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# Assignment 2

72296 Environmental Impact Assessment

# Contents

# 1 Proposed activities and their potential effects

All three major stations in the life cycle of the proposed dairy factory have to be considered for an assessment of the potential effects of the project: preparation of the site and construction, operation, and eventual close-down of the facility. For the purposes of this assignment only the potential impacts of the first two stages shall be addressed as they dominate the life cycle effects. This includes the following activities: *(a)* site preparation and construction work; *(b)* water allocation and abstraction; *(c)* treatment of wastes and wastewater discharge; and *(d)* transport of raw materials and goods.

The different activities at different stages may result in similar effects on a given component of the socio-economic or physical environment, and many impacts can cause a cascade of other effects of varying significance. All project activities are to be evaluated against selected components of the environment, including *(a)* air and atmosphere; *(b)* water and soil; *(c)* vegetation and habitat; *(d)* human health; *(e)* amenity values and cultural heritage; and *(f)* economic base.

## 1.1 Overview

The proposed dairy processing facility is supposed to be located close to the river for easy access to water and for the convenient discharge of wastewater back into the river. The preparation of the site for construction in proximity to the river as well as the proposed take and discharge activities during operation of the factory have direct effects on water quality parameters. Changes to the properties of the body of water (e.g. sediment load, changes in flow patterns, increases in nutrient levels) affect not merely aesthetic values held by residents of the affected region, but are likely to have impacts on the composition of aquatic communities and the health of riparian and aquatic ecosystems.

Major impacts on air quality and amenity values are the emission of particulate matter, gases and odours, generation of noise (during construction and transport of products and raw materials), and 'visual pollution' (e.g. smokestacks and a factory building in the landscape).

## 1.2 Construction

Preparing the selected site for construction requires the displacement of existing uses. On a site close to the river in a rural area, the site may be populated by riparian vegetation. Vegetation in the riparian area and the adjoining uplands may serve as a filter, reducing the amount of sediment, excess nutrients and other pollutants entering the river (Dosskey et al., 2010). This filtering ability is particularly valuable in a region where dairy farming is expanding and with it the cumulative impact of non-point sources of farm effluent is increasing. The clearing of vegetation may also directly reduce available habitat for native species, such as frogs and insects with aquatic larvae (Collier et al., 1995). This impact can mostly be avoided by selecting a site that has already been cleared and does not serve as important habitat to native species.

During dredging and excavation works on the construction site or during the removal of sediments away from the site, sediments may spill into nearby water bodies. An excessive increase in suspended sediments in the river affects water clarity, thereby reducing penetration with sunlight which is needed by aquatic plants and algae to grow. Increased turbidity may also make it difficult for fish to find food or detect predators (NIWA, 2009). As the sediment load of a river increases, its flow characteristics change making the conditions less favourable for certain aquatic species and invertebrate habitat may be destroyed by smothering animals, plants and the river-bed. Sedimentation is less of a problem when the construction site and the transport routes are chosen to be not in the immediate vicinity of the river or other bodies of water.

## 1.3 Effects during operation

During operation of the dairy factory water is abstracted from the nearby river to sustain the processing activities. The amount of water that is used by a dairy factory depends on a variety on parameters, including the range of products that the factory produces and the operations that are involved in production; in New Zealand about 2.2 litres of water are used for every litre of milk that is being processed (Fonterra data, cited in van Asselt & Weeks, 2013)[1]. According to van Asselt and Weeks (2013), dairy processing plants use water mainly for cleaning and sanitising operations, as well as heating and cooling.

The Parliamentary Commissioner for the Environment (2004, p. 110) summarises the potential impacts of water take as follows:

> The environmental effects of water allocation are twofold – the effects of the reduction of water in the water bodies and the effects the use of that water may have on water quality. Abstraction of water from surface water or groundwater, will have an impact on the ecosystems reliant on that water, for example, by reducing the flow of a river, or increasing the temperature of the water. Thus a reduced flow may mean that the river is no longer a suitable habitat or breeding ground for a type of fish.

The major waste material from processing milk in a dairy factory is wastewater carrying organic components (such as proteins, lactose and fat) and inorganic components (e.g. nutrients). Wastewater includes both water that has been removed from the milk and abstracted water that has been used to sanitise equipment, clean the factory, or for heating and cooling. When organic components in dairy factory effluent reach rivers they are converted to carbon

[1] When dairy farming is included in the calculations, one litre of milk requires almost 1,000 litres of water on average.

dioxide and water by bacteria under use of oxygen. Whether the inflow of organic components leads to oxygen depletion with fatal consequences for fish and other members of aquatic communities depends on the re-aeriation characteristics of the river (Barnett, Robertson, & Russell, 1998). Farming practices also influence the contents of the factory's wastewater. Residual antibiotics given to cattle and remains of pesticides that were applied to the feed crops tend to accumulate in the milk and end up in the wastewater after processing; upon discharge these trace amounts enter the food web. Contamination of the river water may make the water unfit for recreational use, even kilometres away from the discharge site.

