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PROJECT DESCRIPTION 3.0

3.0 PROJECT DESCRIPTION

3.1 Site Location and Context

The Site is located in the townlands of Knocknacran (East & West), Drumgoosat, Drummond, Derrynascobe, Enagh, Derrynaglah and Clontrain, Co. Monaghan, to the north and south of the R179, a regional road which runs between Carrickmacross and Kingscourt (Figure 3.1). The Site is accessed via a public road (L4816) which runs south-eastwards from the R179. The town of Kingscourt is located ca. 7 km south of the Site along the R179, and the town of Carrickmacross is located ca. 7 km north of the Site also along the R179.

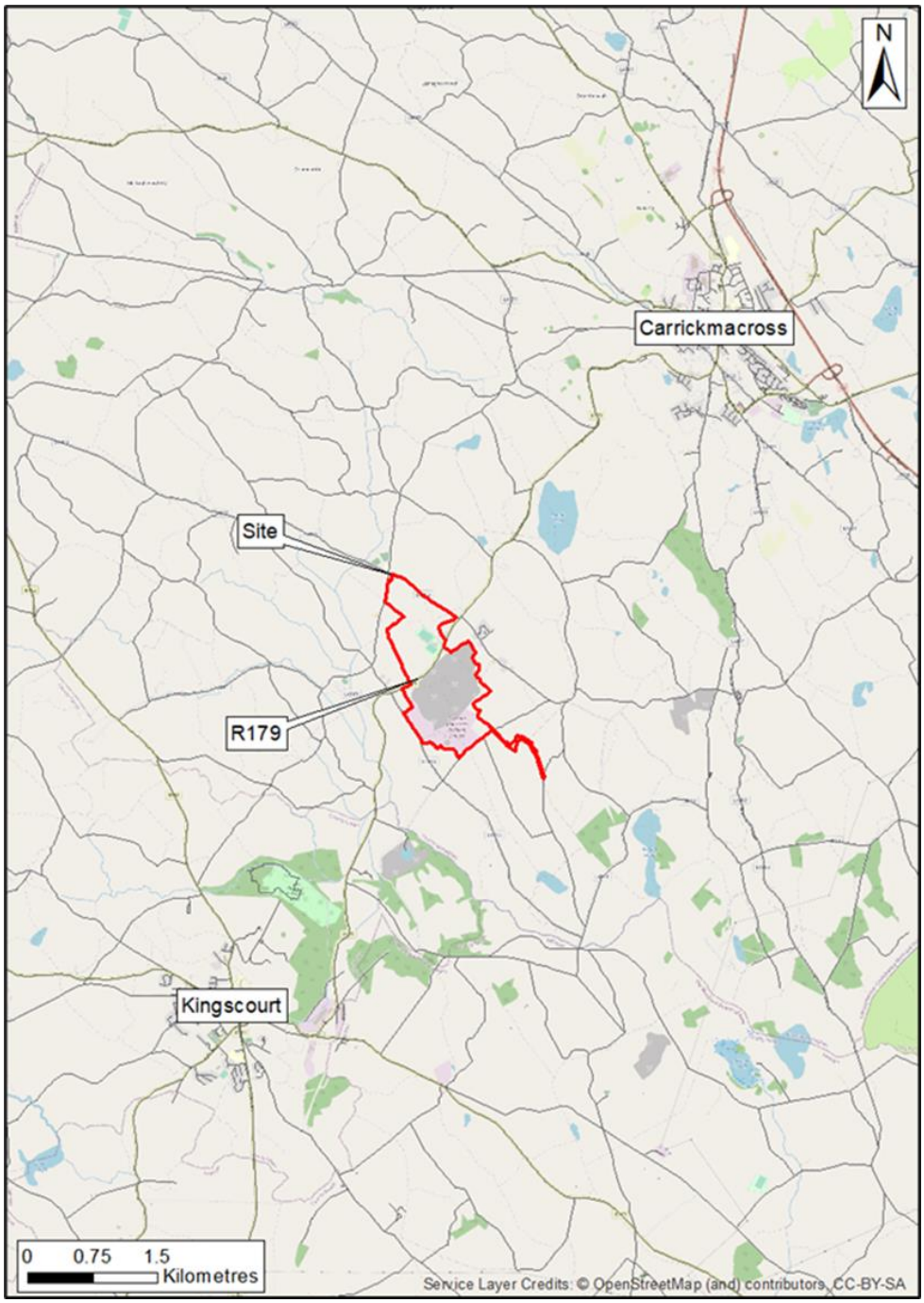


Figure 3.1: Location Plan

Due to the depletion of the gypsum resource from the existing Knocknacran Mine, permission is being sought to develop and recover the gypsum remaining in the former Drumgoosat Underground Mine by open-cast mining methods. The new mine will be known as the Knocknacran West Open-Cast Mine. The former Drumgoosat mine has been the location of a number of subsidence events since it closed in the late 1980's and in recent times has become an area of ongoing concern with respect to subsidence. While measures have been taken to assure and maintain public safety, the proposed development will remove significant areas of the fundamental hazard of old mine workings by open cast mining, will allow the implementation of works that will prevent water movement through the site in the long-term and is expected to facilitate backfilling of old mine tunnels that pass beneath public roads, if safe and practicable to do so. No other proposal facilitates these benefits. The Proposed Development includes the restoration of the existing Knocknacran Mine to near original ground levels and the further development of the Community Sports Complex (Reg. Ref. 20/365).

The existing Knocknacran Mine (open-cast) and the adjacent Drummond Mine (underground) produce gypsum as a raw material for the manufacture of an extensive range of plasterboards, plasters and cement rock. The gypsum is processed through a series of crushing circuits, before being homogenised and subsequently dispatched from the Site. The mines typically produce between ca. 250,000 and 500,000 tonnes of gypsum (calcium sulphate dihydrate – $CaSO_4$ ($2H_2O$)) per annum, depending on market conditions.

The underlying sedimentary bedrock geology is of Permian age (ca. 300 to 250 million years old) and comprises the Kingscourt Gypsum Formation. This formation is comprised mostly of mudstone with two major gypsum (and anhydrite) units. The Upper Gypsum Unit (between ca. 6 to ca. 10 m in thickness) and the Lower Gypsum Unit (between ca. 20 to ca. 35 m in thickness) are typically separated by a unit of red mudstones known as the Middle Mudstone Member (Gardiner & McArdle 1992). A number of later dolerite sills cross-cut the sedimentary geology, and are thought to be of Palaeocene (Tertiary) age (ca. 66 to 56 million years old). Overburden consisting of glacial till, mudstones and dolerites; and interburden consisting of mudstones and dolerites will be required to be removed to extract the gypsum.

According to the National Parks and Wildlife Service's (NPWS) database of designated nature conservation areas, the Site is not located within or immediately adjacent to any designated areas of conservation.

There are no Special Protected Areas (SPAs), Special Areas of Conservation (SACs) or Natural Heritage Areas (NHAs) within at least 15 km of the Site. There are however a number of proposed Natural Heritage Areas (pNHAs) within 15 km, the closest one being Lough Fea Demesne (000560) ca. 3 km from the Site. Habitats within the Application Site include agricultural grassland, semi-natural grassland, scrub, hedgerows, treelines and waterbodies.

3.2 Surrounding Land Uses

The overriding land use surrounding the Site can be characterised as rural in nature, with land uses in the vicinity of the Site being predominantly agricultural and single-house residential. Industrial and commercial activities are also found within the surrounding area.

The lands contiguous to the boundaries of the Site are in mixed use, combining agricultural use, residential use, commercial use (a petrol station adjacent to the Site on the R179) and extractive industry (existing Drummond Underground Mine operated by SGMI which extends laterally beneath the Site to the south, and Cormey opencast Clay Pit which is operated by Breedon Brick Ltd. to the south). There are scattered residential properties in the vicinity of the Site, primarily concentrated along the Regional Road (R179) and the local road network. One residential estate (Clonsedy) is located to the northeast of the existing

Knocknacran Mine site. The village of Drumgoosat is located to the north of the Site and contains a church and graveyard, national school, mushroom farm, shop and several residential houses.

As part of the Monaghan County Development Plan 2019 – 2025 (Section 15.25), extractive industry Policy EIP1 states the following:

"To require all applications for extractive development to submit the following as part of the planning applications;

a) Map detailing total site area, area of excavation, any ancillary proposed development and nearest dwelling and/or any other development within 1km of the application site."

Within 1 km of the Site, there are approximately 150 residential houses (includes unoccupied houses), ca. 2 recent grants of permission to build residences[1] and ca. 18 non-residential units as identified in Table 3.1.

A breakdown of the non-residential activities taking place within 1 km of the Site is shown in Table 3.1.

Table 3.1: Non-residential activities within 1 km of the Site

Activity	Type	Quantity	Licenced Activity
Agricultural	Poultry sheds/poultry farms	4	Yes (1)
Commercial	Petrol Station with deli and seating area	1	No
Commercial	Auto-services	1	No
Commercial	Motor vehicle dealership	2	No
Hospitality	Hotel	1	No
Industrial	Plastic manufacturing	1	No
School	National school	1	No
Commercial/Food	Mushroom farm	1	No
Commercial	Local shop	1	No
Ecclesiastical	Church and graveyard	2	No
Industrial	Waste management services	1	No
Recreational	Magheracloone Mitchells GAA Club	1	No
Industrial	Drummond Mine	1	Yes

[1] To date April 2023 https://monaghan.ie/planning/online-planning-tools/

The agricultural industry is evident within the local area both from aerial imagery and from Corine land use mapping (2018). Within 1 km of the Site, according to Corine land use mapping, pastoral agriculture is the only land use in the area.

3.3 Proposed Development

The Proposed Development (Figure 3.2) is seeking permission for the following:

- Excavation of the former (Drumgoosat) underground mine by open-cast mining methods for the purposes of gypsum extraction at Knocknacran (East & West) and Drumgoosat, Co. Monaghan. Development will include the construction of a Cut-and-Cover Tunnel under the Carrickmacross to Kingscourt regional road (R179) for the transport of gypsum (by haulage truck and covered conveyor) to the existing processing plant area at Knocknacran, and for the transport of overburden and interburden (by haulage truck) to the existing Knocknacran Open-Cast Mine site for ongoing restoration purposes. The construction of the proposed tunnel will necessitate a temporary realignment of the R179 during the tunnel construction period to allow the R179 to remain in constant use. Development will also include: the demolition of one residential house and three unoccupied houses and sheds in the townlands of Knocknacran (East & West), Co. Monaghan; and the pumping of water from the existing Drumgoosat underground workings via an existing borehole on the Knocknacran West Mine site.

- The continued ongoing restoration of the existing Knocknacran Open-Cast Mine located in the townlands of Derrynascobe, Derrynaglah, Enagh, Knocknacran (East & West) and Drummond, Co. Monaghan, permitted under Reg. Ref. 17/217 and operating subject to Industrial Emissions (IE) Licence P0519-04 and Mining Lease M139. The proposed development includes a modification to the existing (approved) restoration plan to return the existing Knocknacran Open-Cast Mine to near ground levels.

- The continuation of use and refurbishment of the existing Knocknacran Processing Plant area, including water treatment facilities and associated infrastructure (including discharge pipeline to the River Bursk) in the townlands of Enagh, Derrynaglah, Drummond, Derrynascobe and Clontrain, Co. Monaghan.

- The Proposed Development will include a replacement vehicular access to the existing Knocknacran Open-Cast Mine and Knocknacran Processing Plant area site from the L4816.

- The further development of a Community Sports Complex (permitted under Reg. Ref. 20/365) located in the townlands of Drummond, Derrynaglah and Knocknacran West, Co. Monaghan which provided for a playing pitch, dressing rooms, welfare facilities, parking and associated drainage/wastewater infrastructure. This proposed development includes the next phase of the Community Sports Complex to include: 2 no. further playing pitches (one with perimeter running track and the other is an all-weather pitch) with associated goal posts, ball stops, dugouts, pitch fencing, flood lighting; a new building to incorporate reception, meeting / club rooms, sports hall, handball alley, changing rooms and toilets, viewing gallery; a part covered grandstand and additional parking and all associated siteworks.

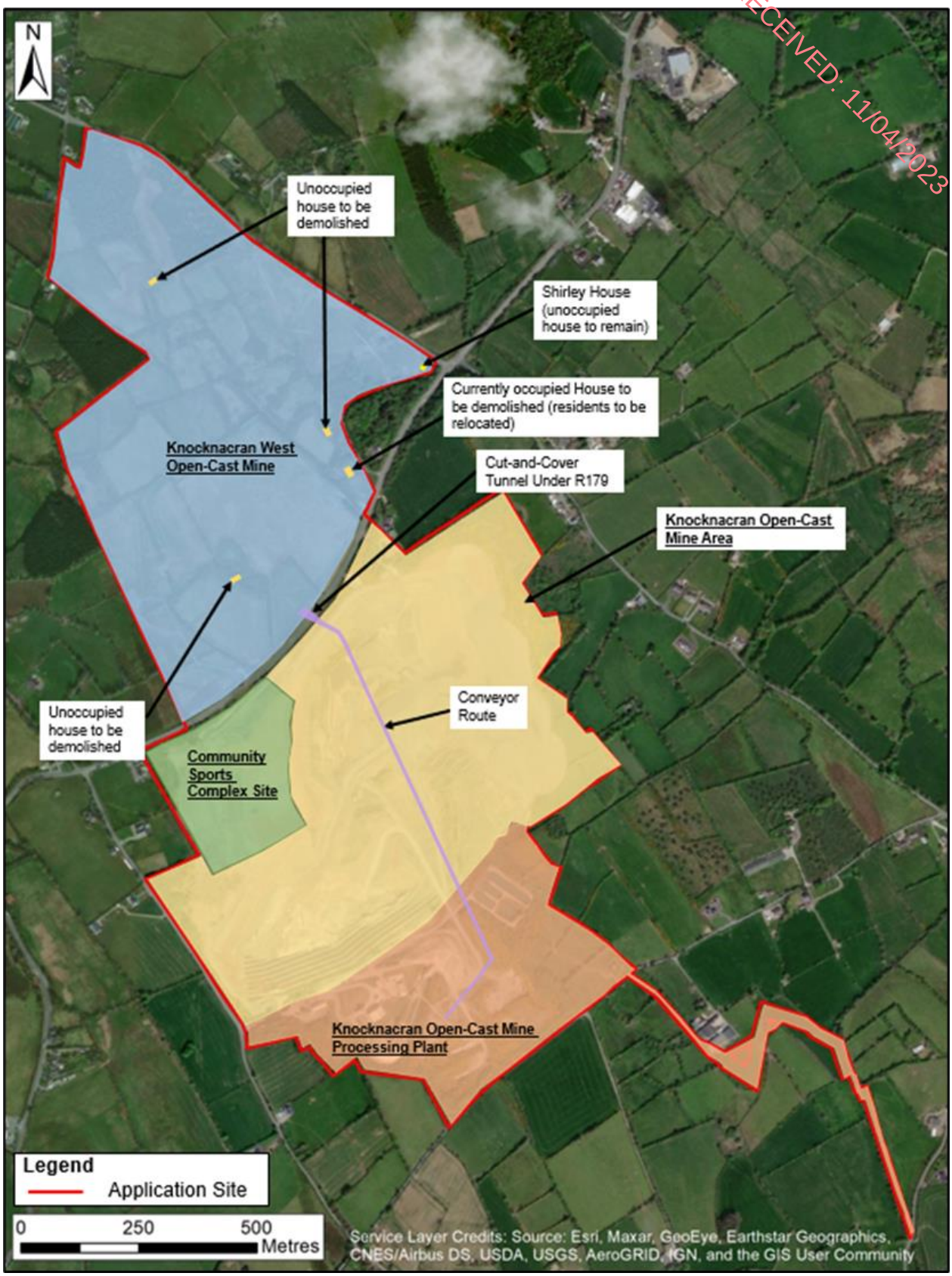


Figure 3.2: Proposed Development Areas

The overall Application Site area is ca. 140.4 ha[2], of which the proposed Knocknacran West Mine comprises ca. 54.3 ha, ca. 24.6 ha comprises the processing plant, ca. 8.6 ha will comprise the Community Sports Complex and ca. 51.5 ha will comprise the restoration area for the existing Knocknacran Mine. Each of these developments will be elaborated on in the following sub-sections.

3.3.1 Terminology

As the development consists of two distinct elements (the Mine Development and the Community Sports Complex Development), each element will be referred to within the relevant subheadings in the EIAR, attention will also be paid to their cumulative impacts where relevant.

Three distinct phases of the development have also been identified; Construction, Operation and Closure/Restoration. Each phase of the development will be referred to separately.

