Rectifying vegetated stormwater assets	**Cost ($)**	**Source/Reference**
(E.g. bio-retention system) in new housing subdivisions where assets transferred to be Council-owned asset. (These assets are not designed to cater for the large sediment loads that flow from house building sites with little, or often ineffective, onsite erosion and sediment control measures in place and can quickly become buried with sediment during the subsequent house building phase).	Up to $100,000 per asset to repair or reinstate assets/per device	Lake Macquarie City Council (NSW) 2014

Table 4 - Examples of cleaning-up costs (sediment impacting drainage infrastructure assets)

Sediment impacting drainage infrastructure assets	Cost ($)	Source/Reference
Average sediment removal from stormwater infrastructure by one SEQ Council that can potentially be avoided. (estimated cost ($250-500/tonne)	$1.46 Million per annum	Healthy Land and Water (QLD) 2019
Cleaning and maintaining stormwater infrastructure by one SEQ Council that can potentially be avoided (closed stormwater infrastructure and stormwater quality treatment devices).	$820,000 per annum (estimated cost)	Healthy Land and Water (QLD) 2019
Removal of sediment from the Lake Macquarie City Council's stormwater system.	$1.1 million per annum (estimated cost)	Lake Macquarie City Council (NSW) 2014
Cost of educting program (associated with sediment control).	$250,000 per annum	City of Cockburn (WA) 2020
Offsite sediment clean-up costs (e.g. sediment discharge into council drainage system/de-silting).	$625 per tonne (average estimated cost)	Healthy Land and Water 2019 and Brisbane City Council 2020 (QLD)
Eric Singleton Bird Sanctuary Wetland - $3 million civil re-construction rehabilitation project (2015). (Involved the diversion of flow from the Bayswater Brook into a gross pollutant trap before entering the wetland through a sedimentation pond combined with a wetland treatment train of over 25,000 square metres). Estimated maintenance cost for sediment removal from sedimentation basin.	$16,000 per annum (estimated cost to remove sediment from Gross Pollutant Trap) $17,500 every ten years	City of Bayswater (WA) 2019
Maintenance of drains where builders sediment has run-off and been captured. (Represents 10% of City of Bayswater 's annual drainage maintenance budget).	$15,000 per annum (estimated cost)	City of Bayswater (WA) 2019
Average cost for cleaning of drainage pits using gully eduction truck and sometimes suction and jetting methods (includes but not limited to educting sediment). (Dependent on pit condition).	$32 - $40 per drainage pit	City of Kwinana (WA) 2021

Table 5 -Examples of cleaning-up costs (sediment impacting drainage infrastructure assets and waterways)

Sediment impacting drainage infrastructure assets and waterways	Cost ($)	Source/Reference
Removing sediment from open drains and creeks SEQ wide – costs that can potentially be avoided.	$375/tonne per annum (estimated cost)	Healthy Land and Water (QLD) 2019
Removal of 1200m³sediment from Wharf St Stormwater Basin (WSSB). The planned depth of boardwalk and bridge structures had to be increased by 4-5m due to extensive sedimentation, at extra cost to the City of Canning. Note that the sediments extracted from WSSB had a high organic matter over sand particles, so it was difficult to determine if it was builders sand or otherwise.	$100,000 (estimated total cost)	City of Canning (WA) 2020

Table 6 -Examples of cleaning-up costs (sediment impacting waterways - sediment removal)

Sediment impacting waterways (sediment removal)	Cost ($)	Source/Reference
Manual "cleaning" of Mabel Talbot wetland 2017 7 Tonnes gross sediments removed (single incident). Gross Pollutant Trap installed in 2018. Allows the removal of three tonnes of undesirable material four times annually.	$5,143/tonne	City of Subiaco (WA) 2019
A) 74.25 cubic metres removed from a sensitive site on the Ellen Brook (inert material disposed onsite). B) As per above in the Ellen Brook - based upon wet sand density (1905kg/m³).	$100.31/m³ $52.66/tonne	Department of Biodiversity, Conservation and Attractions (WA) 2020
Uncontaminated fill dredged from wetland or waterway.	$53.62/tonne (average cost)	Private contractors (WA) 2000

Environmental remediation/restoration costs

Table 7 - Examples of environmental remediation/restoration costs (river pools, creeks, wetlands)

Environmental remediation/restoration activity	Cost ($)	Source/Reference
Waterway restoration (A) Includes treatment of high difficulty sediment removal level at Maylands Lakes. (B) Includes treatment for low difficulty sediment removal level and no remediation required at Maylands Lakes.	 $78.13/tonne $15.63/tonne	 City of Bayswater (WA) 2019 City of Bayswater (WA) 2019
Revegetation - 170,000 plants planted to trap sediment at Eric Singleton Bird Sanctuary Wetland.	$340,000 (estimated cost of plants only)	City of Bayswater (WA) 2019
Waterway rehabilitation and maintenance costs that can potentially be avoided by one SEQ Council.	$200 - $3,000/stream metre	Healthy Land and Water (QLD) 2019
Managing other flow-on impacts of sediment loss from construction sites such as aquatic weeds, algal blooms and fish kills that can potentially be avoided by one SEQ Council.	$120,000 per annum (estimated cost)	Healthy Land and Water (QLD) 2019

"Most toxic stream in New Zealand"

Waiwhetu Stream (considered the "most toxic stream in New Zealand") cost the Greater Wellington Regional Council, the Lower Hutt City Council and the New Zealand Government $26 million to remediate in 2019. Some 4,000 truckloads of contaminated sludge was taken to landfill and the stream widened and deepened. These costs are attributed to industrial pollution mostly, however the removal of sediment resulting from poor erosion and sediment control practices during urban development was considered significant (New Zealand Ministry for the Environment, 2020) (NZMfE).

Enforcement and compliance

Studies by leading international and local stormwater managers and erosion and sediment control researchers and practitioners confirm that sedimentation of waterways caused by poor urban development practices persists. This is despite clear legislative requirements being supported by a range of cost-effective regulatory compliance tools and the availability of simple, affordable, and effective erosion and sediment control practices (HLW, 2019).

