9 WATER

9.1 Introduction

The 2001 Offshore EIS considered the potential impacts to water associated with the construction and operation of the offshore facilities. Since the submission of the Offshore EIS, additional data have been acquired that supplement those provided in 2001. This section presents the new data or refers the reader to information that has been submitted by SEPIL under separate cover, which has been available in the public domain.

In addition, SEPIL now propose to discharge the treated produced water through cores in the umbilical, which terminates in the Corrib Field manifold. The produced water was originally intended to be mixed with treated surface water runoff from the terminal and discharged through an outfall north of Erris Head (constructed in 2009). The treated surface water (rain water collected from areas in the terminal where there is potential for hydrocarbon spills) will still be discharged at this location.

A re-assessment of the potential and predicted residual impact on water from the offshore, near shore and landfall works as well as the operation of the facilities has been undertaken on the basis of the new information.

9.2 Study Methodology

Further to the 2001 Offshore EIS, additional field data have been collected in the marine environment. In summer 2005, Ecological Consultancy Services Ltd (EcoServe) was engaged by SEPIL to conduct a baseline survey around the permitted outfall location off Erris Head. Vertical profiles of temperature and salinity were taken at 17 stations in the vicinity of the outfall location. Similar data were also collected in summer 2007 and 2008 (Appendix 7-3 and 7-4) from the same sample locations. In addition, further water samples were analysed for content of various organic and inorganic substances during these surveys in 2007 and 2008.

The 2007 and 2008 sampling locations at the outfall location are shown in Figure 9-1.

The 2001 Offshore EIS presented the results of dispersion modelling undertaken by Kirk McClure Morton. Additional modelling, presented as Appendix 10.1 in the Terminal EIS (2003), was conducted to consider an outfall location in around 60m water depth, outside Broadhaven Bay. This was the outfall location described in the December 2004 IPPC licence application to the Environmental Protection Agency for the Bellanaboy Bridge Terminal.

The Bellanaboy Bridge gas terminal was granted an IPPC licence by the Environmental Protection Agency (EPA) in November 2007. This licence includes limits on the offshore discharge in terms of its volume and quality. SEPIL's application documents and the licence itself are in the public domain and can be obtained via the EPA website (http://www.epa.ie/terminalfour/ippcApril/index.jsp).

The subject received detailed scrutiny by the EPA and its Inspectors, and the EPA concluded that given the consent limits and monitoring regime proposed, the quality of the environment would not be impacted.