The two distinct elements of the Proposed Development are as follows:

i) The Mine Development which includes the following:

- The proposed 'Knocknacran West Open-Cast Mine'/ (Knocknacran West Mine) where it is proposed to extract gypsum and source material (interburden and overburden) for the restoration of the existing Knocknacran Open-Cast Mine back to near original ground level. Material will be extracted by open-cast mining methods. The proposed mine encompasses the majority of the remaining old workings at the former Drumgoosat (underground) Mine. It also includes the construction of a Cut-and-Cover Tunnel under the Carrickmacross to Kingscourt regional road (R179) for the transport of gypsum (by haulage truck and covered conveyor depending on operational demands) to the existing processing plant at Knocknacran Open-Cast Mine, and for the transport of overburden and interburden (by haulage truck) for the purpose of restoring the existing open-cast Knocknacran Open-Cast Mine. The Cut-and-Cover Tunnel will require the temporary diversion of the R179 during construction, the diversion will be a two-lane diversion ensuring continuous use of the R179. To enable development of the Knocknacran West Open-Cast Mine, the demolition of one residential house and three unoccupied houses and sheds will be required. This development will also require the pumping of water from the existing Drumgoosat underground workings via an existing borehole on the Knocknacran West Mine site. Upon cessation of mining activities, Knocknacran West Open-Cast Mine will also undergo restoration;

- The 'Knocknacran Open-Cast Mine'/ (Knocknacran Mine) area, is located on the existing Knocknacran Open-Cast Mine site, where it is proposed to restore the existing open-cast extraction area using material (interburden and overburden) from the proposed Knocknacran West Open-Cast Mine to near original ground level. The existing Knocknacran Open-Cast Mine will be in active closure and restoration during the operation of the proposed Knocknacran West Open-Cast Mine. This proposed restoration plan is a revision of the existing plan included in the CRAMP (Closure, Restoration & Aftercare Management Plan). The existing mine entrance will also be replaced on this site;

[2] The red line area encompasses a small area of the R179 (ca. 1.4 ha) which accounts for the slight discrepancy in total site area.

- The continuation of use of the current Knocknacran Open-Cast Mine processing plant, water management facilities and associated infrastructure (including mine water discharge pipeline and discharge point), which is to be referred to as the 'Knocknacran Processing Plant'. This is located on the existing Knocknacran Open-Cast Mine site and to the immediate south of the proposed Knocknacran Open-Cast Mine Restoration area; and

ii) The proposed 'Community Sports Complex' where it is proposed to construct a community sports complex. Monaghan County Council (MCC) recently granted permission for a playing pitch, dressing rooms and associated infrastructure/facilities on the Community Sports Complex site under Reg. Ref. No: 20/365. The 20/365 permission relates to an initial phase of development of the proposed Community Sports Complex.

Table 3.2 presents a summary of the project terminology.

Table 3.2: Project Terminology

Term	Definition
Proposed Development	The Proposed Development (Mine Development and Community Sports Complex) encompasses the proposed operation and closure of the Knocknacran West Open-Cast Mine, the restoration of Knocknacran Open-Cast Mine, the continuation of the existing Knocknacran Processing Plant, and the construction and operation of the Community Sports Complex. The Proposed Development is detailed within the planning application, planning drawings, accompanying EIAR, NTS and NIS.
Application Site	To obtain planning permission to permit the Proposed Development, a planning application is required to be submitted to the planning authority (Monaghan County Council) for review. The Application Site defines the boundaries of the Proposed Development for the purposes of the planning application. In this case the Application Site includes the proposed Knocknacran West Open-Cast Mine, Knocknacran Open-Cast Mine Restoration, Knocknacran Processing Plant and Community Sports Complex areas.
site	'site' refers to the individual sites/distinct aspects of the Proposed Development i.e., Mine Development (Knocknacran West Open-Cast Mine site, Knocknacran Open-Cast Mine Restoration site, Knocknacran Processing Plant site) or Community Sports Complex site.
Construction Phase	Construction of perimeter landscaping berms and fencing, Temporary Road Diversion, Cut and Cover Tunnel. Construction of Community Sports Complex.
Operational Phase	Excavation, transport and placement of Overburden and Interburden to access gypsum and restore mined areas, open cast mining of gypsum, transport, processing and despatch of gypsum, management of water. Operation of Community Sports Complex.

Closure and Restoration Phase	Placement of Overburden and Interburden, setting and planting final ground levels, recovery of natural water levels to form a new waterbody. Closure of the Community Sports Facility is not foreseen.

3.3.2 Emissions Control – EPA Licence and Monaghan County Council

Figure 3.3 and Table 3.3, below presents the lifecycle for the Project considered within this EIAR.
It is presented here that the construction and operational phases of the Community Sports Complex will be regulated by Monaghan County Council. There is no decommissioning phase presented for the Community Sports Complex.

SGMI proposes a construction phase followed by an operational mining phase, and a subsequent restoration phase (although ongoing restoration will take place during its operational phase) for the Mine Development.

Emissions to the environment during the construction phase are expected to be regulated by the Local Authority.

Emissions during the operational phase are expected to be regulated by the EPA due to the nature and scale of the activities proposed. This is currently the case for Knocknacran Mine under IE Licence P0519-04.

The point at which the construction phase of the development ceases and the operational phase of the development begins, is once the Cut-and-Cover Tunnel has been constructed and commissioned, allowing the movement of material through the tunnel from the Knocknacran West site to the existing Knocknacran site for restoration purposes.

IE licencing is explicit in that activities that involve the extraction and processing of mineral (gypsum) at the scale proposed requires an EPA licence.

Once an IE licence is put in place for a site, all activities on that site come under the control of the licence. The site becomes a “licenced site”.

It follows that once an EPA licence comes into effect any movement of material lying above the upper gypsum seam (referred to as overburden) or lying between seams of gypsum (referred to as interburden) will be regulated by the EPA licence for the site.

The existing Knocknacran Mine is an example of how an IE Licence is applied to an open-cast gypsum mine. There are no other existing open-cast gypsum mines in the country to compare with.

As Knocknacran Mine is an existing licenced site, emissions related to overburden movement are currently regulated by the EPA. It is planned to seek an extension of the current licence site to encompass the area and activities proposed in this development. It follows that if an activity is regulated on an existing licenced site, it will remain regulated in any site which will be subject to a licence review to bring it into the licence area and licenced activity.

Closure, Restoration and Aftercare Management Plan (CRAMP) is regulated by the EPA under the existing licence at Knocknacran Mine. The proposal to bring overburden from Knocknacran West into the existing Knocknacran site would require the EPA to consider this revised restoration proposal. It follows that this will

mean the movement of overburden from the new development will be under EPA licence control as it will be part of the IE licence area and CRAMP.

In the context of an open-cast mine, overburden removal is a fundamental part of the mineral extraction process. Commercially, overburden removal will not commence if there is any risk of not being able to extract the mineral lying beneath this overburden. Overburden removal will not commence without the requisite licences (in this case EPA licence) in place to extract the underlying mineral.

The existing licence P0519-04 describes a licensable activity for:

"1.3. The extraction and processing (including size reduction, grading and heating) of minerals within the meaning of the Minerals Development Acts, 1940 to 1999, where an activity involves any other operation where either the level of extracted or processed minerals is greater than 200,000 tonnes per annum or the total operational yield is greater than 1,000,000 tonnes, and storage of related mineral waste."

The Minerals Development Acts, 1940 to 1999 Act describes a broad list of activities related to the extraction of minerals to include:

"2.—(1) In this Act, except where the context otherwise requires—

"working" in relation to minerals, includes digging, searching for, mining, getting, raising, taking, carrying away, treating and converting such minerals and the sale or other disposal of such minerals and cognate words shall be construed accordingly."

In the context of SGMI's proposal, this description of *"digging"* and *"searching for"* minerals would be a reasonable description of overburden removal. The Act allows for cognate words to be considered as well.

The mining activity at Knocknacran Mine was first considered and regulated under EPA licence P0519-01. The EPA inspectors report (dated 16th January 2002) refers to overburden on a number of occasions and specifically of interest to the Mine Development;

Page – 2 - *"Mining entails removal of the overburden. Gypsum is extracted in a series of benches. The overburden removed is used to fill the void created by gypsum extraction."*

Page – 4 - *"……removal of the overburden in order to expose the gypsum seams….."*

The EPA inspector's report (dated 28th September 2004) under IE licence P0519-02, states the following in relation to overburden:

Page – 2 *"Knocknacran opencast mine: Mining entails removal of the overburden. Gypsum is extracted in a series of benches. The overburden removed is used to fill the void created by gypsum extraction."*

The proposed development of Knocknacran West Open-Cast Mine will require the removal of overburden and interburden to access gypsum, in the same manner as that currently undertaken at Knocknacran Open-Cast Mine.

The Mineral Development Act and the EPA licencing process both specifically indicate that the removal of overburden is a fundamental part of the mining process and should be regulated by EPA licence.

Should the EPA for some unexpected reason not include this activity within the licence (i.e. the first stripping of overburden materials to access the first gypsum to be extracted from Knocknacran West, then the Local Authority would apply the existing emissions limits for the existing activity. In such a scenario, the licence limits in the existing licence should be applied for the overburden stripping until such a time as the EPA licence comes into force.

In any instance, SGMI give a commitment that no overburden stripping for the purpose of accessing the gypsum deposit in Knocknacran West will be undertaken until an IE Licence to do so is granted by the EPA.

Development Activity Description	Community Sports Complex Construction	Community Sports Complex Operation
Regulating Authority	Monaghan County Council	Monaghan County Council
Construction of Community Sports Complex		
Operation of Community Sports Complex		

Development Activity Description	Mine Construction Activities	Operational Mining Activities	Closure	Restoration	Aftercare	IED Licence Surrender
Regulating Authority - Expected	Monaghan County Council	EPA	EPA	EPA	EPA	Monaghan County Council
Provisional timeline (months)	0 1 2 3 4 5 6 7 8 9 10 11	12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 360	361	400	401	n+1
Planning Permission Granted						
Fencing Boundary of Dev Area						
Construction of Perimeter Landscaping Berms						
Demolition of Buildings						
Construction of Welfare Facilities - WWT						
Construction of Road Diversion (off Carriageway)						
Road Diversion in Use						
Construction of Cut and Cover Tunnel						
R179 Reinstatement						
Relocate pump in Drumgoosat Mine Workings to Knocknacran West and Pipe to Process Site						
First Cut - Overburden Stripping						
Transport of Overburden to Knocknacran Pit Restoration Area						
Installation of Mine Equipment - Primary Crushing, Transport Conveyor						
First Cut - Upper Seam Gypsum Mining						
First Cut - Interburden Stripping						
First Cut - Lower Gypsum Seam Gypsum Mining						
Routine Ongoing Gypsum Mining						
Under Road Backfilling						
Decommission Conveyor						
Decommission Production Plant						
Decommission Road Tunnel						
Decommission Pumping						
Setting final Ground Levels - Knocknacran Existing						
Top soil and seeding Knocknacran Existing						
Setting final Ground Levels - Knocknacran West						
Top soil and seeding Knocknacran West						
Water Level Rebounding						
Aftercare Active Monitoring						
IED Licence Surrender						

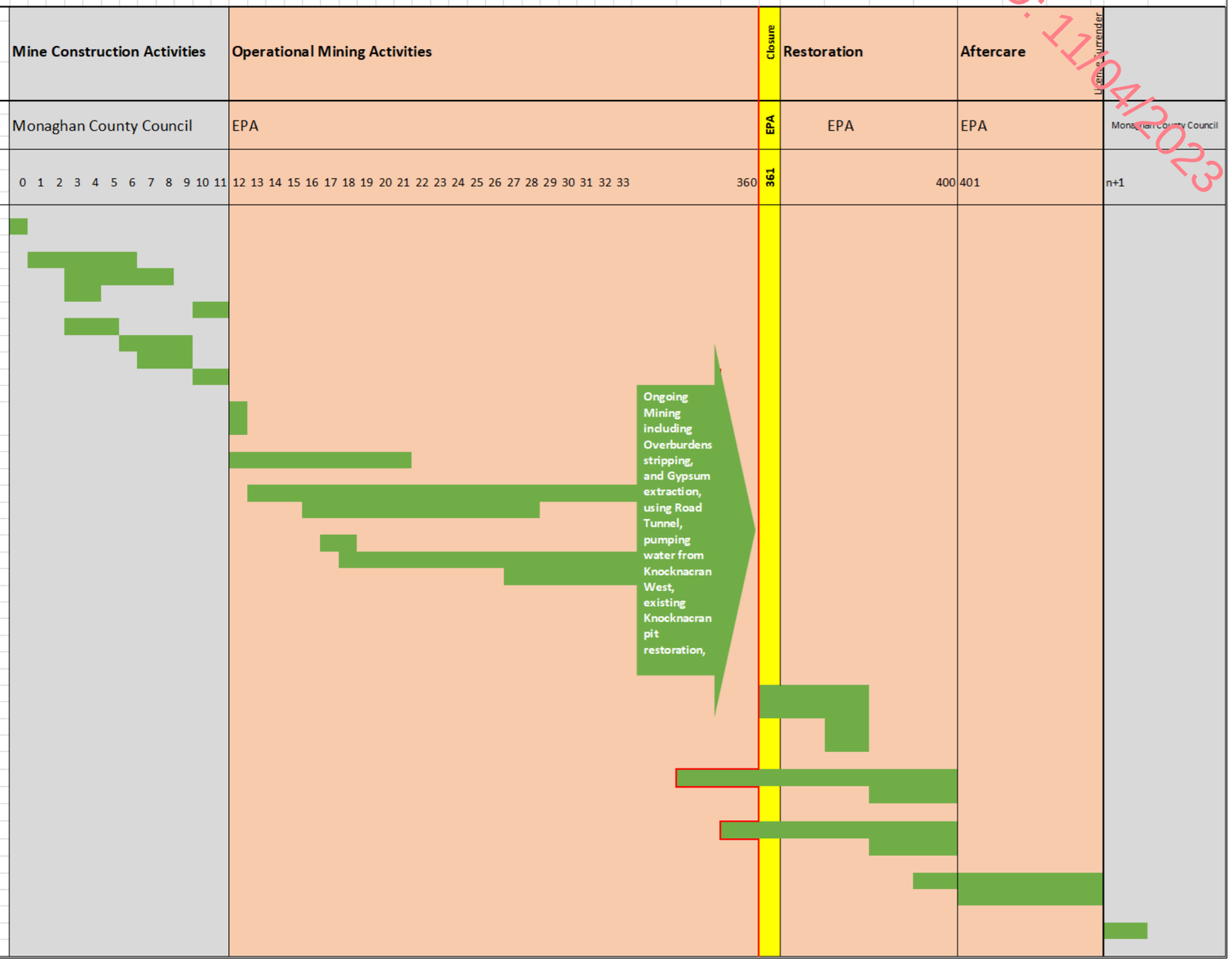


Figure 3.3: Lifecycle for the Project

Table 3.3: Description of Stages of Development

Activity		Description of Activities taking place	Licencing Context	Scheduling
Construction	**Construction Activities:**	Construction of the upgrade to the Community Sports Complex.	Not in EPA licenced Area or an area that will become licenced.	Will commence before mine operation activities take place and will continue during mine operation activities.
		Construction of Perimeter Landscaping involving movement of surface soils in New Mining Area (Knocknacran West) and erection of security fencing.	Part of an Area that is not currently EPA licenced. Not an activity that requires an EPA licence.	Will commence and be complete before Mine operation activities take place.
		Construction of a temporary road diversion and cut and cover tunnel under the R179.	Not an activity that requires an EPA licence.	Will commence and be complete before Mine operation activities take place.
		Construction of new mine entrance.	Not an activity that requires an EPA licence.	Will commence and be complete before Mine operation activities take place.
Operation	**Mine Operation Activities:**	The excavation (by mechanical means) of overburden to access the upper seam of Gypsum.	A mining specific activity for the purpose of extracting Gypsum mineral. Requires an EPA licence.	Will commence after construction activities have been completed and will continue for the life of the mine.
		The drilling, blasting, excavation, transport and crushing of the Upper seam of Gypsum.	A mining specific activity for the purpose of extracting gypsum mineral. Requires an EPA licence. Requires a mining lease.	Will commence after construction activities have been completed and will continue for the life of the mine.
		The excavation (by mechanical means) of interburden to access the lower seam of Gypsum.	A mining specific activity for the purpose of extracting Gypsum mineral. Requires an EPA licence. Requires a mining lease.	Will commence after construction activities have been completed and will continue for the life of the mine.
		The drilling, blasting, excavation, transport and crushing of the Lower seam of Gypsum.	A mining specific activity for the purpose of extracting Gypsum mineral. Requires an EPA licence. Requires a mining lease.	Will commence after construction activities have been completed and will continue for the life of the mine.

		Ongoing phased restoration - The transport and placement of overburden and interburden to previously mined areas, initially in Knocknacran and subsequently in Knocknacran West periodically throughout the life of the mine - operational phase.	A mining specific activity for the purpose of extracting Gypsum mineral. Requires an EPA licence.	Will commence after construction activities have been completed and will continue periodically throughout the life of the mine.
Restoration	**Restoration Activities**	Final placement of overburden and interburden.	Carried out under a formal CRAMP on EPA licenced sites.	Will commence following cessation of Gypsum extraction.
	Closure	The date on which mine activities are deemed to have ceased.		Will commence after mine has ceased operation and before aftercare commences.
		The decommissioning and removal of plant, equipment and buildings after the mine has ceased production.	Carried out under a formal CRAMP on EPA licenced sites.	
		The decommissioning and sealing of road tunnel under R179.		
	Aftercare	A period of active monitoring during which the previously developed area is monitored to ensure restoration has been effective and no ongoing impacts remain.	Carried out under a formal CRAMP on EPA licenced sites.	Will commence after all restoration activities have been completed.
	Licence Surrender	The date on which the site is deemed to be stable and no further formalised monitoring is required.	The date when the EPA licence is withdrawn for the site, after an audit process.	Will commence after a formal closure audit and sign off by the EPA and Statutory Authorities

3.3.3 Knocknacran West Mine

3.3.3.1 Existing Site Conditions

The Knocknacran West Mine site encompasses the former Drumgoosat workings to the north of the R179, Figure 3.4. Prior to the initial subsidence event in September 2018 (refer to Chapter 7.0), activity on the site was mixed use. Above ground the land was previously used for pastoral farming, amenity uses (former Magheracloone Mitchell's GAA Club grounds and Community Centre) and a brownfield area to the north of the site which was the site of the former Drumgoosat Mine surface plant area which has become an area of semi-natural woodland. Below ground the majority of the site comprises the former Drumgoosat Mine workings.