Enforcement and compliance activities related to erosion and sediment control during urban development are primarily reactive, as part of a response to formal complaints related to environment nuisance and a breach of conditions for licensable activities.

The costs of enforcement to Governments are often cited as a barrier to improving erosion and sediment control compliance. This is because a significant breach requiring an infringement to be issued, particularly where prosecution may be the outcome, results in resource-intensive actions including compiling reports, collation of evidence and witness statements.

Healthy Land and Water (2019) concluded that complaints relating to sediment pollution from construction sites can produce often unseen and unquantified costs for SEQ Councils. In consultation with experienced Council regulatory staff, the typical cost of managing Erosion and Sediment Control (ESC) complaints is at a minimum $800, and up to $4,100 per complaint. Stakeholder consultation indicates that some larger Councils may receive hundreds of such complaints each year.

The lack of enforcement/inconsistent enforcement for non-compliance with erosion and sediment control legislative requirements in SEQ has been found to reduce the likelihood of land developers and construction site operators getting 'caught', fined, or prosecuted for non-compliance. On average, there is only a 2.2% likelihood (risk) of a SEQ construction site facing significant enforcement action by a local Council for erosion and sediment control non-compliance (e.g. Environmental Protection Order, 'stop work notice', prosecution), while the cost of complying with existing erosion and sediment control-related legislation to developers/civil contractors (based on 2013 data) far outweighs the cost of not complying by a factor of 14. Consequently, some industry members were willing to risk the chance of getting caught rather than budgeting for the full cost of proper erosion and sediment control implementation in their construction and building projects. These factors contribute to a commercial operating environment where erosion and sediment control compliance is generally considered a low priority, or where staff do want to comply, but are constrained by insufficient erosion and sediment control budgets. Industry feedback suggests that current tendering practices often favour the 'lowest price' ahead of those companies who believe in best practice erosion and sediment control (HLW, 2019).

Based on feedback from LGAs and the low levels of resourcing for monitoring for compliance with erosion and sediment control legislation, policies and guidelines in Western Australia, it is predicted that this situation will be similar for Western Australia.

Monitoring

Very few cases of pro-active monitoring for sediment runoff from urban development activities have been identified during the desk top review for this report. The Auckland City Council (ACC) is working towards taking a pro-active management approach in the future by investigating ways to achieve systemic change in the way compliance on small building sites is monitored and managed by the Council. The Council is also planning to use *IoT smart infrastructure* to measure real-time trends of sediment loss from bulk earthworks sites as an early warning system of failing sediment control. Howick, Upper Harbour and Hibiscus and Bays Local Boards recently confirmed funding of 'end of pipe' monitoring for sediment on selected small site subdivisions within their local board areas. These results will provide early indication of the need for increased enforcement action (ACC, 2019).

Lack of adoption

Although some builders attempt to contain sand on site there are many examples where there is limited adoption of best practice measures to prevent erosion and sediment runoff at its source (i.e. on-site). This is easily observable in Western Australia and can be well illustrated by the experience of the Auckland City Council who recently found that 15 construction sites in a single street were in breach of the Resource Management Act (1999) despite multiple warnings to builders, and a long-term proactive education campaign recently being implemented in this street.

A review conducted by Healthy Land and Water found that since 2006 soil and water management was still not being widely implemented, inspected or enforced by councils. Even with resources made available to councils and builders over the previous four years, further on ground improvement in soil and water management practices on building and construction sites were still needed. The review also identified that an increased on-site regulatory presence and further streamlining of council enforcement procedures that would help improve building site practices.

Sustained and consistent enforcement "builds-up" compliance

Sustained and consistent erosion and sediment control compliance and enforcement activities in the SEQ region have resulted in high levels of effective onsite erosion and sediment control performance within the land development industry, demonstrating sediment load reductions of 60 – 80%. Their level of compliance previously determined was only ~5%; with erosion and sediment control requirements on large scale urban land development sites during construction being 21% for partially compliant sites and 74% for non-compliant sites (HLW, 2019).

Characteristics of a proactive compliance program are included at Appendix 6.

Brisbane City Council has implemented an ESC Compliance Program which achieves over an 80% average compliance rate for inspected major private works (HLW, 2019).

The Derwent Estuary Erosion and Sediment Control Program (DEESCP) focused on an increased regulatory presence on construction sites in 2019. This led to a notable improvement in sediment and erosion control practices. The DEESCP envisions that construction site soil and water management practices will further improve with continued pressure and education for regulatory bodies and the building industry (DEESCP, 2019).

Auckland City Council has reported a willingness by builders to 'do the right thing' appears to be gathering momentum as site owners realise that the council is serious about its approach to sediment. The Council's erosion control initiative, *Close the Gap (GAP),* aims to ensure cost-effective mechanisms for sediment controls are in place on all small sites prior to any land disturbance activity (i.e. closing the gap from when bulk earthworks are signed off and the first building inspection of the foundations). There was an increased level of compliance in the residential construction sector in response to 5,500 residential building sites visits to ensure adequate sediment controls were in place. Recent statistics show 51% of residential construction sites are still lacking appropriate erosion control, however, this is an improvement on the figure of 90% prior to project commencement (ACC, 2019).

The *Flatbush Project* (2018) involved the inspection of 400+ small building sites in four subdivisions by Auckland City Council Officers. There was 100% compliance achieved in the properties visited during the project period when Officers performed follow-up visit after issuing infringements. This pilot program concluded:

- prior education of builders/contractors/owners appeared to be ineffective.
- builders said they *Want to do the right thing but "conform to the norm".*
- no builders interviewed had been subject to any enforcement or compliance inspection issues previously.

- potentially a lack of complaints meant that practices by builders have now become 'acceptable' to the community.
- even though their *Building on small sites Doing it right* booklet was provided to builders and Officers tried to communicate what builders needed to do, and gave several warnings, nothing was done to on site to manage erosion and sediment until the owners were issued with Abatement Notices (AB).
- 72% of builders sampled were issued one AB; 17% two ABs and 11% three ABs.