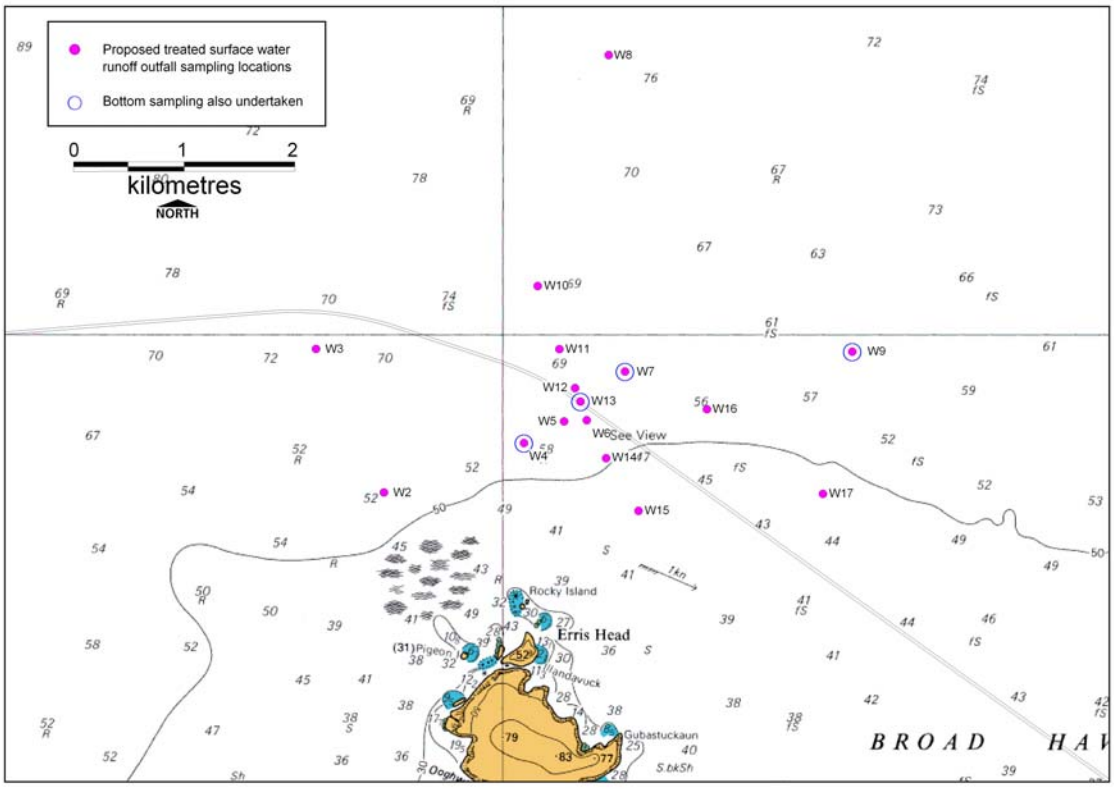

Figure 9-1: Surface and bottom water seawater sampling stations off Erris Head.

Since the licence was issued, and as a result of further discussions with local fishermen, SEPIL now plan to discharge only the treated surface run-off water from the Terminal footprint at the licenced Erris Head outfall location. This discharge will now consist of only treated rainwater run-off and therefore, with the exception of the introduction of fresh water into the marine water at the outfall location, there will be no effects.

The treated produced water will now be transported to the manifold in the Corrib Field through two spare cores in the umbilical. There it will be released at a depth of approximately 350m.

Bacteria and nutrients present in the treated produced water within the cores create the potential for the build-up of a biofilm on the inner walls, which could result in a reduced discharge capacity and in a worst case cause a blockage. Therefore, biocide will be used to prevent biofouling of the umbilical cores.

The chosen biocide will be optimsed to target bacteria in the treated produced water with this potential. The produced water will be treated with biocide on a batch basis prior to the water being injected into the umbilical cores. Typical biocides for this application will rapidly degrade due to hydrolysis. Consequently, the toxicity of the water will reduce whilst treating the produced water discharge system i.e. sumps, discharge pumps and umbilical cores. The toxicity-to-bacteria half life of the biocide is expected to be in the order of several hours. By the time the produced water is discharged at the subsea location of the Corrib Field, the active concentration of the biocide will have reduced to approximately 100 to 200 ppm, with the degradation of the biocide to carbon dioxide, bromide and ammonia. These components, and the remainder of the active biocide will rapidly disperse with the produced water in the area of the Corrib field and will not present a threat to the marine environment.

9.3 Receiving Environment

Much of the background data for the seas around Ireland as presented in 2001 remains valid in that new studies have not changed the significance of the data. Where new data have been acquired that expand the knowledge of the marine receiving environment, these are presented in the following sections.

9.3.1 Stratification and Water Quality

9.3.1.1 Stratification

The findings of the 2005 summer survey off Erris Head indicated that sea surface temperatures ranged between 13.5–14.5°C, whilst at depth (approximately 5m above the seabed) the temperature ranged from approximately 11.5–13.25°C (these data were recorded in July 2005). In general, the temperature of the top layer (25–30m) was relatively constant, after which there was a marked but steady decrease in temperature with depth. The salinity at 5m below the surface ranged between 34.5 ppt and 35 ppt. The bottom salinity ranged from 34 ppt to 35.5 ppt. The change in salinity from surface to bottom did not show any marked halocline. The results from the CTD profiles suggest that the water around the proposed outfall location is relatively well mixed with no strong thermoclines or haloclines present.

The findings from the survey carried out in August 2007 off Erris Head and at a reference station 14 miles to the west were wholly in accordance with these general observations. Temperatures at the surface were just over 15°C with a marked thermocline at approximately 40m. Below this depth, there was little change through the water column with a temperature of *c*. 12°C extending to the seabed at 90m. Again, there was no evidence of any significant salinity differences in the surface waters and through the water column at each station.