Former Drumgoosat underground workings extend under the majority of the site, with some workings extending under the R179 and L4900 (Figure 3.4). The gypsum associated with the underground workings to the south of the R179 has been excavated during mining of the Knocknacran Open-Cast Mine. Since the subsidence event in September 2018, work has been undertaken by SRK (with review by Wardell Armstrong for the Department of the Environment, Climate and Communications) to assess the causes and current, and future, stability of the existing underground workings beneath the site. This is discussed extensively in Chapter 7.0 and appendices (Land, Soils and Geology).

The former Drumgoosat workings have historically been used to store water, however, this is no longer taking place. Instead, the workings are being gradually dewatered by the 'Drumgoosat dewatering borehole' located to the south of the R179. As part of the Proposed Development this borehole will be decommissioned, with future dewatering of the Drumgoosat workings taking place via an existing monitoring borehole located to the north of the R179 (please refer to Chapter 8.0 (Water) for further discussion on the current dewatering at the site).

Since the September 2018 subsidence event, the only activities which have taken place on the Site have related to remediation (through removal of buildings, filling of subsidence features and regrading of the site), monitoring and management of the site. The former GAA Club ground, Community Centre buildings and pitches were removed as part of site remediation works (Appendix 3.1 provides a copy of the Construction Quality Assurance (CQA) Validation Report for the remediation of the disturbance zone at the former Magheracloone GAA grounds). Remediation of crownholes and fissures associated with this subsidence event have also taken place. The site of the former GAA grounds remains not in use, as does the wider site over the former Drumgoosat workings, and will continue to remain not in use for the foreseeable future. Areas which were not directly impacted by recent subsidence events, are currently unmanaged fields and woodland areas.

An active monitoring programme has been established at the site and for the R179 and L4900. As part of the programme, visual inspections, precise levelling, drone surveying and geotechnical monitoring (on a continuous (real time) basis) are undertaken.

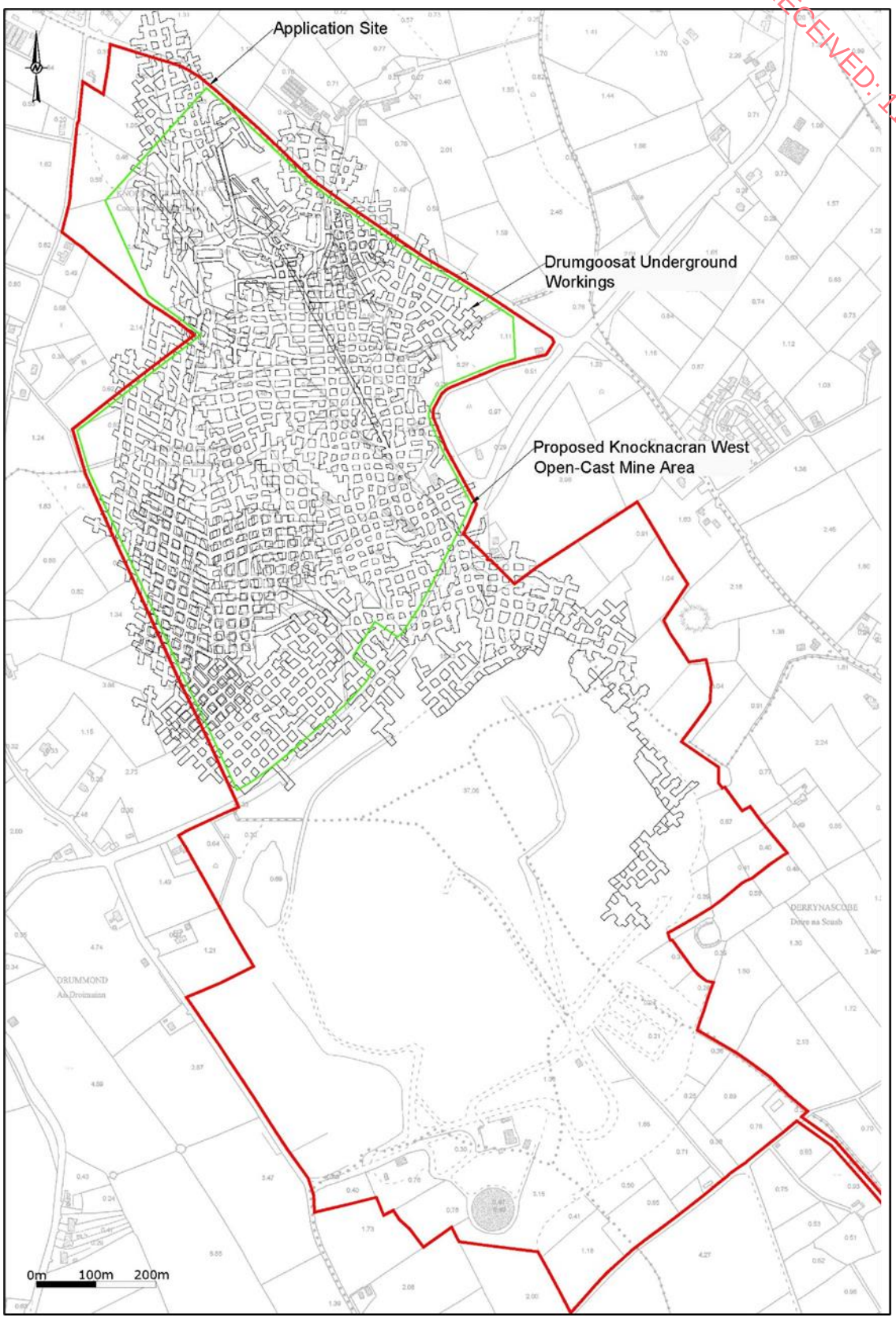


Figure 3.4: Plan showing extent of former Drumgoosat underground workings

3.3.3.2 Proposed Development of Knocknacran West Mine

The Proposed Development is for the extraction of gypsum from the site (the former Drumgoosat Underground Mine) using open-cast mining methods. Material will be extracted from the remaining pillars, overlying room beam / pillar and previously un-mined areas from both the Upper and the Lower Gypsum Units.

The construction stage of the development will see the construction of a Cut-and-Cover Tunnel beneath the R179 and the installation of a semi-mobile primary crusher (and ancillary services) on the Knocknacran West Mine site. A service area (including office/canteen and welfare facilities) will be constructed adjacent to the entrance of the Cut-and-Cover Tunnel. Appendix 3.2 provides a site suitability assessment for the proposed welfare facilities in line with EPA guidelines.

The tunnel will provide access for mobile mining plant, service vehicles, a covered conveyor system and haul road to the existing processing plant at Knocknacran.

Initially a contractor's 'yard' will be established in the northeast part of the Site (accessed through an existing entrance from the L4900). This area will be used during the construction phase of the Proposed Development (site clearance, security fence installation, planting, topsoil and overburden stripping for screening berm construction). Five other existing site entrances will act as points for emergency access and exit to the Site, and as access points for environmental monitoring (Figure 3.5).

As part of the construction phase of the proposed development, a new entrance on the existing Knocknacran Mine site will be constructed and will be used by employees, service vehicles and for the dispatch of materials off-site.

Having completed a Geological Resource Estimate and subsequent Preliminary Mine Design and Operational Schedule for Knocknacran West Mine, a life-of-mine (LOM) of ca. 30 to 35 years was estimated based on an average through-put of ca. 300,000 tonnes/year. While actual output in any year will depend on prevailing market conditions, the Proposed Development seeks to maintain permitted maximum extraction of 500,000 tonnes/year. The development will therefore not involve an increase in processing capacity, nor an increase in permitted traffic movements, as all traffic movements will be in keeping with current permitted movements for the existing operation. Based on supply and demand in the marketplace, the amount of trucks leaving the Site will vary throughout the year (refer to Chapter 14.0, Traffic).

Hydrogeological investigations undertaken as part of this EIAR (Chapter 8.0) predict that the maximum water discharge from the mine over its life, will be within the limits allowed on the current IE Licence (P0519-04) of 12,240 m^3/d.

Gypsum will be extracted by blasting from Knocknacran West to meet the current maximum vibration limit of 7.5 mm/s (peak particle velocity, or PPV) and air overpressure (AOP) limit of 125 dB (Lin) max peak in line/compliance with Reg. Ref 17/217 and with current EPA and DoEHLG Guidelines (Chapter 12.0 Vibration). Blasting will be carried out by qualified personnel to ensure these limits are adhered to. Blasting will take place approximately once every 2 to 4 weeks. All blasting on the Site will comply with Part 5 of the Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2008, as amended (updated guidance published April 2020).

It is considered that the recovery of the gypsum resource from a historical mine site (Drumgoosat) will be a more environmentally sustainable option than recovering gypsum from a greenfield site elsewhere.

The mine operational plan, including phasing is presented in Section 3.5 below.

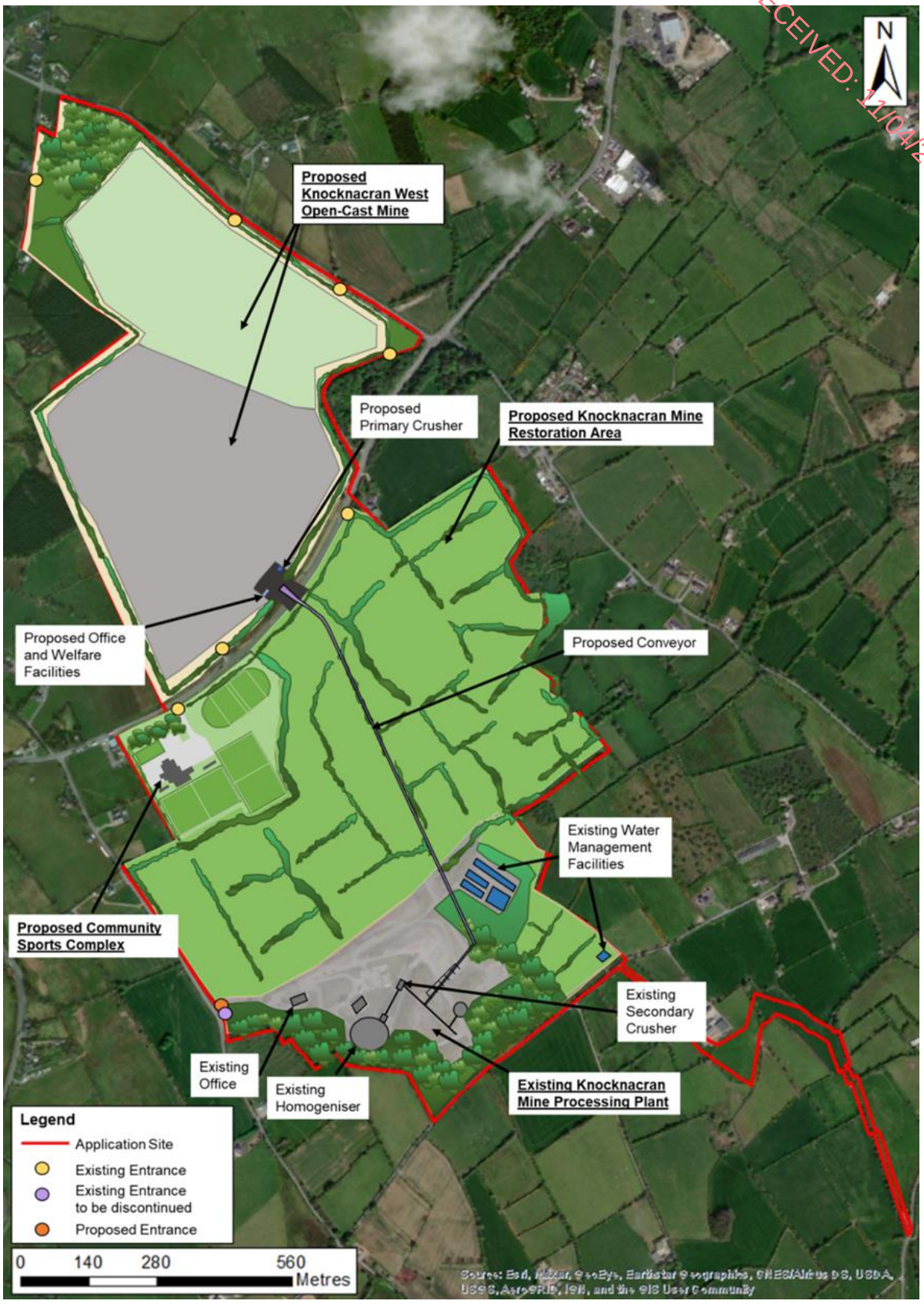


Figure 3.5: Proposed Site layout

3.3.4 Knocknacran Mine Restoration

3.3.4.1 Existing site Conditions

The Knocknacran Mine Restoration site encompasses the existing open-cast extraction area on the Knocknacran Mine site, in addition to some smaller grassland areas and fields surrounding the extraction area (Figure 3.2). The existing extraction area operates under planning Reg. Ref. 17/217. As part of this planning permission, phased restoration of the site is an ongoing process in areas where the resource has been exhausted. Therefore, the existing site conditions can vary rapidly due to the nature of phased operations at the site.

Extraction is currently active in the southern part of the open-cast and operations are permitted to 2027. When blasting of material is required, this typically takes place on average once every 2 to 4 weeks (depending on operational conditions), although in 2020 and 2021 this was more sporadic, due to Covid-19 when the site briefly closed.

3.3.4.2 Proposed Knocknacran Mine Restoration

As part of the proposed Knocknacran Mine Restoration, materials (overburden and interburden) stripped from the proposed Knocknacran West Mine will be transferred via haul truck through a Cut-and-Cover Tunnel under the R179 to the Knocknacran Mine to be used in phased restoration.

A restoration plan is currently in place for the existing Knocknacran Mine under Reg. Ref. 17/217, this allows for the restoration of the site to mixed-use agricultural land and a lake. The proposed restoration of Knocknacran Mine presented in this EIAR would revise the restoration plan currently permitted, to allow the Knocknacran Mine to be restored to agricultural land. A mixed-use area comprising agricultural land, woodland and a waterbody is proposed to be located on the Knocknacran West Mine site upon restoration.

It is proposed to restore the Knocknacran Mine to near original ground levels and provide agricultural land with mixed planting of native hedgerow species. On cessation of mining the conveyor will be removed, and the areas remediated and restored to agricultural land (refer to Appendix 3.3 for the proposed Closure, Restoration and Aftercare Management Plan (CRAMP) for the Knocknacran West Mine).

3.3.5 Knocknacran Processing Plant

3.3.5.1 Existing Site Conditions

The existing Knocknacran Processing Plant (Figure 3.5) is located to the south of the R179. The processing plant is currently used to process gypsum from the existing Knocknacran Mine and from the Drummond Mine before it is transported offsite, via truck to Saint-Gobain's plasterboard factory near Kingscourt, and cement companies as demand dictates.

3.3.5.2 Proposed Knocknacran Processing Plant

It is proposed to continue to use the processing plant (including water management facilities and ancillary structures) currently permitted to process gypsum from the proposed Knocknacran West Mine during its lifetime.

In addition to the construction of a covered conveyor from the Knocknacran West Mine, upgrading of the existing materials handling system at the processing plant site is proposed, to include the construction of a Tripping Conveyor, Reclaim Stockpile Conveyor, extension to the existing Rock Shed and ancillary infrastructure (see Section 3.7 for more details).

The processed gypsum will leave the Knocknacran Mine site onto the L4816 as is the current practice. As part of the Proposed Development, the existing site entrance will be relocated further north along the L4816 to achieve the required sightlines. Chapter 14.0 presents further details of the proposed entrance relocation.

3.3.6 Residential and Unoccupied Houses

One residential house and three unoccupied houses (with sheds) are located on the site of the proposed Knocknacran West Mine in the townlands of Knocknacran East and Knocknacran East (Figure 3.2). The houses are under the control of the Applicant.

As part of the Proposed Development these buildings will be demolished (Figure 3.2). as they lie within the footprint of the open-cast area.

3.3.7 Community Sports Complex

3.3.7.1 Existing site Conditions

The proposed Community Sports Complex site of ca. 8.6 ha is located to the south of the R179 and to the immediate west of the existing Knocknacran Mine site (Figure 3.5 and Figure 3.6). The first phase of the Community Sports Complex development has been completed and commissioned under Reg. Ref.: 20/365.

The area is not located over any areas which have previously been mined by underground methods. The eastern side of the site was formerly part of the open-cast Knocknacran Mine, but this has been backfilled to current ground levels.