This pilot program has been run on small building sites in four other greenfield subdivision developments in Auckland with similar results.

Prevention is cheaper

Much success (and cost savings) by Governments throughout Australia and internationally is also attributed to a preventative and proactive approach at the planning phase of subdivision and commercial and residential building applications. Officers must have a high level of erosion and sediment control technical knowledge however, so they can provide good advice on best practice and act with professionalism (HLW, 2019).

Prevention at source (on-site) is imperative. A layer of soil one centimetre deep prevented from leaving site from an average house block is equivalent to approximately five trailer loads of soil less being deposited in waterways (Ipswich City Council, 2020).

Importantly, generally studies have found that the cost of construction and maintenance of WSUD devices can be reimbursed through the benefits of mitigated pollution damage control costs over a period of five to ten years (NZMfE, 2019).

A cost-benefit analysis undertaken for the SEQ region by HLW in 2013 identified there is a clear economic case for erosion and sediment control regulation and enforcement, with a conservative economic benefit of $1.20 for every $1 invested in current best practice erosion and sediment control.

SEQ Councils are estimated to be investing approximately $2.2 million per year in efforts to improve ESC compliance on building and construction sites. HLW (2019) predicts that:

- Implementation of current best practice erosion and sediment control on urban construction sites within SEQ could reduce annual construction-phase sediment loads by 68,000 - 91,000 tonnes per year.
- Best practice erosion and sediment control in SEQ will reduce construction-phase sediment loads more than 50% per annum.

- Effective control of erosion and sediments on building sites prevents the loss of one tonne of soil on a 500m² lot. (One dump truck load less soil lost for every 10 houses built).
- Best practice erosion control measures can reduce sediment loads from construction sites by 60 - 90%, with high efficiency sediment basins capable of load reductions of 90 - 99%.

Brisbane City Council's compliance program equates to $10 per tonne of sediment prevented from entering waterways (HLW, 2019).

Healthy Land and Water (2015) predicted around 95% of the costs for best practice erosion and sediment control would be initially borne by developers and then incorporated into land prices. They also identified that both the public and private sector generally feel that current poor erosion and sediment control practices could be corrected by government regulators increasing compliance inspection frequency and the enforcement of erosion and sediment control requirements. They believed this would provide a more 'level playing field' across the land development sector and create a strong incentive for companies and operators to properly plan, budget and implement effective and compliant erosion and sediment controls on their projects (HLW, 2019).

The Auckland City Council has also received similar feedback from the residential building industry (ACC, 2019).

Prevention costs (land development and building industry)

Case studies undertaken by HLW (2019) have calculated the likely cost of implementing best practice erosion and sediment control on 'typical' SEQ construction sites to achieve compliance is on average $1,600 per lot for a single house block and on average $34,000 per hectare for a typical medium to large scale development. They also concluded that these costs are not high in terms of the potential fines for non-compliance and the profits made by land developers in SEQ.

Furthermore, the cost of implementing temporary erosion and sediment control measures for new road infrastructure projects has also been calculated to be 20 - 25% of clean-up costs at the end of the project, while the cost of progressively implementing erosion and sediment control pays for itself four-to-fivefold throughout the life of a project.

In contrast, the direct costs to rectify the failures and damage to new road infrastructure as a result of poor erosion and sediment control practices has ranged from 14% to 38% of the total project cost and on most road construction projects, properly designed and integrated erosion and sediment control measures represent a maximum 4% cost to the total value of the project, usually less than 1%.

Stop Work Orders have proven to be a very effective mechanism as extended downtime from addressing poorly controlled stormwater runoff on a site can become very costly in a very short period. For example, the Sunshine City Council issued Stockland Aura Subdivisions Development with a Stop Work order that stated work could not resume until erosion and sediment control compliance efforts were endorsed as sufficient by the Council, at the cost of $3.5 million to the developer, which included "lost time production" (pers. comm., Sunshine Coast City Council, 2020).

Impacts on neighbouring properties (residential and commercial) located adjacent to, and down-slope of, construction sites are also at risk from poorly managed erosion and sediment control. The lost productivity, clean-up and repair costs and, in particular, the potential legal liability to land developers and construction contractors can be considerable, especially if development approval conditions and legislative erosion and sediment control requirements have not been complied with.

Table 8 - Potential impact costs to land developers and builders that can be avoided through best practice erosion and sediment control compliance

Maintenance action	Estimated repair cost ($)	Source/Reference
Loss of soil/fill/sand stockpiles from construction sites in SEQ. (Not including transport costs).	Up to $80/tonne	Healthy Land and Water (QLD) 2019
Cost to land developer importing (and therefore losing) 200-300m³ of building sand.	Up to $7,500	University of Western Australia/CRCWSC 2020
Burst earth bund/drain.	Up to $20+/linear metre	Healthy Land and Water (QLD) 2019
Sediment fence collapse.	Up to $10+/linear metre	Healthy Land and Water (QLD) 2019
Sediment Basin Failure (subdivision). For repair of embankment/outflow, and removal of sediment deposits.	Up to $12,000	Healthy Land and Water (QLD) 2019
Impact on neighbouring property - sediment removal (e.g. from pool, backyard, house) and repair of damaged assets.	Up to $5,000+	Healthy Land and Water (QLD) 2019
Impact on neighbouring property - relocation of affected property owners – temporary accommodation etc.	$180+ per night	Healthy Land and Water (QLD) 2019
Legal costs (e.g. Solicitor, barrister, expert witnesses).	Up to $100,000	Healthy Land and Water (QLD) 2019
Regulatory penalties for non-compliance with erosion and sediment control legislation (urban development). (Refer to Appendix 8).	Up to $60,000 (does not include legal costs)	Depending on severity and legislative requirements for each State.

Costs of compliance (Governments)

The direct operational costs of running an Erosion and Sediment Control Compliance Program may be at least partially, if not fully, offset by:

- savings in other Council expenditure (e.g. stormwater asset maintenance costs) due to lower volumes of sediment entering Council's drainage network).
- the revenue generated through issuing of infringement notices to those companies found to be causing or allowing sediment pollution to occur.