The findings from the survey carried out in July/August 2008 off Erris Head indicate sea surface temperatures ranging between 13.8 and 14.3°C. In most cases the water was well-mixed to approximately 20m with evidence of a thermocline developing below this depth. The coolest water (11.4°C) was observed at a depth of just over 90m. The minimum differences in temperature through the water column (13.8 – 13.0°C) were observed at the shallowest site (60m) that was fairly well-mixed to about 30m. In general, the findings are similar to those recorded during the 2007 survey. As would be expected in a coastal area with little freshwater input, only small differences in the salinities of the surface waters were observed, with small increases through the water column to the seabed. Certain stations displayed slightly erratic salinity measurements that were not in common with the general trend, however these were not evident in the corresponding temperature profiles.

9.3.1.2 Seawater Chemistry

Metals

A single seawater sample was collected from Broadhaven Bay in 2000, and another in 2001, these samples were analysed and the results presented in the 2001 Offshore EIS. Discussions have since been held with the Marine Institute on the metals that should be recorded as part of the baseline and ongoing monitoring around the outfall location to the north of Erris Head. In summer 2007 and summer 2008, twenty-two water samples were collected from around the outfall location located 2.5km off Erris Head, 17 of these from close to the surface each year, and the remainder from close to the seabed. In addition, surface and bottom water was sampled at a number of other sampling locations north of Erris Head (in the general vicinity of the proposed outfall), during summer 2008. The samples were analysed at the UK's Environment Agency laboratories. Results for these analyses are presented in Table 9-1, which also presents the comparable data from the 2001 Offshore EIS for the samples collected in 2000 and 2001.

Table 9-1: Measured Background Metal Concentrations in Broadhaven Bay

Metal	2000	2001	2007	2008	Oceanic concentrations*	Marine Institute#
	mg/l	mg/l	mg/l	mg/l	mg/l	
Arsenic	0.008	0.006	0.00109–0.00156	<0.001 – 0.00145		0.00115
Barium	<0.01	0.00761	<0.1	<0.1		
Cadmium	<0.0001	<0.00004	<0.00004	<0.00004	0.00005	0.000055
Chromium	0.001	0.003	<0.0005	<0.0005		0.000168
Copper	0.011	0.018	<0.0002–0.00245	<0.0002 – 0.00121	0.0005	0.000659
Lead	<0.001	0.000864	<0.00004–0.000545	0.000056 – 0.0408	0.00003	0.00084
Mercury	<0.0001	0.000041	<0.00001–0.00001	<0.00001-0.000019	0.0001–0.0004	<0.000008
Nickel	0.005	0.005	<0.00025–0.0011	<0.0003–0.00035		0.0012
Silver	<0.001	<0.001	<0.001	<0.001		<0.001
Zinc	0.005	0.032	0.00097–0.00842	0.00139 – 0.0295	0.005	0.011

* - concentrations taken from OSPAR Region III QSR, 2000

\# - lowest concentrations measured for each metal during Marine Institute surveys of Shellfish waters around Ireland between winter 2004 and winter 2005

The results from the samples collected in the vicinity of the treated surface water run-off outfall location in 2007 and 2008 tie in well with published data for oceanic waters. In addition, the data recorded by the Marine Institute in surveys of shellfish waters around the Irish coast over the period between winter 2004 and winter 2005 are also in general accord with Broadhaven data from 2007 and 2008. Sample results for 2000 and 2001 tend to show higher concentrations of metals in the water. While this increase may be because samples were collected closer to the coast (within Broadhaven Bay), it is more likely that the laboratory analyses were not as sensitive as those used in 2007 and 2008, where particularly low detection limits were specified. In addition, more rigorous QA procedures were employed in the sampling carried out in 2007 and 2008. It should be noted that analytical techniques are being developed continually and the earlier findings should be treated with some caution.

The results collected in 2007 and 2008 show that the waters off Erris Head have low concentrations of metals – which is to be anticipated given the open nature of the marine environment – and low levels of anthropogenic input in the area. The full reports on the 2007 and 2008 sampling are provided as Appendices 7-3 and 7-4.

Suspended Particulate Matter

Results from 2007 and 2008 indicate that most of the sites had suspended particulate matter concentrations in the surface waters of less than the MRV (minimum reporting value – 3mg/l) indicative of the high clarity of these coastal waters. The quoted MRVs reflect the current analytical methods typically utilised by the regulatory bodies.