3.3.7.2 Proposed Community Sports Complex

The Complex has been designed to cater for the Magheracloone Mitchells Gaelic Football Club's, and other users', current requirements, and future development strategy. The Complex can be accessed using an entrance (permitted under Reg. Ref.: 20/365) onto the R179 (see Chapter 14.0 for details related to traffic).

Reg. Ref.: 20/365 includes permission for a new playing pitch, dressing rooms, welfare facilities, parking and associated drainage/wastewater infrastructure on the Community Sports Complex site. This permission includes permission for the final site access, adequate parking, water treatment and attenuation, and all necessary services for the full development.

Presented below is a summary of the permitted and proposed outdoor and indoor facilities associated with the overall development of the Community Sports Complex.

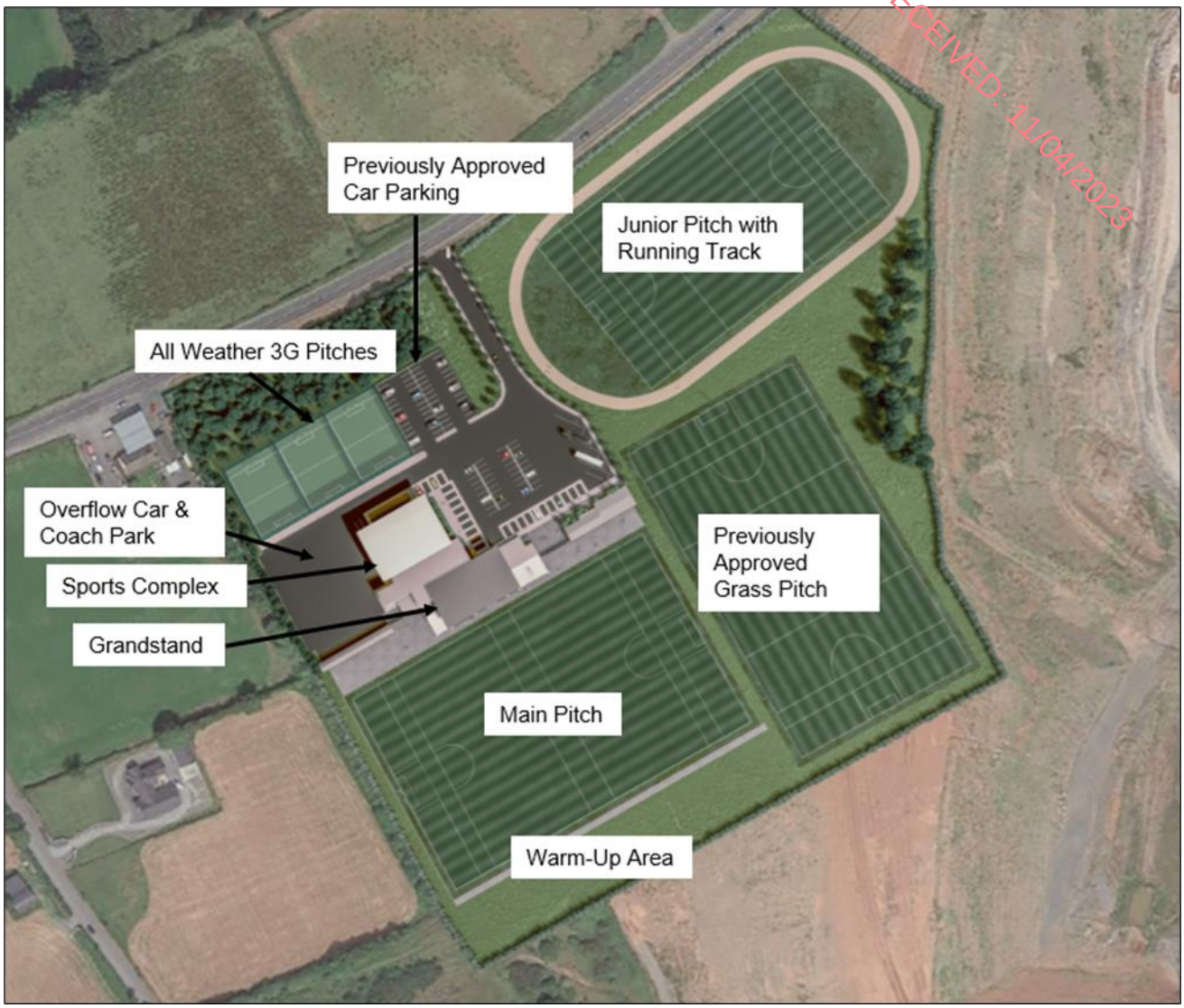


Figure 3.6: Layout showing the overall Community Sports Complex

Permitted under Reg. Ref. 20/365

- Access from the R179 via gates on entrance pillars leading to an internal roadway, boundary fencing, car and coach parking and set down area;
- Practice Pitch: Consisting of a sand-based pitch measuring 145 m x 80 m with 3 m run-off, complete with goals, ball-stops, spectator fencing, dug-outs and floodlighting;
- Single story dressing rooms and toilets; and
- Water management and attenuation system.

Proposed Facilities

- Main playing pitch: Consisting of a sand-based pitch measuring a minimum of 142 m x 90 m with 3 m run-off complete with goals, ball-stops, spectator fencing, and dug-outs;
- Junior Pitch: Consisting of a sand-based pitch measuring 130 m x 80 m with 5 m running track, complete with goals, ball-stops, spectator fencing and dug-outs;

- All Weather Pitches: Three 3G pitches complete with goals, fencing and floodlighting;
- Walking Track: Consisting of a 2.4 m wide edged dust track around the site perimeter;
- Security Fencing: Consisting of a 2.4 m high paladin type fencing along all boundaries in black or holly green augmented / softened with landscaping in appropriate locations;
- Proposed facilities building (see details below); and
- Main Pitch Grandstand: Consisting of a covered grandstand with seating capacity for minimum of 300 spectators and open terracing either side.

Proposed Facilities Building

The proposed facilities building complex is sited centrally to act as a visual buffer and as a spectator management barrier between the R179 and the main pitch (Figure 3.6). Its location minimises travel distance from the changing rooms to the external facilities.

The first-floor gallery overlooks the main pitch and provides a backdrop for the covered spectator stand. Details of the buildings are provided below.

Ground Floor

- Double height reception with Club shop leading to multipurpose sports hall suitable for winter training, indoor sports and large events, complete with large storage area;
    - Handball Alley;
    - Gymnasium;
    - Two senior changing rooms equipped with communal shower;
    - Four changing rooms equipped with shower cubicles suitable for Female and Juniors; and
    - Two Match Officials changing rooms.

All changing rooms will be fully disabled compliant.

- Physio and First Aid rooms;
- Public Toilets; and
- Storage.

First Floor

- Open landing / gallery leading to viewing gallery's to multipurpose hall and Handball Alley;
- Three meeting rooms;
- Club Room with open view to main pitch, access to grandstand, kitchen and storage;
- Public Toilets; and
- Storage.

First floor will be accessed by lift and stairs and will be fully accessible to all.

Single Storey Satellite Building

- Remote changing rooms;

- Shop;
- External public toilets;
- Plant rooms; and
- Storage.

Community Sports Complex Lighting Proposals

The proposed Community Sports Complex will incorporate limited additional lighting proposals to those already permitted for development under Reg. Ref. 20/365. There will be lighting to cover the additional car parking area as part of the current proposals as well as low level floodlighting to cover the all-weather (3G) pitches. These elements of new lighting will be screened by proposed and existing landscaping and located at some distance from residential properties.

Construction of Community Sports Complex Development

Subject to planning permission, the construction of the remaining playing pitches and facilities is intended to commence in 2024. The construction period for the pitches is estimated to be six to nine months, with a subsequent establishment period of one year before the pitches are playable.

The remaining building and ancillary works will be undertaken during the pitch's establishment period, with all construction expected to be completed by 2026.

An initial surface water drainage report was prepared during the first phase of this Community Sport Complex, which has been granted planning permission under Reg. Ref.: 20/365. The initial surface water drainage proposal was designed taking into account that the development will consist of multiple stages. It was sized so that the runoff surface water from all impermeable surface areas from all phases of the development can be managed by the system designed. It is proposed that the surface water discharge from the proposed second phase of the Community Sports Complex development be connected to the recently constructed surface water drainage system as designed in the Storm Water Drainage Proposal Report as granted permission under Reg. Ref.: 20/365. Appendix 3.4 provides the Storm Water Drainage Proposal Report which details the breakdown of the impermeable surfaces over different phases of works. Included in the appendix are revised layout drawings detailing the connection points from the impermeable surfaces from the next phase of works to the recently constructed surface water drainage system.

3.4 Mine Construction Phase

As presented above the proposed Mine Development includes a **construction phase,** followed by an **operational mining phase,** and a subsequent **restoration phase** (although ongoing restoration will take place during the life of the mine during its operational phase). Figure 3.7 presents a schematic cross-section through the gypsum deposits underlying Knocknacran West highlighting the construction and operational phases of the proposed Mine Development.

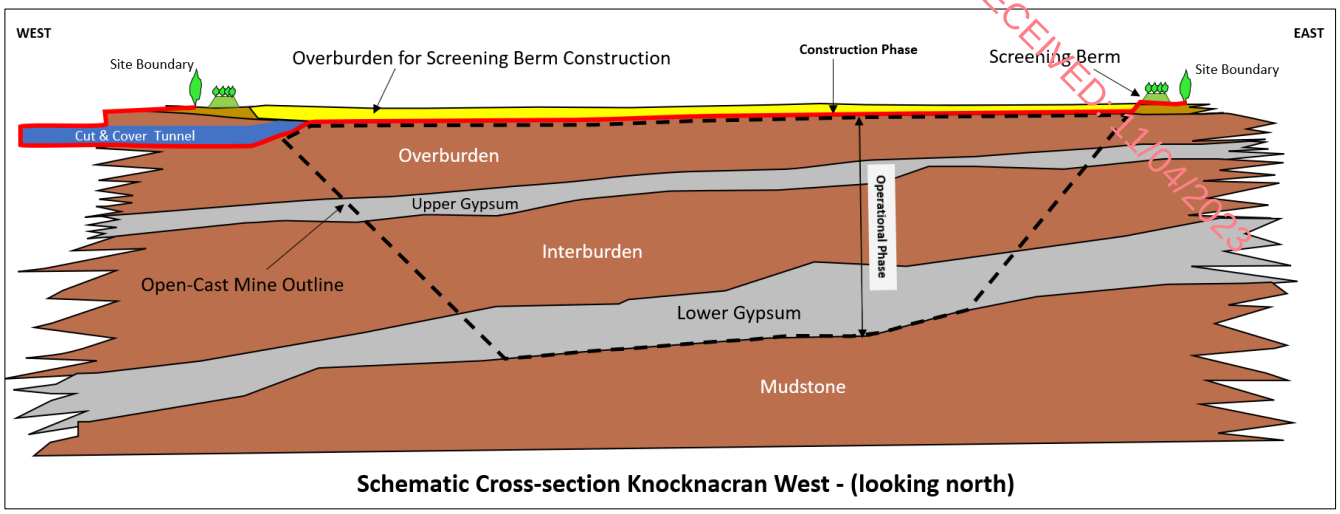


Figure 3.7: Schematic Cross-section Knocknacran West showing Construction & Operational Phasing

The construction phase of the Mine Development will comprise the erection of perimeter security fencing, the construction of a Cut-and-Cover Tunnel under the R179, and the stripping of superficial materials (including topsoil and overburden) for the construction of screening berms around the permitter of Knocknacran West. As part of the enabling works for construction of the Cut-and-Cover Tunnel, a temporary diversion of the R179 will be required, this will be in place for ca. 6 to 9 months (Figure 3.8), and will allow free traffic movement along the R179 at all times during the construction of the tunnel. The diversion will be located to the north of R179 with a 60 km/hr speed limit. Refer to Appendix 3.5 for a Design Report on the Temporary Road Diversion and Cut-and-Cover Tunnel design.

Approximately 200,000 t of stripped material will be used to construct the perimeter screening berms around the Knocknacran West site. Materials will be stripped from areas in close proximity to the screening berms so as to minimise disturbance to existing hedgerows and habitat. The timing of the removal of hedgerows will be under the guidance of a qualified ecologist, and in agreement with the Local Authority. Existing perimeter hedgerows will be bolstered (planted where gaps exist) during this phase.

The woodland between the proposed extraction area and the village of Drumgoosat will be left largely intact and enhanced with additional native planting to improve screening. Screening berms around the perimeter of the Knocknacran West Mine site will be 2 m in height for the majority of the site, with 4 m high berms being proposed for the western and southern perimeter of the site adjacent to, and in view of the R179.

Figure 3.8: Knocknacran West and Knocknacran - Construction Phase

Screening Berms

Prior to the construction of the screening berms an earthworks contractor will be engaged through a tender process, and subsequently mobilised to site to set-up a secure temporary compound to accommodate supervisory offices, welfare facilities and plant parking (the location of which will vary throughout the life of the mine as each stripping campaign is undertaken).

Initially, it is proposed to construct screening berms inside a newly constructed security fence around the perimeter of the Knocknacran West site by stripping topsoil and overburden (superficial materials) (Figure 3.8).

The existing hedgerow around the perimeter of the site will be enhanced (i.e. 'thickened-up') with the planting of additional native hedgerow species. The screening berms will be constructed on the Knocknacran West Open-Cast Mine site to mitigate against noise and potential dust emissions from operations, as well as to offer continued reduced visibility of the site from the public road network and surrounding lands. Berms will be constructed using superficial materials stripped from the extraction area. Figure 3.9 presents a schematic cross-section of the proposed generic boundary treatment for the Knocknacran West Mine site.

In addition, upon construction, the proposed berms will be planted in a native woodland mix. As this mix will be planted with advanced nursery stock, the trees are likely to reach ca. 6 m height within a 4-5 year period, resulting in at least an 8 to 10 m-high 'green' screen surrounding the Knocknacran West Open-Cast Mine boundary.

The screening berms will be left intact for the life of the mine and in perpetuity to provide biodiversity to the local environment.

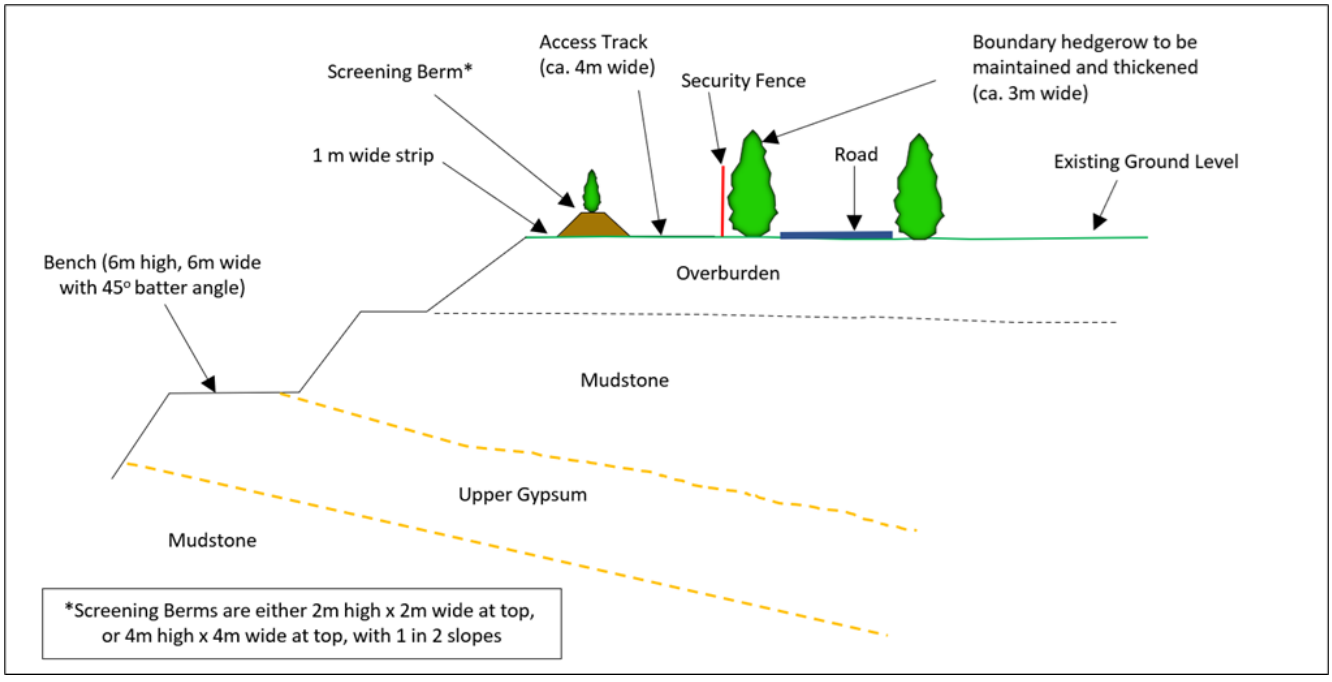


Figure 3.9: Schematic cross-section of generic boundary treatment for the Knocknacran West Mine site

Demolition and Waste Management

As part of the Construction Phase of the development one residential house, a 1980s bungalow will be demolished. It has been agreed with the occupiers of this property that they will relocate to an alternative

house in the local area. In addition to the one residential house to be demolished, three unoccupied houses and sheds will also be demolished (Figure 3.10).