The likely cost of one dedicated Full Time Equivalent Erosion and Sediment Control Compliance Officer resource is estimated at $100,000 per annum (HLW, 2019). Refer to Appendix 7 for examples of the costs of employing Erosion and Sediment Control Compliance Officers, and their roles and responsibilities.

Regulation

The significance of the large financial costs of erosion and sediment loss resulting from unmitigated erosion and sediment loss during urban development is acknowledged by other states of Australia and in New Zealand, where fines and prosecution costs of up to $736,250 (or 5 years imprisonment) aim to act as a disincentive and a mechanism to recoup waterway management costs (Appendix 8).

In contrast, Local Laws gazetted by Local Government Authorities in Western Australia for managing erosion and sediment loss during urban development range from $100 to $500 for the first offence (commonly $200). Penalties do not exceed $5,000 and are based on the offence being of a continuing nature, to an additional penalty with fines not exceeding $500 for each day or part of a day during which the offence had continued. The WA State Government's Department of Water and Environmental Regulation can enforce the *Unauthorised Discharge Regulations under the Environmental Protection Act 1986,* with the assistance of designated Local Government Officers. Infringement penalties of $250 (first infringement notice) and $500 (subsequent infringement notices) apply. If dealt with in a court of law, the maximum penalty for an individual is $5,000 and $25,000 for a body corporate.

Knowledge gaps

Obtaining specific details of the true financial costs incurred by state and local governments to manage this non-point source pollution has proven difficult, which suggests that these costs are not accurately documented or well understood by the organisations who are paying for the clean-up.

It is also important to note that there is a lack of information available to determine if these costs are partially or fully recouped via financial penalties for non-compliance with environmental legislation and/or conditions of land development/land use approvals. Given the apparent low level of penalties applied to non-compliance, it is assumed that these costs are absorbed.

Conclusions

Sedimentation resulting from poor erosion and sediment control practices during urban development is threatening the environmental health and economic "service capacity" of Australia's waterways.

The impacts of poor on-site erosion and sediment management practices on waterway health will be compounded as land that has historically been used for low intensity uses is gradually developed to cater for population growth, and due to predicted climatic changes.

Stormwater management needs to be part of holistic environmental management planning for subdivision, construction and building sites within the development footprint and downstream.

Effective management determines whether water quality is improved, restored, sustained, or degraded. Protecting WA's "future rivers" requires a significant shift in investment and political will, changes in behaviour and shared responsibility for the prevention and management of water-borne sediment discharge.

Adequate and appropriate investment in preventing erosion and sediment loss during urban development from occurring is far less expensive than the "cleanup" costs and costs that currently will are, and will be, incurred to restore and remediate waterways for environmental, recreational, aesthetic, cultural and/or public health and safety purposes.

Evidence confirms that regulators cannot rely on the goodwill of builders and land developers to voluntarily adopt best practice. State and Local Governments need to work more effectively with the land development and building industry, focusing on accountability, changing attitudes and behaviours by raising awareness and

education, and encouraging good behaviour through licensing, monitoring, regulation, and enforcement of legislative compliance requirements.

Ensuring industry is accountable for poor practice erosion and sediment control will reduce the current high level of private financial benefit to land developers and the building industry and the economic costs (public expenditure) to, and management responsibilities of, local and state governments to prevent further water quality degradation and remediate waterways.

Fines for non-compliance must act as a disincentive, aim for cost recovery, and be based on the perceived or known impact/level of risk of environmental harm.

Investment in erosion and sediment control compliance and enforcement activities prior to and during urban development activities combined with industry education and training has resulted in high levels of effective onsite erosion and sediment control performance and provides transparency for industry and the broader community. As illustrated, there is economic benefit for investment in current on-site best practice erosion and sediment control.

Recommendations

The following recommendations are relevant to Western Australia. They focus on State and Local Government, property owners and the community expecting a much higher level of professionalism from the land development and building industry, and poor practices no longer being accepted as the “way things are done”.

- Guidance is provided to the land development and building industry in the selection and application of appropriate erosion and sediment control measures for individual site risks during the different stages of construction, before soils are disturbed, and that all erosion and sediment controls installed on subdivision and construction sites are in accordance with International Erosion Control Association Australasia (IECA) best practice.

- Undertake a “high-profile” proactive compliance monitoring approach that substantially increases the likelihood of non-compliant sites being subject to substantial enforcement action and penalties.

- Increase fines for non-compliance with erosion and sediment control legislative requirements in Western Australia, in line with other Australian States.

- Prioritise actions and reforms relating to erosion and sediment control policy, as defined by the risk from poor erosion and sediment control practices, including industry self-auditing and Stop Work orders for non-compliant sites. These should take into consideration potential seasonal and longer-term variations in weather and climate.

- Compulsory *Erosion and Sediment Control Plans* being required during planning and building approval processes.

- Develop a compliance and education program for Western Australia that aims to achieve best practice erosion and sediment control and raise community awareness.

- Develop and support "IECA-Approved” accredited training for land developers, the building industry, and Local Government Officers. (Providers regarded as technically proficient in erosion and sediment control and training in accordance with recognised best-practice techniques).

- Well targeted short- and long-term economic incentives are made available for the construction industry to comply with erosion and sediment control legislative requirements in a timely and efficient manner.

- Investment by Governments and industry in examples of erosion and sediment control innovation or best practice.

- Water sensitive urban design is well supported politically and economically as best practice for urban development across Western Australia, and support is provided to assist Local Governments to facilitate WSUD. (Refer to CRCWSC's *A review of existing funding models, economic regulatory frameworks, policies and mechanisms,* 2020*).*

References

Healthy Land and Water. 2013. Updated 2019. The Case for Best Practice Erosion and Sediment Control Compliance - A South East Queensland Perspective.

Healthy Land and Water. 2019. Economic Costs of Sediment SEQ. Solutions protecting your world presentation.