Ammoniacal Nitrogen

In 2008, with the exception of two sites, all ammoniacal nitrogen results were less than the MRV (0.01mg/l) in general somewhat lower than had been the case in the 2007 survey. These concentrations are very low and it seems unlikely that ammoniacal nitrogen is influenced by land run–off but is more likely to be generated in-situ as excretion products from grazing zooplankton.

Trace Organics

For the majority of sites around the permitted surface water run-off outfall, concentrations of organics were reported as less than their relevant detection limit (or MRV). However in the case of phenol and dimethyl benzenes positive values were observed at several sites, albeit still at very low concentrations – typically < 0.5 µg/l. In

2007, 5 sites also had reported values for phenol marginally above the detection limit. With the exception of acenaphthene (1 site) and naphthalene (1 site), no PAHs were reported at concentrations greater than their respective detection limits – both positive results were very close to the limit of detection. In 2007 a small number of sites had PAH results marginally greater than the detection limits.

Whilst some persistent organic compounds have been detected in 2007 and 2008, at such very low concentrations they reflect the pristine nature of the environment.

9.4 Characteristics of the Proposed Development

A decision has since been made to limit water discharges at the Erris Head outfall location to treated surface water run-off only. This outfall was installed in 2009 "piggy-backed" to the larger gas pipeline. Treated produced water from the terminal site is now proposed to discharged via the umbilical at the manifold in the Corrib Field, where the end of two umbilical cores will be modified to terminate within the manifold cover.

Water quality modelling has been undertaken to investigate the impact of discharging produced water at a depth of approximately 350m in the area of the Corrib Field and is included as Appendix 9-1 of this report.

9.5 Potential Impacts of the Proposed Development

The potential impacts assessed for the offshore operations, remain as described in 2001. In the sections that follow, changes from the 2001 Offshore EIS are described.

9.5.1 Remaining Facilities Installation

Estimates of the volume of black and grey wastewaters, discharged from vessels during the remaining offshore and nearshore works, are provided in Table 9-2. Estimates have also been provided for galley wastes from the installation vessels.

The following works requiring offshore installation vessels have been considered in terms of discharges to the marine environment:

- Rock placement works will require a fallpipe vessel to undertake (remedial) works to aid the stability of the flowlines and jumpers, pipeline, and water outfall pipe . In the nearshore waters a side stone casting vessel will be utilised (supported by a bulk carrier for supply of rock) in order to place an armour layer of heavier grade material.
- At the Corrib field itself, a construction vessel will be required for installation of the tie-in spool between the central manifold and the pipeline.
- Umbilical laying will be carried out by a reel-lay vessel supported by a survey vessel and a trenching support vessel, potentially followed by stabilisation works should trenching not be successful in all areas

Table 9-2: Black and Grey Water and Galley Waste Production Estimate during Pipeline and Umbilical Installation from Remaining Offshore Construction Works Associated with the Pipeline and Umbilical Installation

	Total man days	Black and grey water (m^3)	Putrescible galley waste (tonnes)
Remaining nearshore and offshore construction activities	10094	2524	3
Assumptions: Black and grey water is produced at a rate of 0.250m^3 per person per day Putrescible galley waste is produced at a rate of 0.0003 tonnes per person per day			

Given the wide area and long period over which the discharges will be made, the magnitude of the impact is classified as negligible. The discharges shown above are in addition to those from the 2008 and 2009 pipeline construction periods. Such discharges will be quickly dispersed by wave and tide action, and discharges during future installation operations will not be "additive".

9.5.2 Umbilical and remaining pipeline rock placement works

During Installation

Installation of the umbilical will involve the use of a umbilical laying vessel, a trenching vessel and an ROV/Survey support vessel. A diving support vessel will also be used to expose the end of the umbilical conduit in Broadhaven Bay.

The rock placement works nearshore (outer armour layer) will involve the use of a side stone casting vessel supported by a bulk carrier. Any further works in the Corrib field, along the pipeline and umbilical as well as nearshore (remedial work to the filter rock layer placed in 2009) requires the use of a flexible fall-pipe rock placement vessel.

The construction period has now become extended over a number of seasons, and there will therefore be more than one period where construction operations result in raised levels of suspended solids. However, given that the mobile sediments in Broadhaven Bay are naturally raised into suspension by the wave and current regime, raised suspended solids levels from construction operations will not create a cumulative impact above that created naturally.