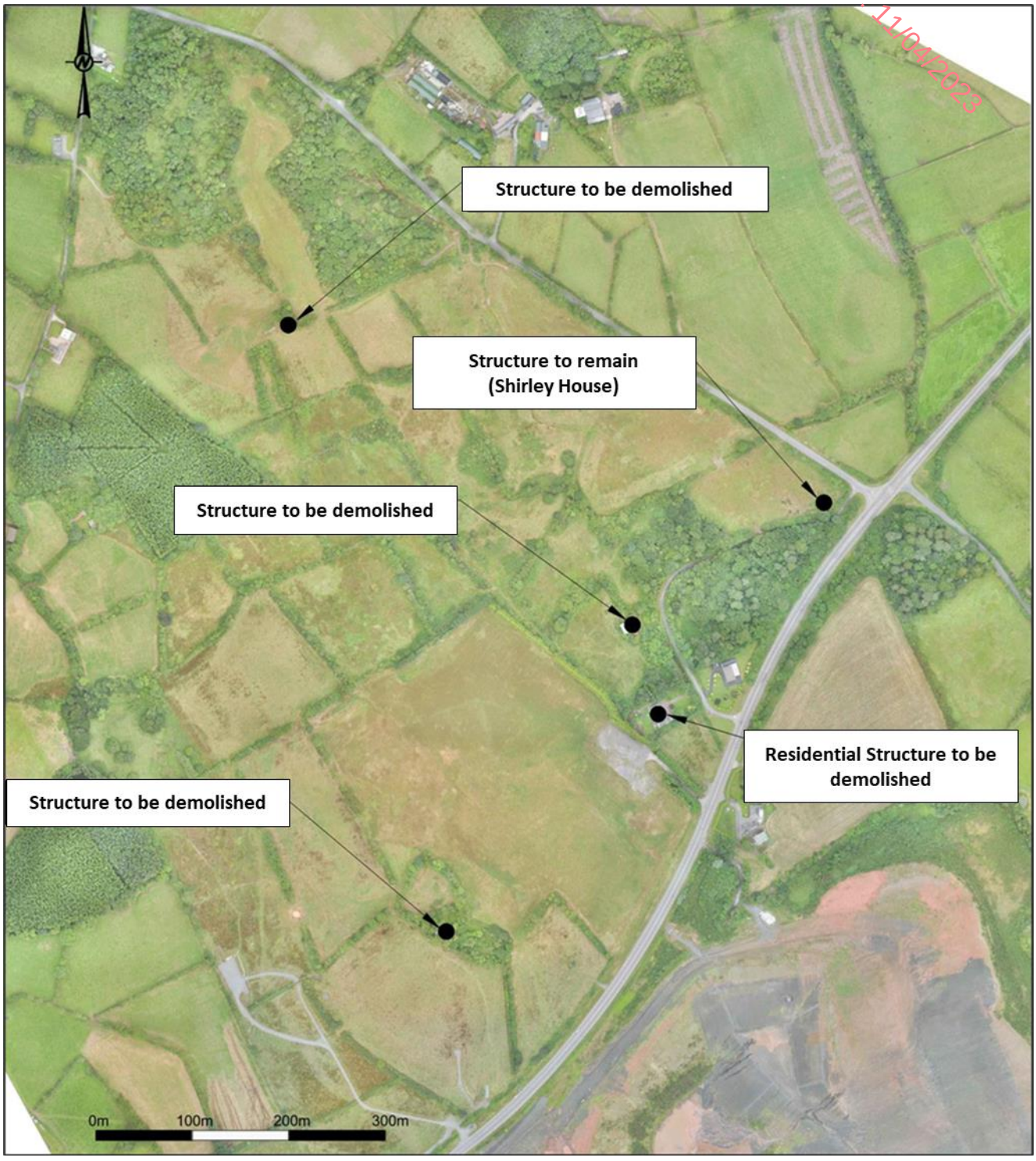


Figure 3.10: The proposed development and structures to be demolished

A specialist demolition waste contractor will also be appointed by the Applicant to oversee waste streams on the site, and their appropriate and authorised removal from site during demolition works, should materials not be salvaged and re-used on site for restoration purposes.

Segregation of waste streams will occur on site during demolition works. Inert materials comprising concrete, blockwork and rock fill will be separated and stockpiled for re-use as restoration backfill. Timber will be segregated into separate skips onsite, other wastes (e.g., bulky waste) will be placed in a combined skip for handling at an authorised waste facility. Valuable materials such as cut building stone and natural roofing slates will be removed carefully to avoid damage and make available for re-use.

Any demolition of buildings with potential to support nesting birds will be undertaken outside of the bird nesting season. If there is a necessity for demolition of buildings within the nesting season, a suitably qualified Ecologist will carry out a series of nesting bird checks in advance of any works to ascertain breeding activity in affected areas.

A Resource Waste Management Plan (RWMP) had been prepared for the proposed Mine Development (Appendix 3.6). This plan has replaced the 'Construction and Demolition Plan and By-Products Management Plan' in accordance with the 'Best Practice Guidelines for the Preparation of Resource & Waste Management Plans for Construction and Demolition Projects' (EPA 2021). The RWMP will be revised and updated once a demolition waste contractor has been appointed subject to approval by the relevant authorities. An initial asbestos survey was undertaken on 16th August 2022 by About Safety Ltd. on the four structures to be demolished on the Knocknacran West site. The survey report is included in Appendix 3.6. Asbestos has been confirmed in three of the structures, in insulation board, slate strips on gables, gaskets, pipe and cowl, roof sheeting and gutter. A specialist asbestos contractor will be engaged to remove this material during demolition works, and dispose of it in the correct manner.

The RWMP will be revised and updated once a demolition waste contractor has been appointed subject to approval by the relevant authorities.

With regard to the retention of the demolition waste arising from the former GAA facility, which was used for backfilling fissures and crown holes, Golder prepared a CQA Validation Report for the *'Remediation of Disturbance Zone: Magheracloone GAA Grounds'* (Appendix 3.1). The CQA report details the pre-works surveys that assessed the waste streams from the demolition works, and subsequently assessed the suitability of waste streams onsite; including assessing inert materials (concrete, blockwork and rock fill) which were suitable for re-use as backfill in crown holes and fissures. The inert material was separated onsite and stockpiled in advance of re-use in crown holes. Other waste material, which was unsuitable to be used as backfill, was sent offsite to a licenced facility for disposal. Subject to receipt of an IE Licence from the EPA, and following initial stripping this inert material from backfilled fissures and crownholes will be segregated and stockpiled for re-use as capping for site access roads and compound yards.

Temporary Road Diversion (R179) and Cut-and-Cover Tunnel

The development of gypsum mining at the proposed Knocknacran West Mine will involve the construction of a Cut-and-Cover Tunnel under the main Carrickmacross to Kingscourt regional road (R179). The construction of the tunnel will necessitate the temporary diversion of the R179 for a period of 6 to 9 months, during which time the free flow of traffic will continue along a specially constructed temporary road diversion of the R179 (Figure 3.8). The tunnel will allow for the transport of gypsum (by haulage truck and covered conveyor) to the existing processing plant at Knocknacran Open-Cast Mine, and for the transport of overburden and interburden (by haulage truck) to the Knocknacran Open-Cast Mine for restoration purposes. The proposed tunnel will allow for free flow of mine operational traffic and material between existing

(Knocknacran Mine and Plant Site) and future areas (Knocknacran West Mine) while removing interaction with existing R179.

The design of the temporary road diversion takes into account the location of the extensometers used for monitoring potential roof beam movement in the underlying underground mine workings, while allowing for the tunnel to be constructed in one phase. A copy of the Trigger Action Response Plan (TARP) associated with the extensometers for the R179 is provided in Appendix 7.7.

A Design Report, drawings and supporting documentation outlining the proposed crossing of the R179 is provided in Appendix 3.5. Each of the in-road services providers have been contacted and details of their services are discussed in Chapter 16.0 (Material Assets). In addition, correspondence from each of the service providers is also provided in Chapter 2.0 (Scoping) as part of the scoping process. The PDR includes information and plans dealing with the following items:

- Details of the proposed make-up of the temporary road diversion and design standards, including drainage;
- Details of the proposed design speed and design standards to be used;
- Carriageway cross-section;
- Structural design;
- Location of in-road services;
- Fencing, Lighting, Signage and Road Markings; and
- Road Safety Audit for the temporary road design.

The proposed tunnel structure will consist of two buried parallel precast reinforced concrete UAN box tunnels providing for mine access underneath the existing R179. The proposed structure will have a clear span of 7 m for the Main Access Tunnel (for haulage of overburden and interburden during stripping campaigns, and main access), and 5 m for the Parallel Access Tunnel (for the transport of gypsum to the Plant Site by covered conveyor) respectively. The structure will have an internal height of 5 m, and an overall length of ca. 36 m. At each end, there will precast reinforced headwalls and precast reinforced wing walls.

Approach to the proposed tunnel structure will follow the horizontal and vertical alignment requirements of the reinstated R179, tying into the proposed structure at a level governed by the vertical alignment of the proposed Knocknacran West Open-Cast Mine access.

It is proposed that the Vehicle Restraint System (VRS) for the structure will be an N2 Safety Barrier on both verges of the mainline over the structure, which will comply with DN-REQ-03034 (formerly NRA TD 19) and IS EN 1317. Pedestrian protection will be provided at the top of the headwalls and wingwalls in accordance with DN-STR-03011 (formerly BD 52).

Appendix 3.5 provides a Design Report for the proposed Temporary Diversion Road and the proposed Cut-and-Cover Tunnel below the R179. Section 6.13 of Appendix 3.5 presents commentary on the closure of the tunnel following cessation of mining and restoration of the site. Appendix 3.7 provides a Geotechnical Interpretative Report to support the design of the proposed Temporary Diversion Road and proposed Tunnel below the R179.

All traffic management requirements will be agreed with the appointed Contractor and Monaghan County Council.

Construct new mine entrance from the L4816

A replacement vehicular access to the existing Knocknacran Open-Cast Mine and Knocknacran Processing Plant site from the L4816 will be constructed to improve sightlines.

3.5 Mine Operational Phase

As part of the operational phase of the mine, overburden and interburden will be removed (stripped) to access the gypsum on the Knocknacran West site, in the same manner as that currently undertaken at Knocknacran Open-Cast Mine.

The point at which the operational phase of the development will begin is once the Cut-and-Cover Tunnel has been constructed and commissioned, allowing the movement of material through the tunnel from the Knocknacran West site to the existing Knocknacran site for restoration purposes (refer to Section 3.4 above).

A materials handling economic trade-off assessment was undertaken and established that in-pit primary crushing with crushed gypsum being transferred to the processing plant via a series of conveyors through a Cut-and-Cover Tunnel was the optimal solution for the development of Knocknacran West.

It is intended to extract gypsum (by blasting) from the proposed Knocknacran West Open-Cast Mine, which has an overall footprint of ca. 54.3 ha for mining activities.

Approximately 12 Mt of stripped materials, comprising overburden and interburden (mudstone and dolerite) will be transported on haul roads, through the Cut-and-Cover Tunnel and used to backfill the existing open-cast at Knocknacran Mine. The balance of the stripped materials, making up approximately 16.5 Mt, will be deposited in the northern pit area of the Knocknacran West Open-Cast as part of the mine's phasing sequence. Upon the completion of extraction of gypsum from Knocknacran West Mine, a portion of the stripped materials will be used to profile and remediate the open-cast.

Approximately 9 Mt of gypsum (and anhydrite) from the Upper and Lower Gypsum Units will be hauled to a semi-mobile primary crusher on the pit floor, before being transported by covered conveyor to the Knocknacran Processing Plant site via the Cut-and-Cover Tunnel, under the R179, for processing prior to being transported off-site by truck.

3.5.1 Operating Hours

It is proposed that the operating and maintenance hours for the proposed Knocknacran West Mine will be from 08:00 hours to 20:00 hours Monday to Saturday. Pump inspections will take place as required. Transport and processing of gypsum from the Knocknacran Processing Plant will continue to take place between 06:00 hours and 21:00 hours Monday to Saturday.

Extraction, movement and placement of overburden and interburden as part of the phased restoration of the site will take place between 08:00 hours to 20:00 hours Monday to Saturday, during striping specific campaigns as dictated by market conditions.

No blasting will take place on Sundays or Public Holidays.

The mine site will not be operated on Sundays or Public Holidays.

3.5.2 Staffing and Manning

Mine site operations generate employment for up to 40 full-time personnel, with a number of additional sub-contractors (up to ca. 45 at any one time) depending on operational needs. Indirect site employment is generated by contract overburden removal/stripping, contract drilling and blasting, suppliers of products and

services such as fuel and oil and machinery suppliers. The current permitted gypsum mining at the Knocknacran Mine (and Drummond mine) site is a fundamental part of the historic gypsum mining that has taken place at this location. The mine sites provide the only accessible and commercially operated gypsum reserve in Ireland, supplying an essential raw material to a number of significant manufacturing industries on the island of Ireland.

In particular, gypsum is the primary ingredient for construction products. Gypsum is used for the manufacture of plasterboard and plaster products. The existing mine operations directly support a further ca. 165 direct employees at their sister facility near Kingscourt. Gypsum is an essential ingredient for cement and resultant concrete and concrete products, with SGMI being a key supplier to cement manufacturers on the island. Cement Manufactures Ireland (CMI) the independent trade organisation, part of IBEC, estimated in 2016 that the cement industry in Ireland directly and indirectly supported upwards of 2,000 jobs.

3.5.3 Drilling and Blasting

Normally no drilling and blasting of the interburden (mudstone and dolerite) material is expected due to the normally soft and semi-consolidated nature of the material.

The gypsum from both the Upper and Lower Units will require drilling and blasting due the competency of the rock. Conventional drilling followed by blasting will be employed, with blasting volumes individually tailored to each blast to ensure compliance with noise and vibration limits. Blasted rock that exceeds 800 mm in diameter will be stockpiled close to the operating face and broken up to less than 800 mm by an excavator with a hydraulic rock breaker tool.

Drilling and blasting will be undertaken by a specialist contractor. Holes will be drilled to a depth of ca. 20 m at optimal burden and spacing and filled with appropriate explosive products. The blast volume will be restricted to ensure compliance with vibration and noise limits and explosive initiation will be carried out using Nonel (non-electric) methods. Chapters 11.0 (Noise) and 12.0 (Vibration) of this EIAR present mitigation measures in relation to the blasting of gypsum in the proposed mine.

Blasting of the gypsum is expected to take place once every 2 to 4 weeks, as drilling and blasting frequency varies with gypsum demand.

3.5.4 Mine Water Management

The water management system for the current Knocknacran Mine, Drummond Mine and adjacent plant site/associated infrastructure is operated to comply with the conditions of IE Licence P0519-04, by controlling the quality and the quantity of water being discharged offsite.

The water level in the former Drumgoosat workings will be managed by a dewatering well (the Drumgoosat well) Water will be pumped from the Drumgoosat well on the Knocknacran West site to the existing settling pond area on the Knocknacran site via the Cut-and-Cover Tunnel.

The water inflow into Knocknacran West Mine will be derived from rainfall and sub-surface water. A water management plan will be implemented which will be based on the predicted volumes of water that will be generated within the open-cast on a bench-by-bench basis as the open-cast footprint is extended.

The water at the base of the developing open-cast will be channelled via trenches and canals, towards a main sump area. A pump sized to cater for the predicted water volume will pump the water from the sump through a pipe via the Cut-and-Cover Tunnel to the existing settling pond area.

Section 8.4.7 of this EIAR presents a Water Management System for the Site as a whole, with Sections 8.6.2.1, 8.6.4.3 and 8.6.6.4 of the same chapter providing a description of the Water Balance for the Site.

3.5.5 Geotechnical Design of Knocknacran West

The geotechnical parameters of the materials underlying the site have been well established by previous work. During 2018 and 2019 Golder conducted additional borehole, sampling and laboratory testing to confirm the stratigraphy and material parameters associated with the proposed Knocknacran West Mine.

A total of 9 representative cross-sections around the perimeter of the proposed Knocknacran West Mine were selected for stability analyses to meet the design criteria for a Factor of Safety (FoS) of 1.5 for the overall open-cast slope. The cross-sections were created using a combination of logs from previous boreholes within the footprint of the proposed open-cast mine and logs from the Golder 2018-2019 ground investigation / monitoring well drilling programmes. In all cases the cross-sections are developed from existing ground surface to the top of the Lower Seam Gypsum unit.

The following slope stability cases were analysed:

- An inter bench slip surface for the different strata; and
- An overall slope slip surface.

In summary, based on a review of historical data and recent slope stability analyses (using limit equilibrium modelling software SLOPE-W version 10.0.2.1001) carried out by Golder, the FoS varies from between 1.5 to 2.3 for the overall open-cast slope, and from 1.2 to 2.5 for the inter bench which meets design criteria FoS values. The proposed Knocknacran West Open-Cast Mine will be developed on a phased basis, which will require detailed design of the long-term perimeter slopes and the short-term internal slopes. These detailed designs will be optimized to extract the Lower Gypsum Unit and maintain the required FoS and thus may have shallower or steeper overall slope gradients depending on the nature of overburden materials present in that phase footprint. Appendix 7.12 provides a copy of the Knocknacran West Pit Slope Stability Preliminary Assessment report (Golder 2019).