Oldham C.E., Eynon F. and Ocampo, C.J. 2020. Quantifying sediment export from an urban development site: Heron Park, WA. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

United States of America Environmental Protection Agency. 2012. Winter Watershed Tip series brochure. What is Sediment Pollution?

Department of Water and Environmental Regulation (DWER) 2020. https://www.water.wa.gov.au/water-topics/water-quality/managing-water-quality

Allen C. Gellis et al. 2020. Elsevier Journal of Hydrology: Pavement alters delivery of sediment and fallout radionuclides to urban streams. Volume 588; 124855.

Dr. Kerry Trayler, Department of Biodiversity, Conservation and Attractions 2020, personal communication 2020.

Sediment Task Force, 2019. Local Government Case studies and associated documents. https://www.perthnrm.com/resource/sediment-management/

New Zealand Ministry for the Environment. 2020. Our freshwater 2020 summary. https://www.mfe.govt.nz/overview-our-freshwater-2020

Auckland City Council. 2020. Council initiative improving erosion compliance across Auckland. Our Auckland. Issue 6 and https://ourauckland.aucklandcouncil.govt.nz/articles/news/2019/07/closing-the-gap-sediment-control-from-the-start/

Derwent Estuary Erosion and Sediment Control Program. 2019. Derwent Estuary Erosion and Sediment Control Program Review.

Staff member. Ipswich City Council. Personal communication 2020.

New Zealand Ministry for the Environment. 2019. Literature Review Sediment Attributes and Urban Development. Prepared for Ministry for the Environment by Morphum Environmental Ltd.

New Zealand Ministry for the Environment. 2006. Water is polluted in urban, farming, and forestry areas. Our Freshwater 2020. Issue 2.

Water Sensitive Cities. 2020. A review of existing funding models, economic regulatory frameworks, policies and mechanisms. https://www.watersensitivecities.org.au/content/why-isnt-wsud-being-funded-at-scale-in-australia/

Department of Agriculture and Water Resources. 2013. Main pollutants in urban run-off and their impacts.

Boulton A J, Brock, MA, Robson BJ, Ryder, D.S., Chambers, J. M. and Davis, J.A. (2014). Australian Freshwater Ecology: Processes and Management. 2nd edition. John Wiley and Sons.

APPENDICES

Appendix 1 - Main pollutants in urban run-off and their impacts
(Department of Agriculture and Water Resources 2013)

• **Sediments** - Sediments are transported from streets and paved areas, rooftops, construction sites and other areas. Loads are generally 10 to 100 times greater in urban run-off than from undisturbed land and can be transported and deposited at any time as flow velocities decrease. Physical impacts include siltation and smothering of ecosystems, blocking of sunlight and reduction in water clarity. Chemical impacts relate to the transport of pollutants, such as nutrients and pathogens, which attach to the sediments.

• **Nutrients**—urban streams often show higher nutrient concentrations and less efficient nutrient uptake rates (Walsh et al. 2005). This causes eutrophication and aquatic growth stimulated by nutrients entering the water, which can alter the visual appearance of the water, lowering its beneficial value. Visual impacts may include floating matter (algal blooms) and slimes. Other and Water Resources 47 impacts can include dissolved oxygen depletion and objectionable taste and odour from algal blooms.

• **Heavy metals**—stormwater run-off from urban areas (including roads, roofs and industrial sites) contains significant loads of heavy metals, which are of concern because of their potential toxicity to aquatic organisms.

• **Hydrocarbons**—hydrocarbons can enter stormwater from vehicle wear and emissions and chemical spills. They can be directly toxic to aquatic organisms and bioaccumulate through the food chain. Hydrocarbons can also cause oil slicks on the surface of the water, degrading the visual amenity of the waterway.

• **Organic carbon**—organic carbon is a major pollutant in urban stormwater run-off. The most common impact is the reduction in dissolved oxygen in water through its microbial consumption. This can lead to anaerobic conditions, resulting in fish kills, foul odours, discolouration and slime growth.