9.5.3 Operation

Sacrificial Anodes

Sacrificial anodes are designed to lose material to the surrounding water to maintain an electrical potential across the pipework, which helps to prevent corrosion. The anodes will be made from an aluminium-zinc-indium based alloy. For the Corrib subsea development, more detailed engineering calculations now estimate that 85 tonnes of anode will be required for the pipeline, a reduction from the 105 tonnes estimated in 2001. The anodes are positioned as collars around pipelines.

The typical percentage composition of these anodes is presented in Table 9-3.

Table 9-3: Typical Composition of Sacrificial Anodes

Element	Composition (%)	Total tonnage for Corrib export pipeline
Zinc	4.0 (approx)	3.4 (approx)
Indium	0.015 (approx)	0.0128 (approx)
Iron	0.09 (max)	0.077 (max)
Silicon	0.20 (max)	0.17 (max)
Copper	0.004 (max)	0.0034 (max)
Others (each)	0.01 (max)	0.0085 (max)
Others (total)	0.05 (max)	0.0425 (max)
Aluminium	Balance	81.3 (min)

The tonnages of anode given above have been calculated in accordance with a DNV standard (DNV RP B 401), based on a long-term test programme. The anodes will dissolve if an electrical reaction is able to occur between them and other parts of the pipework. Such a reaction (current) will only be able to take place if there are other parts of the pipework exposed to seawater. Normally, the epoxy pipe coatings prevent the metalwork encountering seawater. However, it is possible that in some places the coatings could become damaged, and therefore the anodes could partially dissolve. The tonnages of anode to be used in the development are based on 2% of the pipework being exposed to seawater over a period of 30 years.

9.5.4 Discharge Pipeline (Outfall Pipe) and Umbilical Discharge

The design of the surface and produced water treatment systems have been updated since 2001, and it is now planned that the discharges are made on a continuous basis, rather than the batched discharge that was previously proposed. The IPPC licence issued in November 2007 for the terminal was based on the continuous discharge, with maximum daily volumes as follows:

- Treated Produced water – 6m^3/hour or daily maximum of 144m^3 (allowing for additional capacity in the event of recycling of water from the treatment)
- Treated Surface water run-off – 30m^3/hour or daily maximum of 720m^3 (allowing for moderate - high rainfall events).

The volumes quoted are those upon which the design of the water treatment systems in the terminal have been based.

It should be noted that the maximum anticipated produced water flow rate is 3.3m^3/hour (in the early years of production, falling to less than 1m^3/hour after year 10). It is currently estimated that there is a limit of approximately 2.7m^3/hour on the capacity of water discharge through the cores in the umbilical. When the production of produced water is at its estimated highest level (3.3m^3/hour), there will be an excess 0.6m^3/hour which cannot be discharged. This volume will be stored on site and removed periodically by road tanker to an appropriately licensed waste water treatment plant.

The average surface water run-off rates are calculated to be around 2.1m^3/hr. In the event of extreme rainfall events with surface water run-off rate in excess of 30m^3/hr, the excess volume will be retained in the open drains system and sump until it can be treated and discharged.

The treated produced water will normally have a lower salinity than the surrounding seawater and is thus less dense than the receiving water. Consequently, once it is discharged it will rise through the water column, mixing as it ascends. The initial velocity will be relatively small and the processes giving rise to the attenuation of the contaminant concentrations will be due to the effluent's inherent buoyancy and subsequent advective dispersion as it moves away under the influence of the local current field. This will result in the entrainment of contaminants into the surrounding water body, ensuring that they are diluted to background levels within a short distance.

Modelling of the discharge at the subsea manifold has been carried out by HR Wallingford (Appendix 9.1). The results show that concentrations of contaminants are expected to be diluted by approximately 100 times within 5m of the discharge point. Thereafter, these very low concentrations are further diluted to within 10% of background level within the next 350m. Whilst the modelling has demonstrated that the effluent plume disperses less rapidly at the highest expected ambient currents (i.e 0.35 m/s), for 90% of the time currents are significantly weaker (i.e. <0.2 m/s) reducing the distance to within 10% of background to under 200m. Local currents appear not to have a significant directional bias as would be expected if they were predominantly tidal in origin. However there is evidence that northeastward flows dominate. it is therefore unlikely that there will be a build up of discharged constituents around the site.