Section 7.6 of this EIAR presents a discussion on Geohazards (Ground Stability) for the Proposed Development as a whole, including the implementation of a Trigger Action Response Plan (TARP) for both the L4900 and R179.

3.5.6 Mine Plan - Operational Phases

The proposed operational phases (extractive and restoration) to be undertaken as part of the mining activities are presented below. A Construction Environmental Management Plan (CEMP) will be developed on foot of a grant of permission being received. Versions of this document will be further developed by the Contractor as the Project goes through the construction phase.

Initially, it is proposed to expose the Upper and Lower Gypsum Units in the northeastern part of the Knocknacran West Mine site (adjacent to the L49000) by stripping overburden and interburden in a south-westerly direction, as the gypsum is closest to the surface in the northeastern part of the site, and dips from the northeast to the southwest across the site, getting deeper to the southwest.

The gypsum will be mined taking into account the Design Criteria. Regular daily inspections on bench (and haul road) integrity will be carried out by mining personnel under the guidance of a geotechnical engineer. Gypsum blasted from the open-cast benches will be hauled by truck to a semi-mobile crusher on the open-cast floor before being fed onto a series of covered conveyors for transportation under the R179 via a Cut-

and-Cover Tunnel to the existing Knocknacran Processing Plant. Subsequently, the crushed gypsum will be homogenized before being despatched from site.

A summary of the proposed Mine Development phases is provided below in Section 3.5.7. For mine planning and scheduling purposes, the life of the proposed Knocknacran West Mine is taken to be ca. 30 to 35 years, based on a gypsum mineral resource of ca. 9 Mt, being mined at a rate of ca. 300,000 t/yr. The extraction of the gypsum will necessitate the striping of ca. 28.5 Mt of Overburden and Interburden (primarily mudstone and dolerite rock) to be used in the phased restoration of the existing Knocknacran Open-Cast Mine and the Knocknacran West Mine subsequently. Figure 3.21 and Figure 3.22 provide the location of key infrastructural items associated with the proposed mining development.

Topsoil and overburden/interburden will be stripped on a phased basis during specific 'stripping campaigns' as market conditions dictate to expose gypsum as the mine develops in a westerly direction. Initially the materials stripped will be used in the continued phased restoration of the Knocknacran Mine and subsequently in the restoration of the Knocknacran West Mine. Interburden stripped in the latter phases of the development of the Knocknacran West Mine will be stockpiled in the eastern part of the Knocknacran West site for use in final restoration on cessation of mining.

Design Criteria

The design of the proposed open-cast mine is based on the criteria presented below and follows the HSA's 'Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2008' (April 2020). Key findings from the geotechnical slope stability analyses for the proposed open-cast mine (Appendix 7.12) have informed the design of the open-cast:

- Benching in overburden to base of overburden (i.e. the rock-head);
- 6 m high benches with 6 m benches widths, and a 45o batter angle on bench faces in the interburden (and a batter angle of 27o in the overburden). Geotechnical parameters are supported by extensive operational data from the existing Knocknacran Open-Cast Mine and geotechnical analysis of borehole data within the new development area (refer to Chapter 8.0, Section 8.xxxx);
- The installation of drainage channels on each bench to form part of the overall water management system for the excavation throughout its life;
- Maintain bench height where design, ground/geotechnical conditions and regulations/guidelines allow;
- Safety berms/edge protection designed at 1.5 x or higher than the radius of the largest wheel/tyre;
- Haulage ramp width designed at 17 m (including a safety berm and drainage channel) to allow for comfortable two-way passing of dump trucks; and
- Haulage ramp to have a gradient of no greater than 10%.

The operating processes involved in the mining of the gypsum will continue to include the following:

- The use of hydraulic excavators and dump trucks to remove topsoil, overburden and interburden;
- The extraction of gypsum in a series of benches primarily by blasting;
- The use of rock-breakers to carry out secondary breaking of over-size material;
- The transportation of broken rock by dump truck to a semi-mobile in-pit primary crusher, where it is crushed to minus 150 mm;

- The delivery of the minus 150 mm material by covered conveyors, via a Cut-and-Cover Tunnel beneath the R179, to a secondary crusher at the existing Knocknacran Processing Plant site that will crush the gypsum to minus 75mm;
- The minus 75 mm material will be sampled on a regular tonnage basis, to establish gypsum grade and quality, before being conveyed to the homogenizer and loading bin for transport to the plaster and plasterboard facility near Kingscourt;
- A chute diversion will be installed after the sampler to allow for anhydrite-rich cement quality rock to be conveyed to the existing rock shed for sale into that market; and
- The existing Texas Instruments PLC and SCADA operating system will be re-placed with a new centralised PLC/SCADA system with remote access to ensure optimum operational efficiency of the plant components.

The proposed phases to be undertaken at the mining sites (i.e. Knocknacran Mine, Knocknacran West Mine and Knocknacran Processing Plant) are presented below (Section 3.5.7).

The current water management system in operation at the Knocknacran Mine consists of two separate systems, one for water which comes into contact with the gypsum (characterised by high concentrations of sulphate and conductivity) and one for water which does not come into contact with the gypsum. Initially the development of the Knocknacran West Mine will necessitate the continued use of the existing in-pit sump system on the Knocknacran Mine site adjacent to the proposed conveyor route way. As the Knocknacran West Mine is developed an in-pit sump system will be developed within Knocknacran West Open-Cast Mine, replacing the in-pit sump system in the existing Knocknacran Mine over time. A water balance and proposed water management plan for the Site as a whole is presented in Chapter 8.0, Water.

3.5.7 Mine Operational Phasing

The Knocknacran West Mine will be developed in a series of phases; a construction phase followed by an operational mining phase, and a subsequent restoration phase (although ongoing restoration will take place during the life of the mine during its operational phase).

The operational phase can be divided into further operational phases of the proposed development based on process plant blending requirements in conjunction with optimised overburden/interburden stripping to ensure a consistent supply of high-quality gypsum[3].

The point at which the operational phase of the development will begin is once the Cut-and-Cover Tunnel has been constructed and commissioned, allowing the movement of material through the tunnel from the Knocknacran West site to the existing Knocknacran site for restoration purposes.

For the purposes of presenting the operational phase of the proposed Mine Development, the life of the mining operation at Knocknacran West has been further divided into a number of operational phases 1 to 6; these are presented below. In addition, Appendix 3.8 provides the phasing of the mining and restoration phases for Knocknacran West with regard to the progressive deepening of the Knocknacran West open-cast and its subsequent restoration.

[3] Quantities of overburden, interburden and gypsum are design estimates. Actual quantities of materials extracted will depend on market and mining conditions throughout the life of the mine.

Mine Operational Phase 1 (Years 1 and 2)

Approximately 2 Mt of overburden and interburden material will be stripped over the initial 2-year period and this will be undertaken by a contractor.

The stripped material will be used to construct the haul road and conveyor routing across the existing Knocknacran Mine.

A detailed breakdown of the activities proposed for Phase 1 of the development is presented below.

- Mobilise earthworks contractor to site and set-up:
    - A hardstand area to facilitate parking of subcontractor vehicles (private) and receipt of consumables for the earthworks; and
    - A secure temporary compound to accommodate supervisory offices, welfare facilities and plant parking (the location of which will vary throughout the life of the mine as each stripping campaign is undertaken);
- Commence overburden and interburden stripping to expose gypsum;
- Install open-cast mining infrastructure on the northern (Knocknacran West) side of the tunnel. Infrastructure will include:
    - Office unit and lunch room;
    - Welfare facilities comprising toilet and wash hand basin (see Appendix 3.2 for site suitability assessment report);
    - First aid station (including safety shower and eye-wash); and
    - 1MVA transformer and associated infrastructure within a fenced-off area. The transformer will provide power and lighting to the semi-mobile in-pit crusher and facilities;
- Commence construction of overland conveyor and haul-road routing across existing Knocknacran Open-Cast Mine from materials currently stored at Knocknacran from previous mining activities;
- Install tripping conveyor, conveyor stockpile bins and stockpile re-claim conveyor at Knocknacran plant site;
- Install semi-mobile crusher;
- Complete conveyor and road routing across existing Knocknacran Mine and install tunnel and overland conveyor link to tripping conveyor;
- Install and commission new PLC and SCADA to control, monitor and provide technical information for existing process plant and upgrades, including all conveyors from the semi-mobile crusher; and
- Commission semi-mobile crusher, conveyors and processing plant.

Section 3.7 provides detail on the main infrastructural elements of the materials handling and processing plant.

A fleet of (50/75 t) excavators, (40 t) ADTs (Articulated Dump Trucks), bulldozers, graders, tractors, bowsers and rollers will be used to undertake this phase of the work. Phase 1 is shown in Figure 3.11 below.

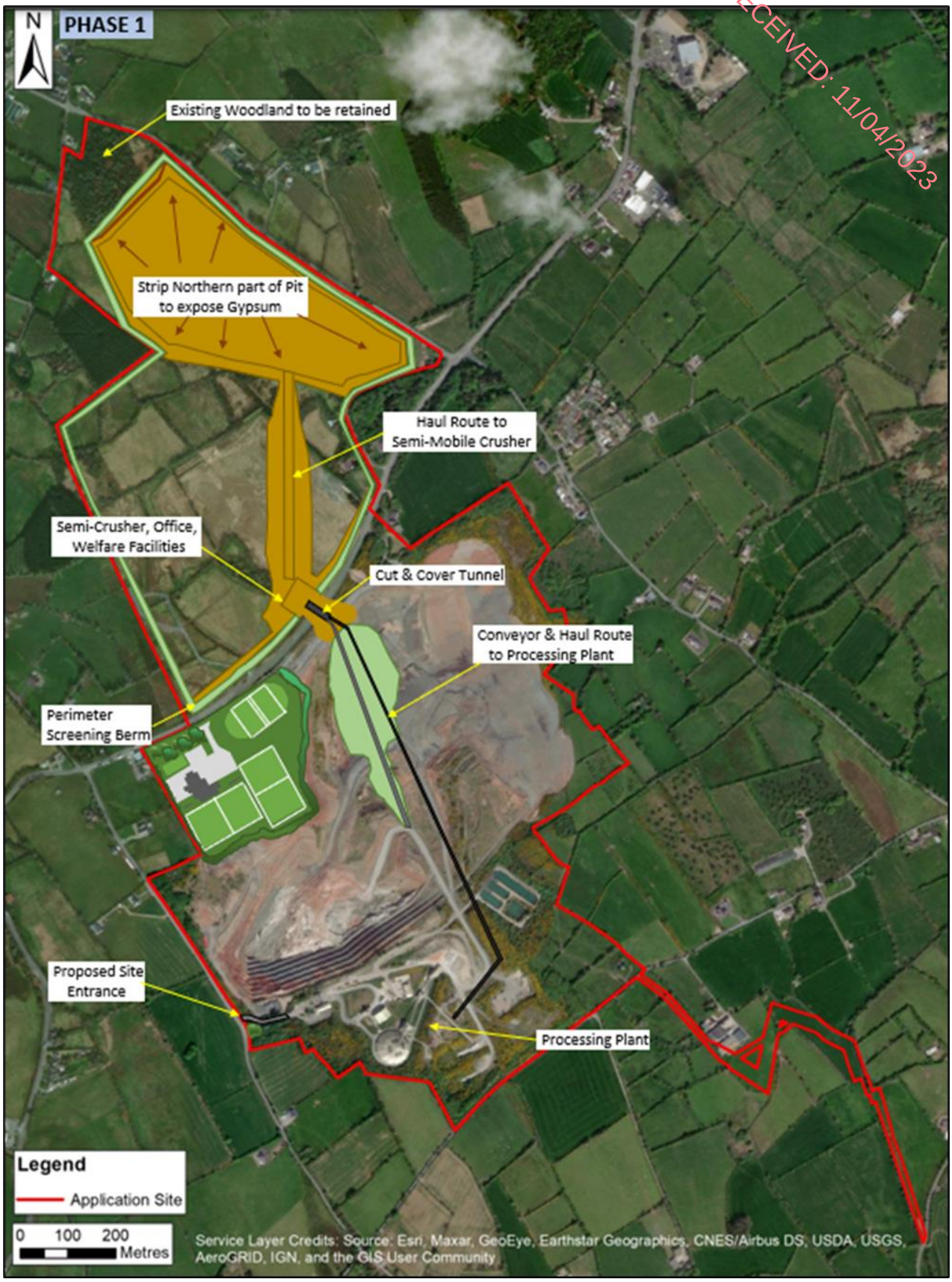


Figure 3.11: Knocknacran West and Knocknacran - Operational - Phase 1

Mine Operational Phase 2 (Years 3 to 5) - Commencement of Gypsum Production

Following commissioning of the materials handling infrastructure, gypsum production will be ramped up to ca. 300,000 t/yr (or as market conditions dictate) during this phase of the development, with the stripping of overburden and interburden from the northern portion of the Knocknacran open-cast (Figure 3.12). A haul route will be constructed between the working area in Knocknacran West and the Cut-and-Cover Tunnel for the transport of gypsum to the existing plant site at Knocknacran. Initial restoration of the existing Knocknacran Open-Cast will take place adjacent to the playing fields to the west of the conveyor with materials stripped from northern part of Knocknacran West.

By the end of Year 5, it is envisaged that ca. 900,000 t of gypsum will have been mined from the northern part of Knocknacran West Mine (depending on market conditions).

By the end of this phase, it is planned to have stripped a total of ca. 5 Mt of overburden and interburden from the northern part of Knocknacran West Mine.

Approximate tonnages of gypsum mined, and material stripped in Phase 2 are estimated to be:

- Upper and Lower Gypsum: ca. 900,000 t; and
- Overburden and Interburden: ca. 5 Mt (used to backfill the existing open-cast at Knocknacran Mine).

Drilling and blasting of the gypsum will be required and will be undertaken by an experienced and licenced blasting contractor. The gypsum once blasted will be handled by SGMI.

The stripped material will be excavated by an experienced earthworks contractor.

Figure 3.12: Knocknacran West and Knocknacran - Operational - Phase 2

Mine Operational Phase 3 (Years 6 to 10)

Phase 3 will include advancing the southern face of the northern part of the pit by stripping additional interburden to deepen the pit and expose more of the Lower Gypsum Unit (Figure 3.13). Restoration of the existing Knocknacran Open-Cast Mine will continue to take place adjacent to the playing fields to the west of the conveyor in preparation for seeding.

Phase 3 will be undertaken during years 6 to 10 of the development.

Approximate tonnages of gypsum mined, and material stripped are estimated to be:

- Upper and Lower Gypsum: ca. 1.7 Mt; and
- Overburden and Interburden: ca. 5 Mt.

Drilling and blasting of the gypsum will be required and will be undertaken by an experienced and licenced blasting contractor. The gypsum once blasted will be mined by SGMI with a fleet comprising of 50/75 t excavator(s) and 40 t ADT(s).

The stripped material will be excavated by an experienced earthworks contractor with a fleet comprising 50/75 t excavators and 40 t ADTs and used to backfill part of the northern area of the Knocknacran West Mine.