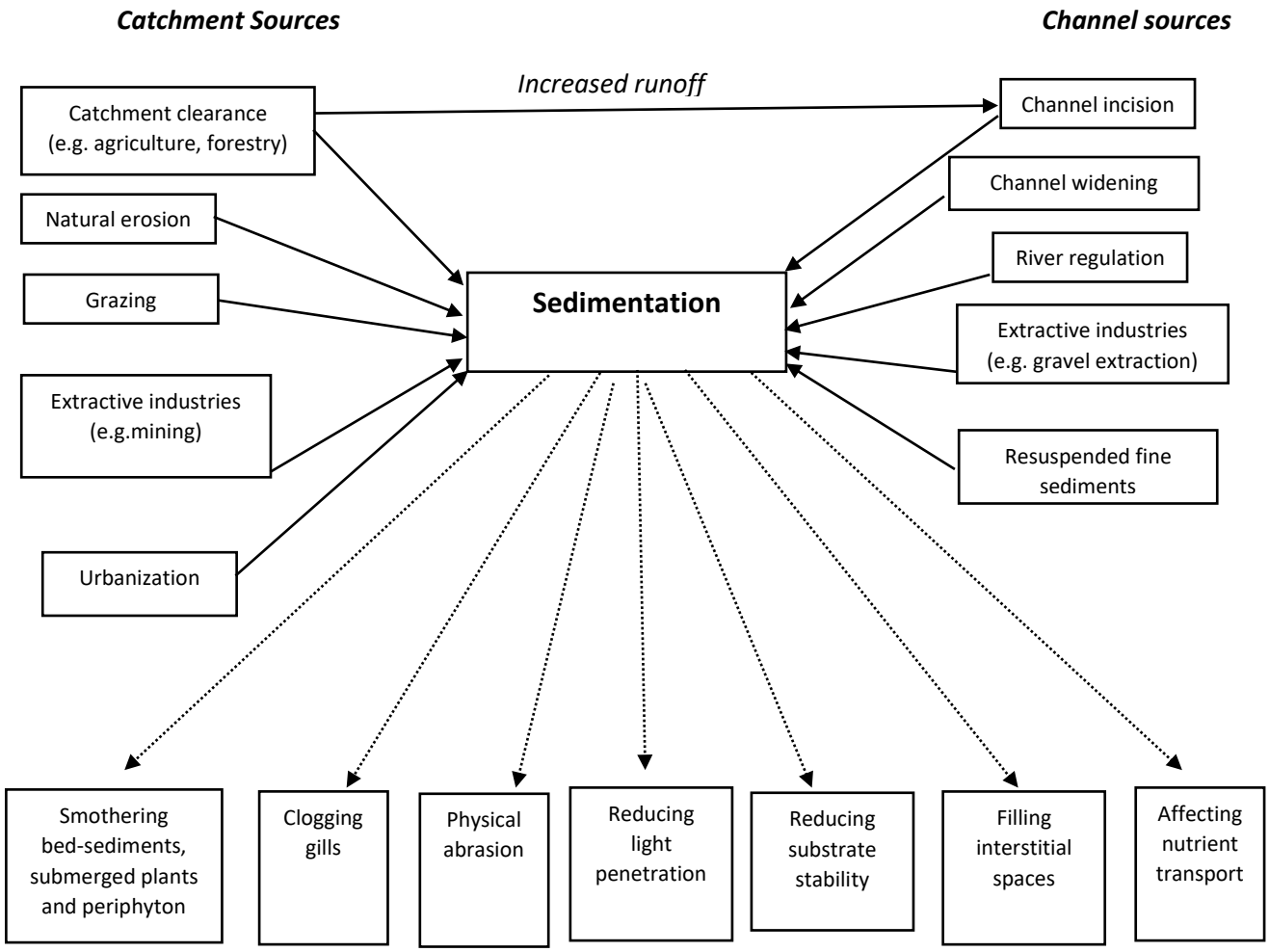
• **Pathogens**—pathogens are sourced from animal faeces and sewage overflows. They are vectors of disease that can reduce the recreational and aesthetic amenity of the receiving water body.

• **Temperature**—streams that receive water from conventionally drained urban areas usually have elevated water temperatures, most likely due to heating by impervious surfaces and dominant piped pathways for water to the streams. Warmer water can stimulate physiological processes in streams and worsen the problems of nuisance algal growth. Other streams adapted to cooler temperatures may suffer thermal stress (Walsh et al. 2005).

• **Litter** - (paper, plastics, glass, cigarette butts)- visual amenity of waterways, degrades habitat for aquatic biota and clog the drainage system, impeding the flow of stormwater. Some litter contains volatile solids that may be toxic to some organisms.

Sources and impacts of sedimentation

(Boulton A J, Brock, MA, Robson BJ, Ryder, D.S., Chambers, J. M. and Davis, J.A, 2014).



Appendix 3 - The conceptual pattern of sediment yield with varying land use.
(New Zealand Ministry for Environment, 2016).

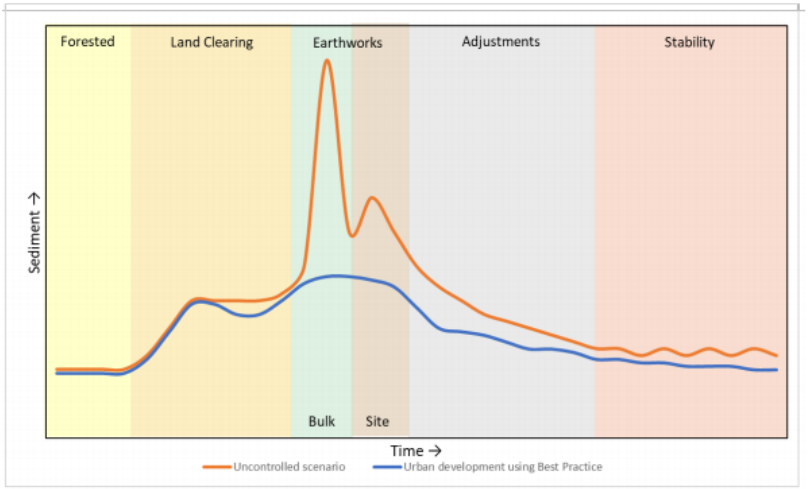


Figure 6: Conceptual Pattern of Sediment Yield with Varying Land Use

Appendix 4 - General phases of urbanisation with associated process changes, channel conditions and morphological adjustment.
(New Zealand Ministry for Environment, 2016).