According to van Asselt and Weeks (2013), milk is repeatedly heated and cooled during its way through the factory. UHT (ulta-high temperature) treatment and other processes used to kill off harmful bacteria in the milk, for example, results in heated wastewater. As most aquatic ecosystems are very sensitive to temperature, discharges of warm wastewater could significantly affect the composition and dynamics of aquatic communities around the discharge location; hence, wastewater discharges are usually required not to alter the natural temperature of the sink waterway by more than one to two degrees (Barnett et al., 1998).

## 1.4 Other activities and socio-economic effects

Related activities such as the transport of raw materials from farms to the factory and the transport of finished products to local stores and export sites bring about a chain of higher-order effects, such as an increase in the use of fossil fuels and an increase in noise levels. Regular transportation with heavy vehicles puts additional stress on roads, requiring more maintenance work. A greater demand in social services for workers who move to the area to work at the factory may also stress the community's budget. All of the above effects could lead to a reduction of life quality for residents in this area.

The inventory of impacts does not end here, however. The potentially beneficial effects of the proposed project also have to be considered and—if possible—quantified. The establishment of a dairy factory close to dairy farms provides a boost to the local and national economy and creates numerous job opportunities—temporary jobs for construction workers as well as stable employment for engineers, maintenance personnel, factory workers, managers, and in the transportation sector.

# 2 Significance

The process of impact assessment is conceptually open-ended. As one of its major goals is to aid a decision-making process, however, each step in the assessment must be completed within a given time frame. Hence, limits are imposed on the level of detail, the length of the time period for which impacts can be assessed at the expected level of detail, and the number of interactions that can reasonably be considered. To set these limits, judgments must be made on how significant each potential impact is, a decision on how much detail and how much effort in avoiding or mitigating the impact is appropriate, and whether the residual impact is insignificant enough to be acceptable. These judgments are crucially guided by the practitioners' own values and the values they consider in the evaluation process (Lawrence, 2007a). As the determination of significance is inherently subjective, it should not be an activity performed only by experts and with a claim to objectivity, but should aim to be a collaborative procedure guided by reasoned discourse (Lawrence, 2007b).

One of the goals of impact assessment is to weigh the desired positive impacts of a proposal against the expected negative impacts in order to evaluate whether the project plan should be pursued or discarded. The dairy factory could, for example, result in an increase in the number of employment opportunities, enlarge the economic basis of the region, increase the country's export volume, etc. While it is possible to quantify many of these positive effects (e.g. by estimating from experience with similar projects) it is not clear how to weigh these potential economic benefits against the expected negative impacts on the biophysical and social environment without imposing market norms on intrinsic ecosystem and community values. Just how much more valuable is the somewhat polluted river now compared to a somewhat *more* polluted river if the project was implemented? Involving the public in a collaborative approach may not lead to satisfying results. As Lawrence (2007b) writes, "the collaborative approach is viewed as too quickly equating public concerns and issues with impact significance, at the expense of other sources of insight and knowledge."

According to Lawrence (2007b), the approach to determining impact significance is usually "limited to ad hoc and inconsistent judgments with reasons and/or to the staged application of thresholds and/or criteria." The Resource Management Act 1991 does not prescribe a process for the assessment of significant effects. As all major projects require resource consents, however, impact significance is, in practice, reflected by the management plans and established by resource consent decisions of regional and territorial councils. The Ministry for the Environment bemoans that a "lack of clarity and certainty in some regional plans (eg, a lack of enforceable limits) has led to issues being decided consent by consent and often relitigated", resulting in "decision-making processes [that] are litigious, resource-consuming and create uncertainty" (p. 18 Ministry for the Environment, 2013).

Since the National Policy Statement for Freshwater Management (2011) the "national values of fresh water" have been made explicit, but their postulation does not give rise to a guideline by which the significance of activities affecting these values could be determined. For example, the statement made in the NPSFM that water is valued for "cleaning, dilution and disposal of waste" conflicts with the statement about respecting water's intrinsic values such as "the natural conditions of fresh water, free from biological or chemical alterations resulting from human activity" (Ministry for the Environment, 2011). Resolving this ambiguity, the NPSFM intends a limits-based regime to be established where regional councils are expected to collaborate with the community to translate individual values and freshwater objectives into enforceable limits for individual water bodies (Ministry for the Environment, 2011, p. 14). The implementation and enforcement of this National Policy Statement—and pending its implementation, decisions relating to the significance of project impacts on the environment—crucially depend on a sound information base derived from regular monitoring. The National River Water Quality Network enables the measurement of various water quality indicators (e.g. temperature, dissolved oxygen, turbidity, nutrients etc.) at 77 sites and has been used to measure nation-wide water quality trends. In total there are about 600 monitoring sites (Davies-Colley et al., 2011).