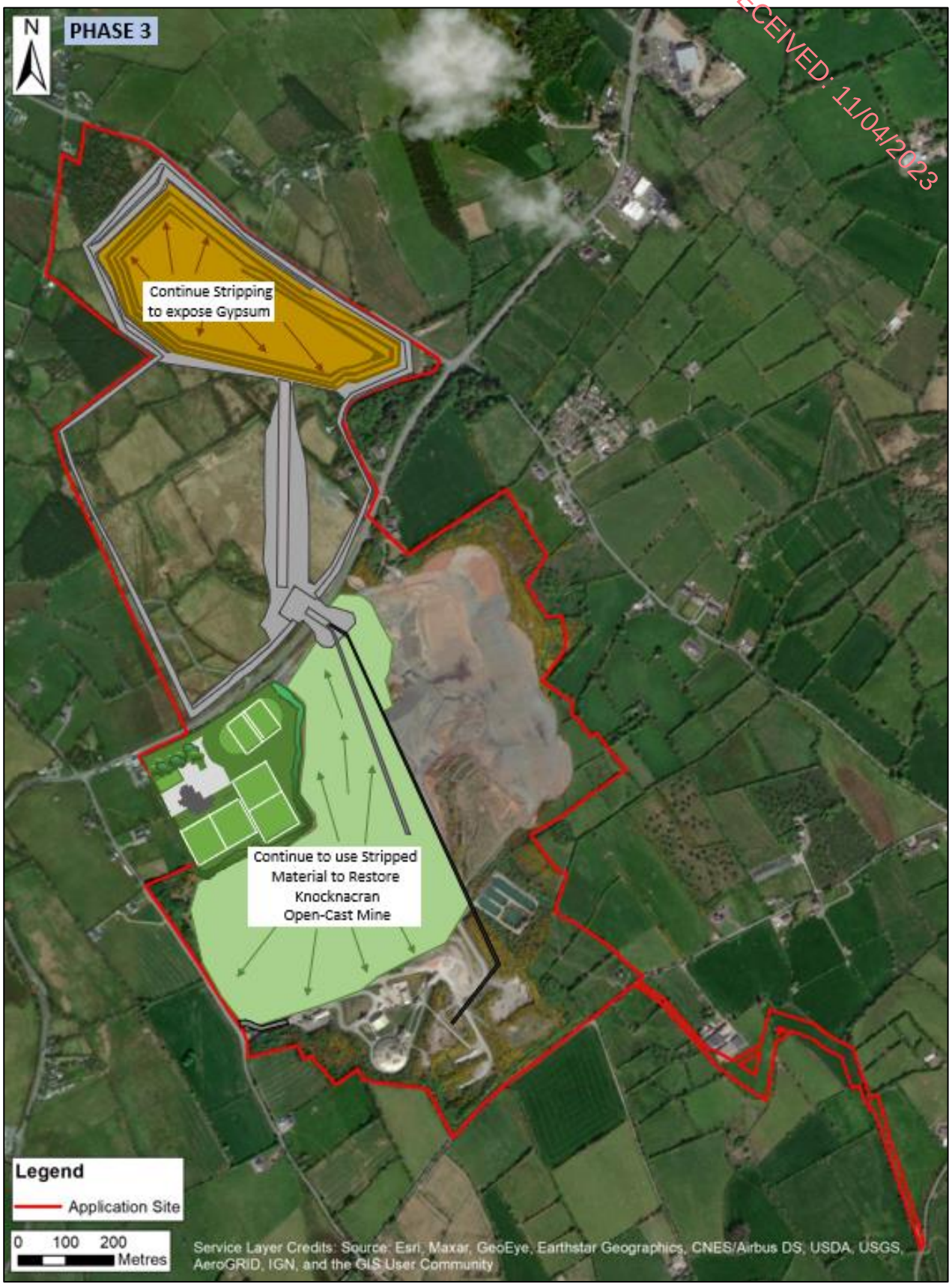


Figure 3.13: Knocknacran West and Knocknacran - Operational - Phase 3

Mine Operational Phase 4 (Years 11 to 15)

Phase 4 will comprise extending and deepening the northern pit further and will be undertaken during years 11 to 15 of the development. During this phase, it is estimated that the Knocknacran Mine void will be restored to near original ground levels. Remaining materials stripped during this phase will be stored within the footprint of the northern part of the Knocknacran West Mine (Figure 3.14).

Approximate tonnages of gypsum mined, and material stripped are estimated to be:

- Upper and Lower Gypsum: ca. 1.7 Mt; and
- Overburden and Interburden: ca. 8 Mt.

Drilling and blasting of the gypsum will be required and will be undertaken by an experienced and licenced blasting contractor. The gypsum once blasted will be mined by SGMI.

The stripped material will be excavated by an experienced earthworks contractor with a fleet comprising 50/75 t excavators and 40 t ADTs and used to backfill the remaining void area of Knocknacran Mine.

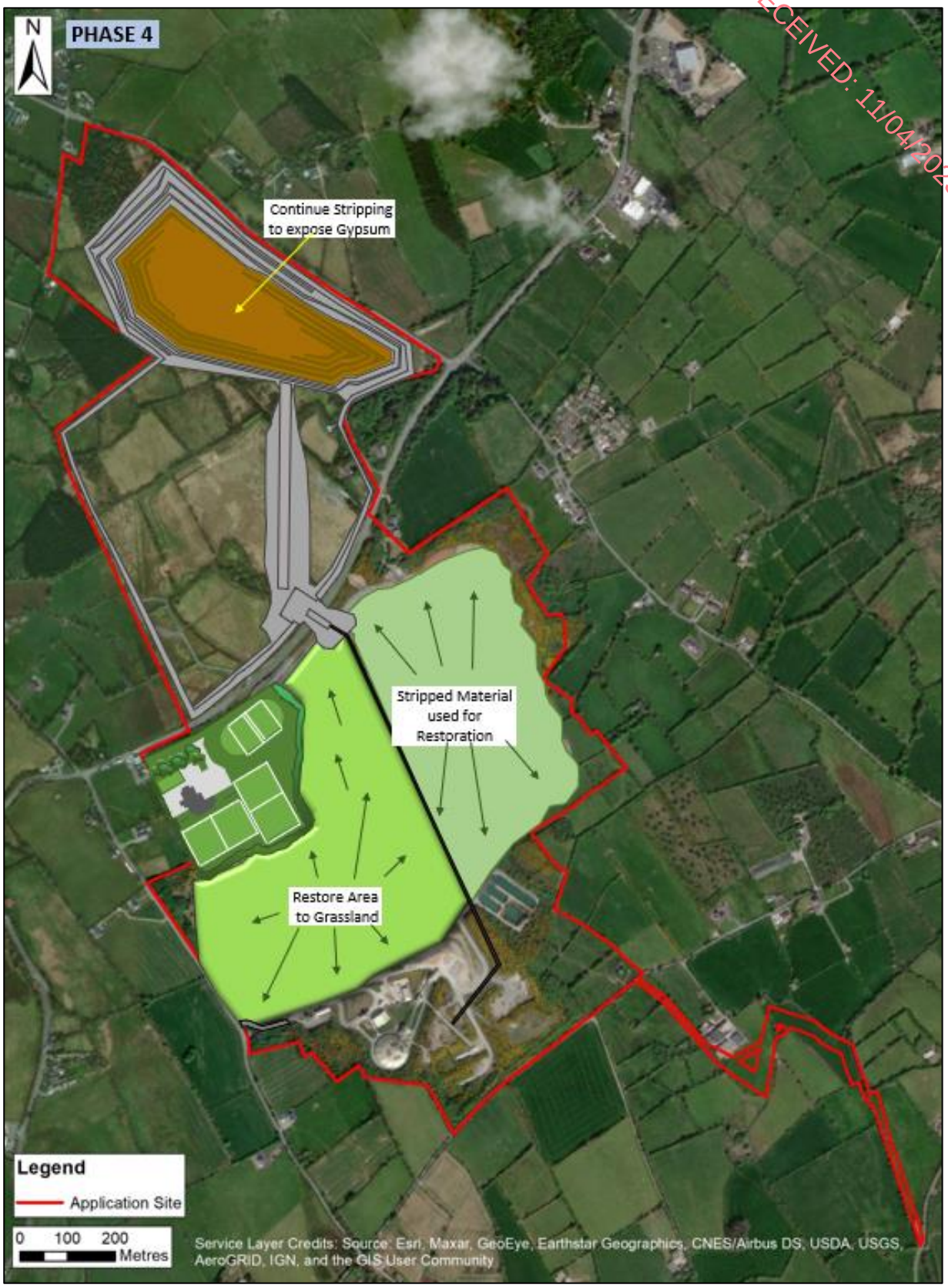


Figure 3.14: Knocknacran West and Knocknacran - Operational - Phase 4

Mine Operational Phase 5 (Years 16 to 20)

Phase 5 will comprise stripping the overburden and interburden within the southern portion of the proposed open pit and will take place during years 16 to 20 of the development (Figure 3.15).

Approximate tonnages of gypsum mined, and material stripped are estimated to be:

- Upper and Lower Gypsum: ca. 1.7 Mt; and
- Overburden and Interburden: ca. 7 Mt.

Drilling and blasting of the gypsum will be required and will be undertaken by an experienced and licenced blasting contractor. The gypsum once blasted will be mined by SGMI.

The stripped material will be excavated by an experienced earthworks contractor with a fleet comprising 50/75 t excavators and 40 t ADTs and used to backfill the northern area of the Knocknacran West Mine. Any excess stripped material will be stored in the northern area of the pit prior to being used for final restoration of the open-cast following cessation of mining.

Figure 3.15: Knocknacran West and Knocknacran - Operational - Phase 5

Mine Operational Phase 6 (Years 21 to 30)

Phase 6 will extend the southern pit to the southwest (Figure 3.16). These activities will be undertaken during this phase of the development (depending on market conditions and operational constraints).

Approximate tonnages of gypsum mined, and material stripped are estimated to be:

- Upper and Lower Gypsum: ca. 3 Mt; and
- Overburden and Interburden: ca. 3.5 Mt.

Drilling and blasting of the gypsum will be required and will be undertaken by an experienced and licenced blasting contractor. The gypsum once blasted will be mined by SGMI.

The stripped material will be excavated by an experienced earthworks contractor with a fleet comprising 50/75 t excavators and 40 t ADTs and stored in the northern area of the Knocknacran West Mine for use in final restoration following cessation of mining.

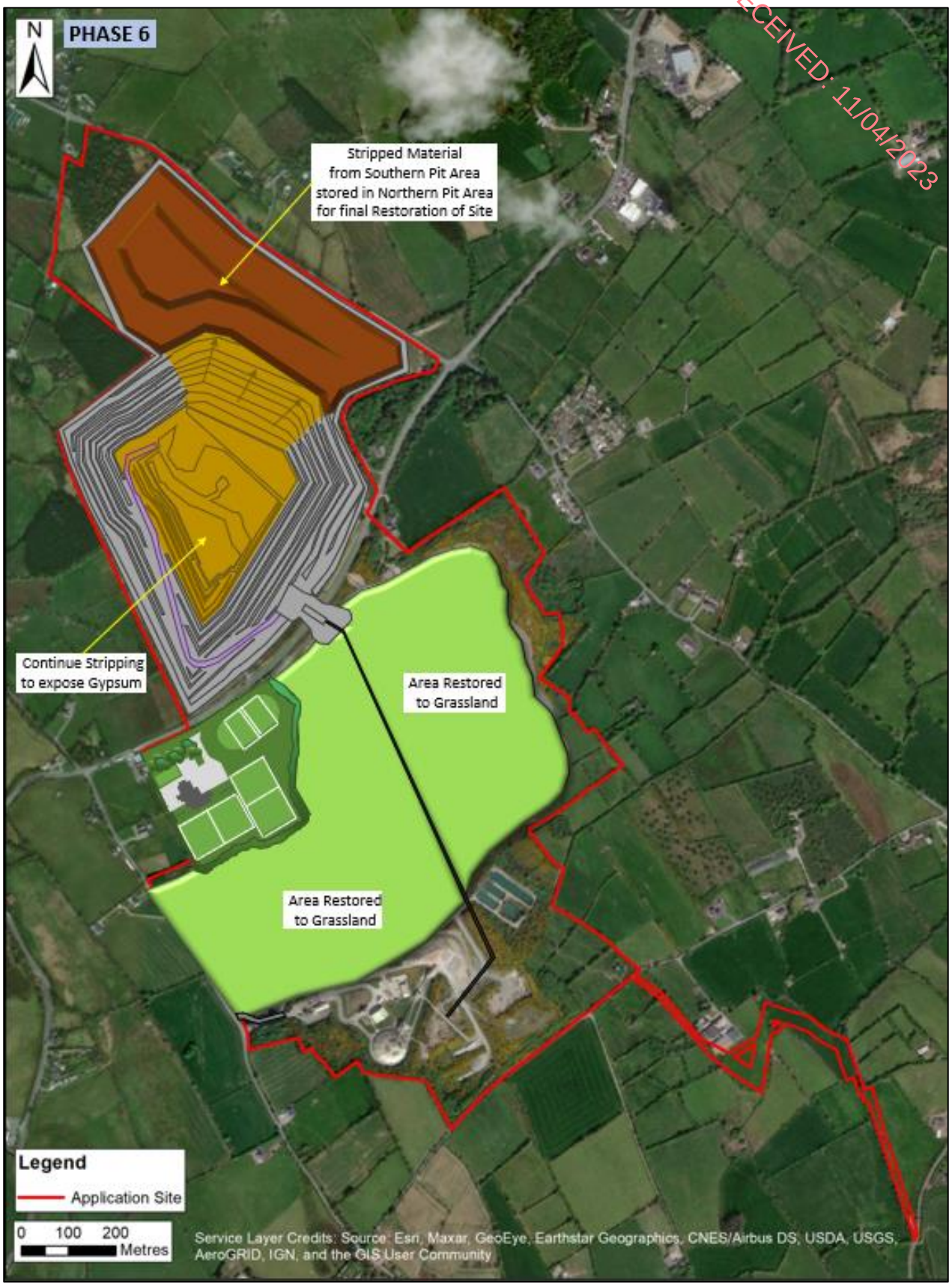


Figure 3.16: Knocknacran West and Knocknacran - Operational - Phase 6

3.6 Mine Closure and Restoration

Following cessation of mining at Knocknacran West Mine, all plant and infrastructure will be removed prior to restoration of the site, and disposed of by auction or through a licenced contractor.

Features will include a waterbody-lake (following cessation of mining pumps will be turned off and water levels allowed to rebound to natural levels – see Chapter 8.0 Water for more details), and areas of natural grassland/wildflowers and woodland.

Excess stripped material stored in the northern pit area will be used to backfill and profile the southern part of the Knocknacran West Mine. Final profiling of the open-cast slopes will be completed to ensure that any in-situ gypsum is covered, and benches are made safe. This will allow the planting of native grasses, wildflowers, scrub and trees to be undertaken and biodiverse habitats to be developed. Access to the haul ramp and upper benches will be made secure and the area where the haul ramp enters the water will be graded and planted with plants suitable to that environment, adding additional biodiversity to the site as a whole.

Following cessation of mining the level of the waterbody in the Knocknacran open-cast is expected to rise slowly with time to a final level of 38-39 m OD (allowing for seasonal fluctuations), when the lake will overflow into the original Corduff Stream on the northeast side. The final surface area of the open water body will be about 26 ha. The final water body will be about 36 m deep, 500 m in width, and 760 m in length. The Corduff Stream is an ephemeral stream, with negligible flows being recorded during drier months. Appendix 8.1 provides detail on the stream size, form, streamflows and current environmental setting of the Corduff (and Magheracloone) Streams. An assimilative capacity study for the Corduff Stream is also provided in Appendix 8.1.

The restoration plan for Knocknacran West will allow the creation of additional areas of shallow water that will support the development of habitat. Based on current planning, it will be possible to create a shallow water littoral zone. The proposed area of backfill in the northern end of the Knocknacran open-cast will be re-graded to create additional areas of shallow water. Depending on access and on local topographic variations, part of the upper pit crest may be flattened to a 15° slope to a depth of about 5 m. The actual plan will be optimized based on conditions encountered during excavation of the open-cast and backfilling of the peripheral zones. The reinstated Corduff Stream will be designed to enhance and promote aquatic habitat and marginal plant succession to provide habitat for wading birds and wild fowl. In the context of the site, this will result in a nett gain of habitat.

In terms of safety measures on the benches, the overall open-cast mine design is based on the analyses and modelling of the geotechnical parameters of the materials underlying the site (from boreholes), and from experience gained in mining the existing Knocknacran Open-Cast Mine over the past 30 years.

As part of this geotechnical modelling, a total of 9 representative cross-sections around the perimeter of the proposed open-cast mine were selected for stability analyses (using limit equilibrium modelling software SLOPE-W version 10.0.2.1001) to meet the design criteria for a Factor of Safety (FoS) of 1.5 (as described in Section 3.5.5 above).

The design criteria for the proposed open-cast mine follows the HSA's 'Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2008' (April 2020). In terms of bench design and safety, the following criteria have been used:

- 6 m high benches with 6 m benches widths, and a 45° batter angle on bench faces in the interburden (and a batter angle of 27° in the overburden);
- The installation of drainage channels on each bench to form part of the overall water management system for the excavation throughout its life;
- Maintaining bench height where design, ground/geotechnical conditions and regulations/guidelines allow; and
- Providing safety berms/edge protection designed at 1.5 x or higher than the radius of the largest wheel/tyre.

Figure 3.17 presents the proposed final restoration plan of the mining sites at Knocknacran and Knocknacran West. Figure 3.17 also presents the location for cross-section lines across the site, showing existing ground level, proposed excavation level, restoration level and water level of the waterbody following cessation of mining in Knocknacran West. The cross-section details are provided in Figure 3.18 and Figure 3.19 below.

Essentially there will be three distinct habitats created during the rehabilitation of the Knocknacran West Open-Cast Mine:

- Open Water Habitat.
- Shoreline / Washland Habitat.
- Open Ground Habitat.

Each of these habitats are quite different from the other and will require different measures to establish and support diverse and sustainable ecosystems.

A consideration that is quite unique to this project compared to other habitat creation projects is that the size of the open water body will increase year on year as the area rewaters, and as such the rehabilitation plan to establish the new habitats needs to be able to be flexible with this changing environment.

The priority is to introduce only native species and this work will be carried out under the guidance of an ecologist and as part of a Biodiversity Action Plan.

Habitat surveys will be completed to monitor the performance and success of the rehabilitation. In the early years pruning and general maintenance will be carried out to promote success but ultimately the habitat will be designed to be self-sustaining, with minimal input required from the landowner.

Open Water Habitat

The open water habitat will be akin to a lake. The water quality will be of suitable quality to support a diverse range of species. It will not be necessary to introduce any species as indigenous species will migrate from nearby waterbodies and colonise the open water. The shoreline of the lake will be of a suitable depth to support benthic populations of macroinvertebrates. It is known that disconnected virgin freshwater bodies will over time develop a population of invertebrate life as species such as mayfly and stone fly etc. can colonies these areas by flight. Species such as frogs can migrate to the waterbody and even fish eggs can be transported by vectors such as birds, so that fish populations can become established. There is no plan to introduce any vertebrate aquatic species such as fish and indeed protections may be installed at the outlet of the lake such as a gabion basket wall to ensure that fish life from the waterbody does not migrate into the receiving surface waterbody (Corduff Stream). Saint-Gobain will liaise with Inland Fisheries Ireland with respect to the open waterbody and associated habitat.