The dispersion studies are not capable of simulating accurately the situation with the manifold protection cover in place. The modelled jet velocity of ca. 1m/s with a single riser is very much larger than the velocities at which the effluent would flow from seven access ports. This will reduce the initial-dilution due the reduction in the momentum-induced jet mixing. However, this may be offset as the effluent will effectively be emerging from a multi-port outfall.

During the Oral Hearing for the IPPC licence application, conducted by the EPA in in Belmullet in April 2007, Professor Peter Matthieson commenting on the discharge which was proposed off Erris Head at the time, stated that…

> *In view of the high level of treatment to be provided, there will be no damage to whitefish, crab or lobster fisheries in the vicinity of Broadhaven Bay. Similarly there will be no predicted impacts on other marine organisms.*

The same levels of treatment will be used for the water to be discharge through the umbilical and it is therefore concluded that there will be no impacts to marine organisms in the area of the Corrib Field resulting from the discharge.

9.6 Do-Nothing Scenario

No change from 2001 Offshore EIS. Further consideration of the do-nothing scenario is addressed in Section 13.7.

9.7 Mitigation Measures

For all offshore aspects of the project other than the pipeline installation in Broadhaven Bay, and the discharge off Erris Head and in the Corrib Field, the mitigation measures as proposed in 2001 Offshore EIS remain valid.

9.7.1 Discharge Pipeline (Outfall Pipe) and Umbilical

9.7.1.1 Environmental Quality Standards

In considering the design of the water treatment plant for the terminal and given the outcome of the original (2001) assessment of alternatives (treated water would be discharged in Broadhaven Bay), the Environmental Quality Standards (EPA, 1997) were used as discharge limits. While the outfall location for the produced water is now in the Corrib Field itself, it is still proposed that the water will be treated to such stringent levels.

Treatment of produced water discharge to this degree is unusual, as the EQS is typically a measure of background concentrations rather than a limit applied to an undiluted discharge. The dilution and dispersal afforded by the location of the discharge (in 350m water) will serve to further reduce the concentrations of contaminants in the discharge rapidly.

9.8 Predicted Impact of the Proposed Development

The predicted impact of all aspects of the proposed development remains as stated in the 2001 Offshore EIS. In the case of the pipeline rock placement works and umbilical installation, where some changes have occurred as a result of modified installation methods and more data becoming available on the background water quality, the predicted impacts are restated for completeness. The predicted impacts of treated water discharge from the two water outfall locations are addressed below.

9.8.1 Rock placement and Umbilical

Placement of rock over the pipeline section in Broadhaven Bay, and the burying of the umbilical using a subsea plough/jetting tool, will have a minor, short-term, localised impact (see Table 3-1 for installation period), creating increased turbidity. Given that the installation period has been extended, the impacts will be perceived over a longer time period, though they will effectively be negligible.

9.8.2 Discharge pipe (outfall pipe) and Umbilical

During operation, the discharge from the outfall location north of Erris Head will consist of treated surface water run-off from hard surfaces around the terminal, effectively treated rain water and therefore no impacts are predicted. The discharge on the seabed in the Corrib field will consist of produced water, which has been treated to reduce contaminant concentrations to those required by the existing IPPC licence. The concentrations specified in that licence were such that there would not be damage to marine organisms. No effects are therefore predicted.

9.9 Monitoring

The terminal operations have received an IPPC licence from the EPA. Several conditions in that consent relate to the monitoring of the treated produced water to be discharged off Erris Head, including water quality, sediment quality, biomonitoring, and biological effects monitoring. While the relevant baseline work has already been completed for the Erris Head discharge, given that now only treated surface water run-off is proposed for discharge at that location, and that the treated produced water is to be discharged in the Corrib Field, a change to the IPPC licence is required. A licence review application has been submitted to the Environmental Protection Agency in this regard. While revised monitoring plans would be subject to such a revised licence, it is anticipated that in the case of the treated surface water discharge, data already collected will be sufficient as a baseline.

In order to ensure that the produced water discharge does not present a risk to the marine environment, a programme of toxicity testing of the treated produced water effluent is proposed. The details of this programme will be subject to the revised IPPC licence conditions.

9.10 Reinstatement and Residual Impacts

Based on the assessments made in the 2001 Offshore EIS and further consideration of the potential impacts carried out by the EPA in granting the IPPC licence, the reinstatement and residual impacts are still considered negligible.