Following a limits-based approach and with the help of monitoring networks, it would be practical to impose absolute limits for a variety of water health indicators. Whether a residual impact on the physical environment is significant or not then is a matter of evaluating the expected level of the impacts of a proposed activity in light of the measured quality trends. In the case of the planned dairy factory, the significance of the impact of discharging warm water into the river not only depends on the absolute value of the temperature difference between wastewater and river water, but also on the cumulative temperature increase due to human activity reflected in the mean temperature of the affected body of water. Case studies can be used to estimate the magnitude of the impact. If the limit on water temperature would be exceeded by the plant's wastewater discharge, the impact would be rated as significant and in need of mitigation to avoid significant effects on the aquatic ecosystem. The same approach is applicable for any impact that affects quantifiable environmental properties, such as the release of organic and inorganic compounds, or the contamination with residual antibiotics and pesticides. According to the description, the river is already used as a sink for the wastewater of another dairy factory; dairy farming is said to have expanded in this area, indicating that the inflow of organic and inorganic components from farm effluent and non-point sources has also increased. It is likely that under these circumstances, the cumulative impacts of wastewater discharge would be deemed significant.

Other impacts cannot easily be quantified. This includes higher-order impacts such as the stress that an increased number of workers may exert on local community services. The likelihood of these impacts depends on the state of local facilities and the cumulative workload they are sustaining. As it is difficult to find appropriate indicators for the state of social values and impractical at best to set upper limits for such ill-defined concepts, a limit-based approach to significance estimation is unlikely to succeed. This is an area where there is probably no better way to assess significance than to ask for direct community involvement.

# 3 Mitigation

In the process of applied EIA, actions relating to the avoidance, minimisation or reduction of project impacts as well as the compensation for an impact on a particular component of the environment are referred to as mitigation measures. Keeping in mind that EIA is a decision-making tool that includes weighing negative and positive impacts against each other, mitigation may also include actions that promote or increase the beneficial effects of a proposed development (Erickson, 1994). As proposed activities can cause adverse effects far from the project site that would not normally be addressed in a cost benefit analysis, mitigation is also a way by which the proponents are made to take responsibility for adverse effects and pay for measures to reduce or avoid them altogether, rather than externalising the costs to affected communities or the general public (RMIT University & UNU Online Learning, n.d.). This issue remains a challenge with higher-order social impacts that are difficult to quantify.

Any mitigation measure must be matched by a monitoring measure to ensure that an activity designed to reduce an adverse impact has the intended effect and does not introduce any additional adverse effects that would require mitigation themselves (compare Erickson, 1994). While it is feasible to monitor quantifiable quality indicators for resources in the biophysical environment (e.g. nutrient load of a river, water temperature, air pollution, generation of greenhouse gases), there is no standard method to proactively measure the many potential unintended side-effects of a mitigation measure. As a mitigation measure and associated monitoring can be very expensive, the project planners have to consider alternatives to proposed activities early on in the planning process. The requirement for listing mitigation measures in the EIA process hence encourages an inclusive, open approach to development.

## 3.1 Measures to address potential impacts of the proposed project

The temporary effects of construction work on the river, such as sedimentation from earthworks, could be minimised by establishing permanent vegetated riparian buffers or by using temporary filtering devices such as hay bales or mesh fences to reduce the amount of sediment polluting the water (NIWA, 2009). A permanent vegetated buffer zone would not only be a minimisation measure for the effects of construction work, but also reduce the impacts due to leakage from dairy farms.

The adverse effects of water take cannot easily be mitigated unless the abstracted amount is reduced. The cumulative allocations of water in the region should stay well below the maximum amount that may be taken while maintaining minimum flows that are required to sustain aquatic ecosystems and existing fish and invertebrate populations. A new factory should be designed to use less water; this could be accomplished by reusing water where reuse does not have sanitary implications (e.g. using grey water for cooling). To prevent serious problems associated with temporary over-allocation (such as hostile rises in water temperatures due to low flow or water levels), key indicators near the factory site need to be monitored constantly.

The generation of wastewater is closely linked to the amount of water that is abstracted from the river. Reducing water consumption would equally reduce the amount of wastewater to be discharged. When the adverse effects on river water outweigh the effects of energy consumption, wastewater could be treated internally to allow its reuse. Treating wastewater before discharge is also a way to reduce the contamination of waterways with excess nutrients, harmful bacteria, as well as organic and inorganic compounds. An alternative to discharging wastewater in rivers is the application to soils as fertiliser, such as pasture or farm land, thereby recycling nutrients. Dependent on the amount of nutrients removed by plants or other means, however, nutrients can be lost to groundwater or be washed into open water bodies where they accelerate the process of eutrophication (Barnett et al., 1998). Hence, this attempt at mitigation itself is in need of an impact assessment.

Approximate word count: 2880

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