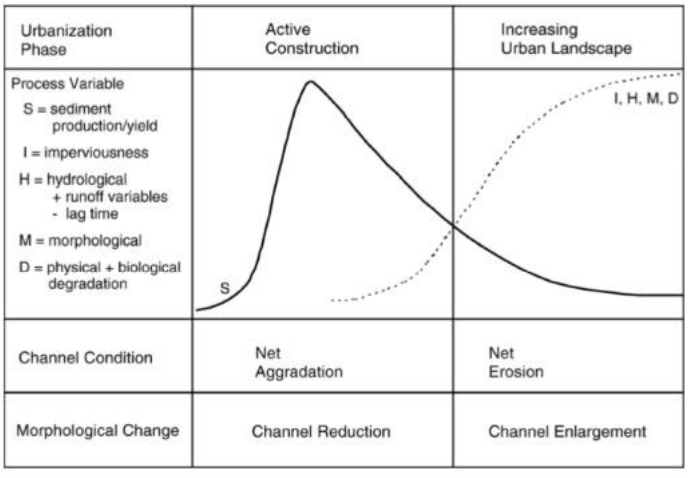
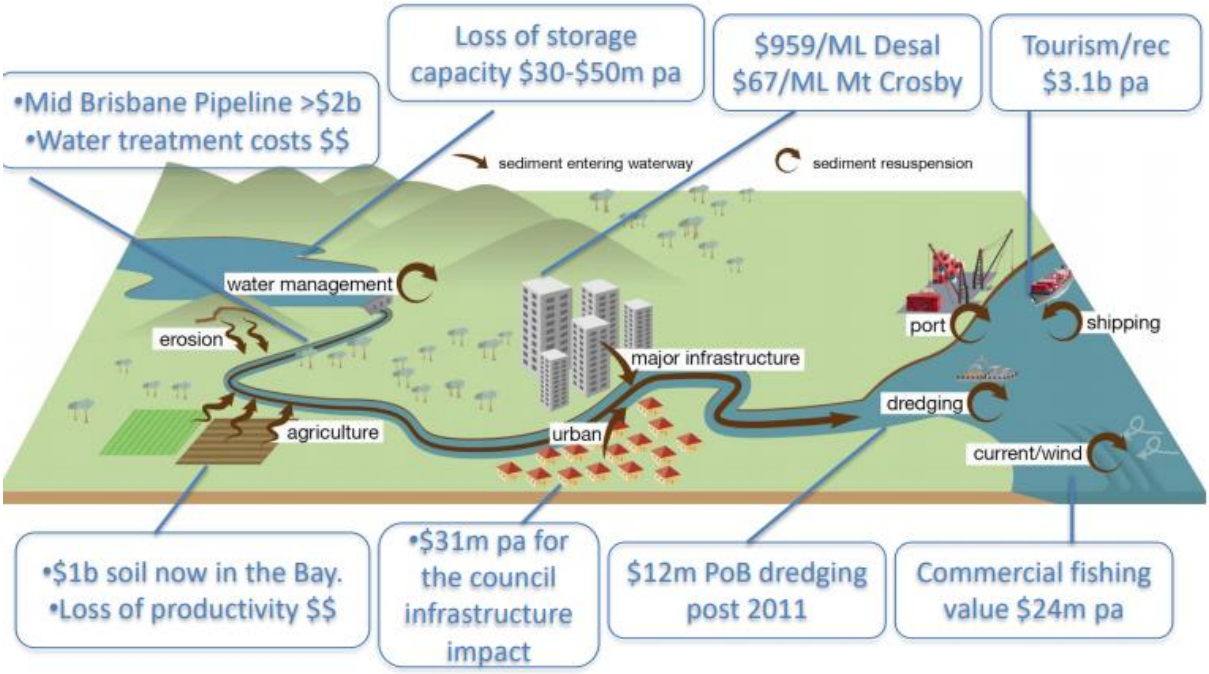


Figure 5: General Phases of Urbanisation with Associated Process Changes, Channel Conditions and Morphological Adjustment. Source: Chin, (2006).

Appendix 5 - Economic Costs of Sediment - Moreton Bay Catchment, North of the Brisbane, South East Queensland

(Healthy Land and Water 2019).



Appendix 6 - Characteristics of a proactive compliance program

(Sediment Task Force, 2020)

A proactive erosion and sediment control compliance program could include:

- Ensuring State and Local Governments development projects effectively aim to mitigate erosion and sediment control on site.
- Focusing on what is locally relevant and important.
- Reviewing and improving the regulatory framework, compliance, planning and reporting procedures, documentation, incentives and financial disincentives (to act as deterrent).
- Aiming for compliance that reflects policy and best practice standards.
- Securing corporate ownership and commitment (senior management level).
- Achieving cross-department (e.g. planning, engineering, operations management, building, environment, development and enforcement).
- Awareness of issue and knowledge of erosion and sediment control management tools, strategies and infrastructure.
- Facilitating departments to work together to monitor and enforce compliance.
- Empowering all staff able to observe potential breaches to have the knowledge, skills and authority to report incidents of non-compliance (absence, presence and/or adequacy appropriate erosion and sediment controls).
- Implementing a centralised incident reporting system to quickly resolve breaches and to assess collective impacts (including downstream impacts).
- Providing high quality education and training to build staff and industry capacity.
- Investing in infrastructure to capture the “sediment that got away” and aim for cost recovery for this investment.
- Committing to regular assessments (e.g. water quality monitoring, drainage infrastructure damage checks, sediment source investigations, analyse investment in environmental restoration).
- Identifying key barriers to successful management and adopt new strategies to overcome these.
- Proactively assist builders and developers to understand and fulfil their obligations.
- Securing a sufficient level of resourcing to ensure on-site compliance.

Appendix 7 - Costs of employing Erosion and Sediment Control/Compliance Officers and roles and responsibilities

(Sediment Task Force, 2020)

Organisation	**Role**	**Responsibilities (examples)**	**Cost**
Brisbane City Council 2017	Erosion and Sediment Control Officer (1)	Interprets plans relating to erosion and sediment control in a legislative and regulatory context, in accordance with the current International Erosion Control Association (IECA) standards and undertakes investigations and compliance enforcement actions, including the issuing of statutory notices and high value infringement notices.	$70,000 pa (listed salary)
Ipswich City Council 2020	Senior Environment Officer and 2 Environment Officers.	Investigations regarding erosion and sediment control on construction sites for 50% of officer's time required to respond to all environmental nuisances and licensable activities.	Unknown
DEP Tasmania (2010)	Regional Sediment and Erosion Control Officer	Works with councils/building industry in greater Hobart region to improve soil/water management practices on construction sites: - series of site audits across six municipalities current level of compliance with best practice soil and water management and comparing results to initial review conducted in 2006. - undertake 150 building and construction site inspections during 2010 across six Southern Tasmanian municipalities, indicating where controls are required and educating builders where improvements can be made, and ensuring Council building compliance staff often attend inspections. - development of a new system for regulating soil and water management on building and construction sites. - creation of new training programs for building practitioners and council staff in regulatory roles.	$100,000 per annum
Kingborough Council (Tasmania)	Stormwater Investigation Officer	Focus on stormwater impacts on recreational water quality, including weekly stormwater sampling program that includes sand and sediment as a parameter.	Unknown Permanent full-time
Auckland City Council/*Close the Gap*	Regulatory Compliance officers (2)	Ensure adequate sediment controls are in place (800 - 1,000 small sites that start each month are checked for compliance). • provide evidence of the extent of non-compliance and requirements for installation of appropriate erosion and sediment controls prior to 'first cut' (before development begins). • improve internal notification that development is about to begin. • investigate administrative implications of introducing a mandatory pre-start sediment control inspection. • assesses options for a self-certification process if the erosion and sediment control devices are installed by an approved 'installer'. • 'Tool Box Talks' for developers (12) and Small Building Sites Demonstrations (2).	Unknown

Appendix 8 - Applicable financial penalties for non-compliance with erosion and sediment control legislation *and examples of penalties issued* ***(Australia and New Zealand).***
(Sediment Task Force, 2021)

Government Authority	**Applicable financial penalties**
Queensland State Government Environmental Protection Act 1994	Regulatory penalties: (e.g. Infringement Notices and court penalties) $8,835 - $736,250 (or 5 years imprisonment) Environmental Protection Act 1994, (as at 01 July 2015).
Brisbane City Council (QLD)	Fines for failure to implement appropriate erosion and sediment control measures can be up to $13,000 for development related offences.
Mackay City Council (QLD)	On the spot fines of $2,000 a day, prosecution costs of up to $416,500 or 5 years in prison for individual; more for a company.
Sunshine Coast City Council (QLD)	Under local laws, council can fine those who do not use the correct erosion and sediment control measures. For example, council can issue an on-the-spot fine of $2,000. Fines may reach over $1 million in court proceedings for major offences causing environmental harm. Stop-work notices may be issued.
New South Wales State Government Environment Protection Authority	Water Pollution fines issued by Councils/Shires are Individuals $4,000 and Corporations $8,000. EPA fines - $8,000 - $15,000 for each identified non-compliance incident. (On-the-spot fines of up to $8,000). Prosecutions in court: $1 million for corporations, $250, 000 for individuals (Protection of the Environment Operations Act 1997) with a further penalty for each day the offence continues. More serious offences can result in penalties of up to $5 million.
Sediment Blitz (NSW) (Sydney and Central Coast-collaborative management)	2016 - $127,000 fines for non-compliance issued for 204 sites. 2018 - $212,000 in fines issued from 746 site inspections. 2019 - $291,000 in fines issued from 784 site inspections.
NSW Environment Protection Authority	Gold mine operator fined almost $200,000 in penalties and costs for allowing muddy water to pollute waterways due to failure to install adequate sediment and erosion controls.
NSW Environment Protection Authority	City of Newcastle fined $55,000 for water pollution from 3 cases of faulty sediment ponds by EPA NSW.
Port Stephens Council (NSW)	Company fined $18,000 for water pollution offences when sand and soil entered stormwater pits.
NSW Environment Protection Authority	EPA NSW fined construction company $15,000 for polluting local waterway when sediment basins fail.
NSW Environment Protection Authority	Coal mine fined $15,000 when sediment laden, saline water was discharged into Nine Mile Creek.
Wingecarribee Shire Council (NSW)	Construction company fined $10,000 for polluting local waters by pumping sediment laden wastewater into public stormwater drains.
Orange City Council (NSW) fined construction company for potential risk of water pollution	$8,000 fine and $4,180 in court costs. (Total of $12,180). (Conviction for not putting in proper sediment control measures at a construction site).
Northern Beaches Council (NSW)	Penalty payable under a penalty notice issued by a Council officer for water pollution under the Act is $8,000 for a corporation and $4,000 for an individual.

Government Authority	Applicable financial penalties
City of Canada Bay (NSW)	If an individual or company is found to be polluting waterways or the stormwater system, they can be liable for fines of up to $8000 per pollution incident. $6000 fine issued after a construction site allowed sediment to run into a storm water drain.
Inner West Council (NSW)	Construction site fined $4000 fine for sediments being discharged.
Victorian State Government Department of Land and Water Conservation 2001	$1,500 on-the-spot fine if soil, cement slurry or other building materials to enter the stormwater system.
EPA Victoria	Construction company fined more than $8000 for sending streams of sediment, turbid water and a haze of excavation dust along a busy Melbourne street.
EPA Victoria	Construction company $7929 for discharging sediment laden water into a conservation zone.
South Australia State Government Environmental Protection Act	Maximum fines of $4,000 for an Environment Protection Order, $120,000 for a corporate body and $60,000 for a person for a Clean-up Order.
Tasmanian Government Urban Drainage Act (UDA) 2013 Environmental Management and Pollution Control Act 1994	$500 commonly - Local Government By-law Up to $16,400 for an individual breach under UDA (Delegated Officers) Unlawfully causing an environmental nuisance by the emission or discharge from: a. residential premises of a pollutant in water, wastewater or any other form of liquid – first fine $308 per offence. b. any premises or place, other than residential premises, of a pollutant in water, wastewater or any other form of liquid - $770 per offence.
Northern Territory	Local Government By-laws apply (various)
Australian Capital Territory Environment Protection Act 1997	Offence to allow any substance other than rainwater to enter the stormwater system. Contraventions of the Act can lead to an on-the-spot fine of up to $200 for an individual and $1,000 for a company. More serious offences can lead to penalties of up to $50,000, six months in jail and a criminal record.
New Zealand Resource Management Act 1991	Failure to follow the directions of Abatement Notices may result in infringement fines of $750 for every day of failure to comply. Prosecution possible and enforcement orders sought to prevent any further building work taking place. If there is deliberate intent to ignore the directions or ongoing non-compliance council can prosecute, with fines of up to $300,000.
Auckland City Council, New Zealand 2019	$67,000 Remuera property developers fined for polluting streams with sediment for repeatedly polluting waterways by washing sediment into the stormwater system.
Auckland City Council, New Zealand 2019 Dean Hu, Mender Construction Limited and Tao Ma were sentenced in the Environment Court for charges relating to the RMA 1991	$50,551 in fines was imposed by the court for all three defendants in respect of offending in Wright Road, Redvale.
Auckland City Council, New Zealand 2019	$42,500. The penalty was handed down in the NZ Environment Court after the company allowed sediment from a subdivision site to enter the river.