Q Rating tests will be conducted to monitor the establishment of macroinvertebrates within the waterbody and ecosystem, and this will also be a good measure of the biodiversity of the habitat.

Shoreline / Washland Habitat

A shoreline is a habitat that provides major opportunity for the development of diverse habitat. The washland is the land next to the shore that will become covered in water seasonally and during periods of heavy rainfall.

The shoreline will support benthic macro invertebrate populations, plants, and invertebrate populations including mammals and birds.

The shoreline is an important habitat and is capable of supporting a diverse population of flora and fauna. To maximise the potential of this area reprofiling of the open-cast at the projected elevation of the final shoreline will introduce inlets to maximise contact area between land and water, which will maximise the extent of this habitat.

Plant species will be introduced by transplanting from donor sites around the area, such that the species introduced will be indigenous. An amount of soil will be imported with the root system during the transfer of the donor species to enhance the growing media. A shallow cover of soil (from the stripping of the Site) will be introduced on the land that will become shoreline and then lakebed as the lake expands. The shoreline species will be introduced in the early years of rewatering as the initial shoreline is established and these species will push out naturally as the water rises and the shoreline expands.

No invertebrate or vertebrate species will be introduced, these species will colonize naturally once the habitat is established. Ecological surveys, including bird surveys will be conducted routinely to monitor the success of the habitat.

Open Ground Habitat

The open ground habitat will be planted with a selection of grasses, shrubs and plants to form a diverse habitat. It is proposed to seed areas of the Site with a range of seed mixes to increase the cover and to improve the habitat value. The grass mixes will be consistent with species in the surrounding lands. The first planting of pioneer grass species will occur following the final contouring of the open-cast mine slopes. Planting will be used to facilitate a long-term process of succession and colonization in order to create a diverse ecological habitat.

The open ground that will be above the elevation of the final water level will have a deeper cover of soil so that it can be planted with tree species such as birch and alder. These species tolerate harsh and exposed conditions and will create shelter for other tree species to be planted such as oak.

Hawthorn, hazel and dogwood will also be planted, and these woody plants will encourage bird species to establish in wooded areas and assist with the dispersal of seeds and the natural plantation of the Site. Tree and hedge plantations will be placed to create links with existing hedgerows creating corridors for fauna to move from area to area. They will also create habitat islands which will help in the dispersal of seed.

Habitat surveys will be completed to monitor the performance and success of the rehabilitation. In the early years pruning and general maintenance will be carried out to promote success but ultimately the habitat will be designed to be self-sustaining, with minimal input required from the landowner.

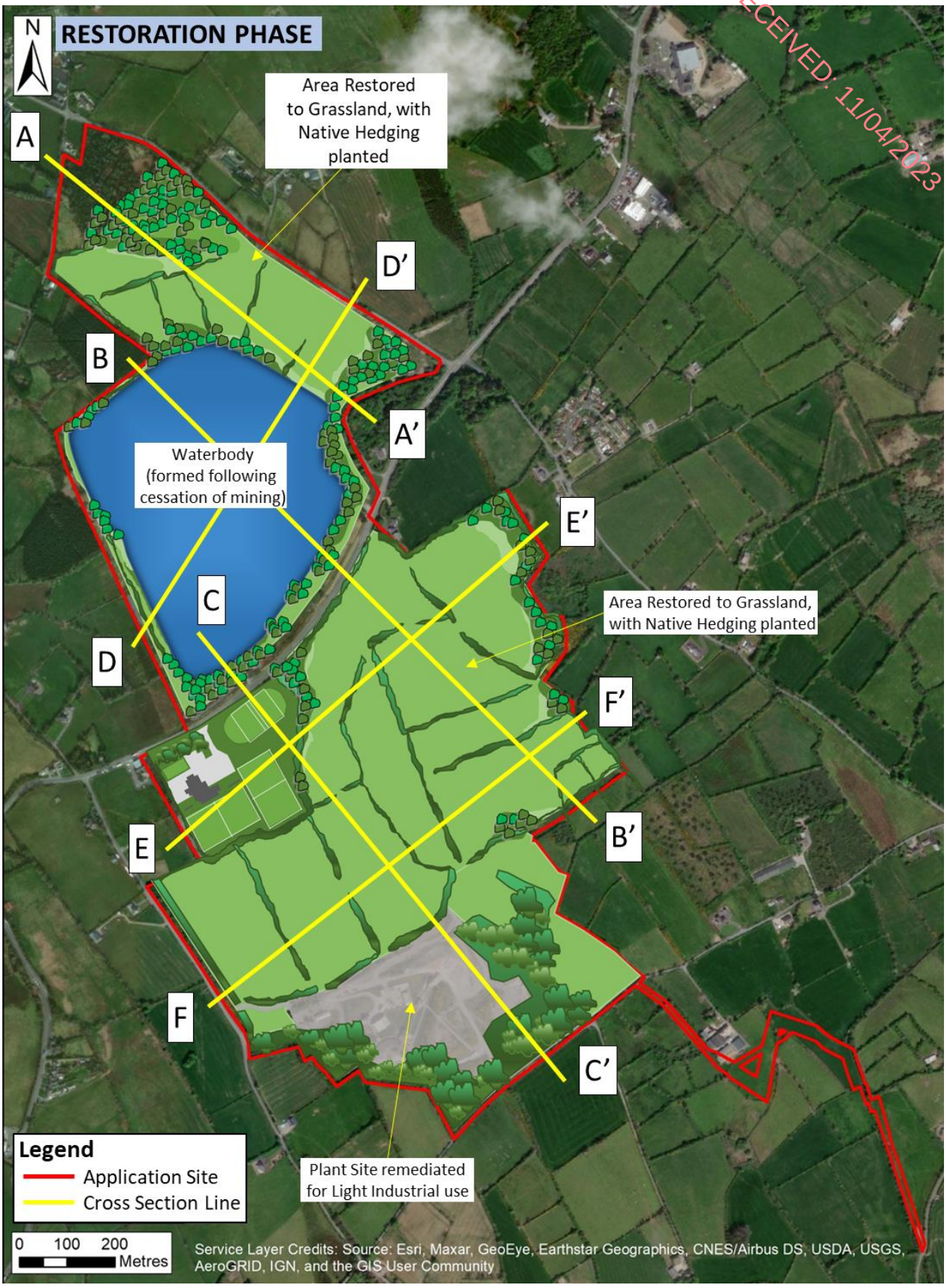
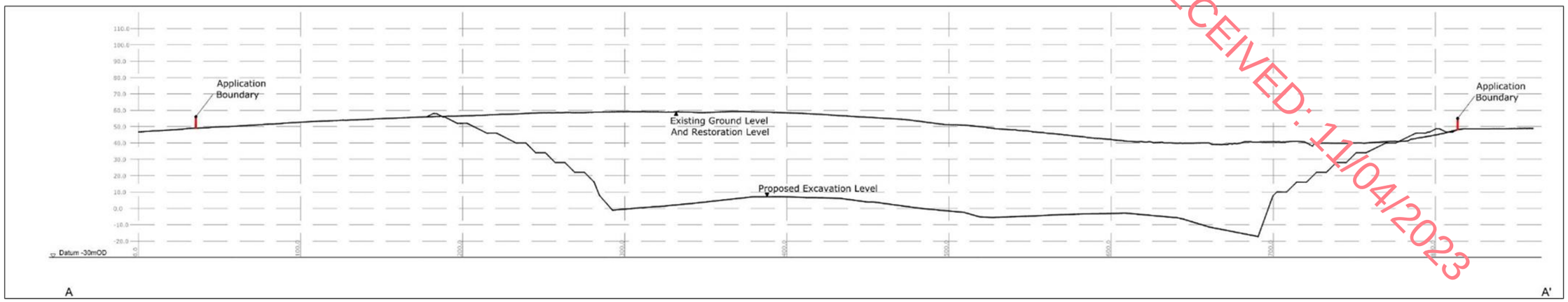
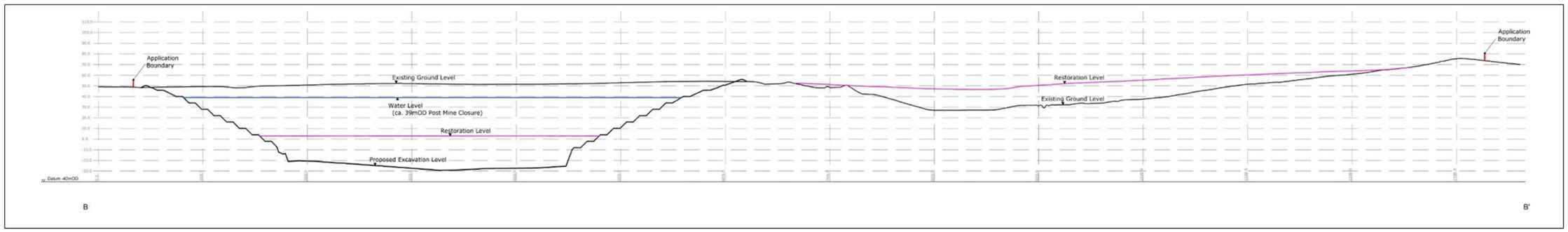


Figure 3.17: Final Restoration Plan - Knocknacran West and Knocknacran - Phase 7 (inc. cross section lines)

A severance package will be put in place to incentivise employees to remain with the company until such time as they receive their redundancy notice. If an employee leaves without receiving their redundancy notice they will not receive any severance benefits. Employees will only be made redundant when their skills are not required.





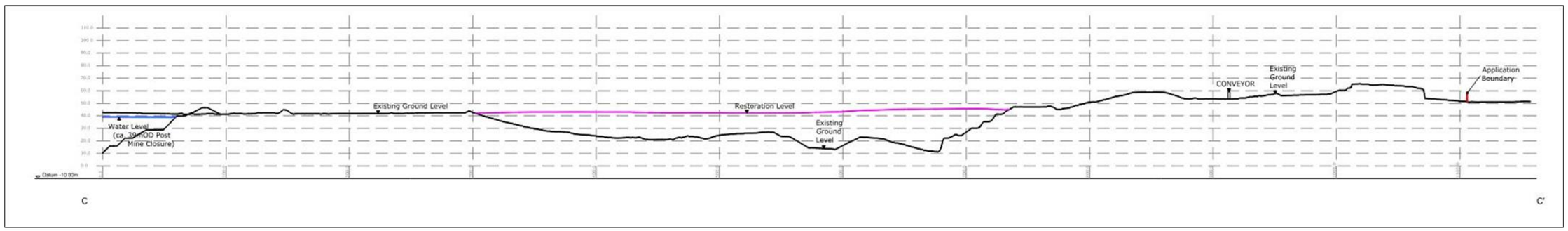
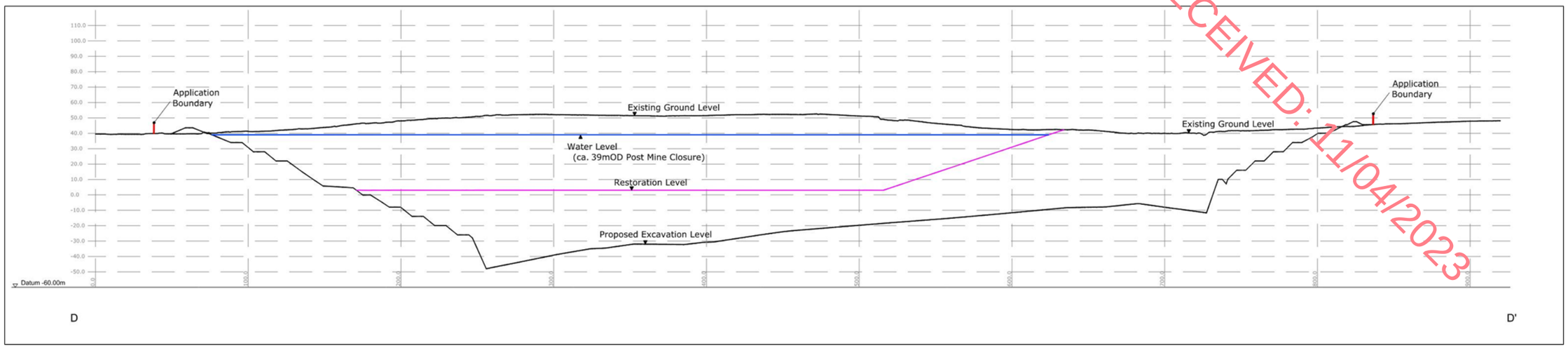


Figure 3.18: Cross-sections A to C showing the excavation extent, restoration level and water body level



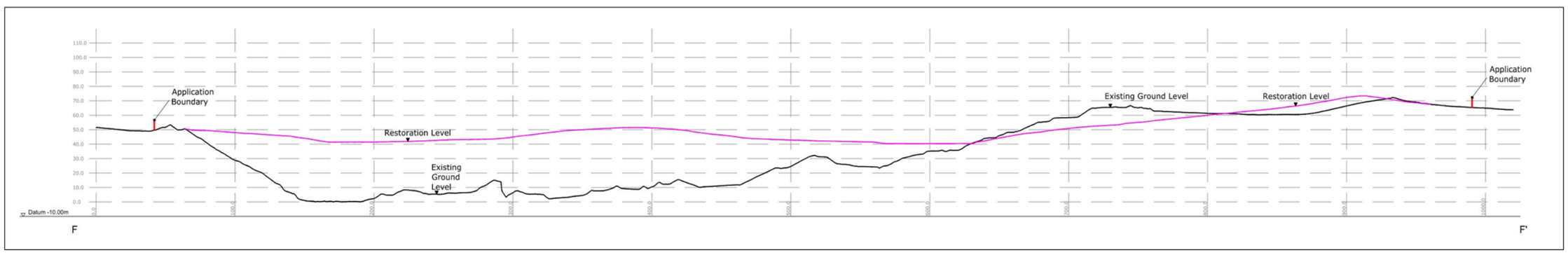


Figure 3.19 Cross-sections C to F showing the excavation extent, restoration level and water body level

3.7 Mine Site Infrastructure

This section provides a summary of the main aspects of the development's infrastructure (Figure 3.20, , Figure 3.21 and Figure 3.22).

Initially, stripped material will be transported on haul roads, through the Cut-and-Cover Tunnel and used to backfill and restore the existing Knocknacran Mine, with the balance of the stripped materials being stored in the first to be excavated northern area of the Knocknacran West Mine for use in the subsequent remediation of that site.

Gypsum (and anhydrite) from the Upper and Lower Gypsum Units will be hauled to a semi-mobile primary crusher on the open-cast floor, before being transported by covered conveyor to the Knocknacran Processing Plant site via the Cut-and-Cover Tunnel, for processing prior to being transported off-site.

In-pit Primary Crushing (1)
The blasted gypsum will be hauled and direct tipped into a ROM (run of mine) bin which will feed a semi-mobile crusher. The crusher will be located on the open-cast floor and will be moved as the open-cast develops. The primary crusher will crush the rock to 100% passing 150 mm.

Conveyor Transport of Gypsum (2)
The crushed rock will transfer onto a conveyor belt system comprising of two single drum ramp conveyors within the open-cast, a single drum tunnel conveyor which passes through the Cut-and-Cover Tunnel, a double drum overland conveyor and a single drum tripping conveyor which will allow for offloading of the gypsum into stockpile bins (**5**). The conveyor belts will be installed with rotation and blocked chute sensors to ensure safety and efficiency of operation. A haul road for service vehicles will be constructed to run parallel to the conveyor, allowing access for explosives and emergency vehicles.

Offices & Welfare Facilities at Knocknacran West (3)
Additional infrastructure within the open-cast area will include an office unit with lunch room, welfare facilities (toilet, shower and hand basin), first aid station and a transformer located on a platform area at the proposed open-cast crest. Appendix 3.2 provides a site suitability assessment for the proposed welfare facilities in line with EPA guidelines. The Step-up transformer will be installed at the main transformer to enable cost and energy efficient transfer of power to the semi-mobile crusher along the conveyor ramp. A step-down transformer will be located at the electrical panel at the crusher.

Water Management Arrangement (4)
Water will be pumped from a main sump (**4a**) located on the open-cast floor to the existing water management system located adjacent to the Knocknacran Processing Plant. Refer to the Water Chapter (8.0) for a water management plan.

The existing water management system consists of a series of 4 holding ponds (**4b**) to facilitate the settlement of suspended solids. The ponds have a capacity of ca. 14,000 m^3 and store water prior to discharge from the site to the River Bursk. The ponds are constructed of earth embankments and are lined with mudstone.

A pumphouse (**4c**) containing pumps for the discharge of water to the River Bursk is located on the southern side of the ponds. The pumphouse is a concrete-block structure. Water is pumped from the lagoons, via the pumphouse, to the holding tanks (**4d**) prior to discharge using an automated valve to the River Bursk. The flow of water from the holding tanks to the River Bursk is monitored on a real time basis from the site administration building (**11**).

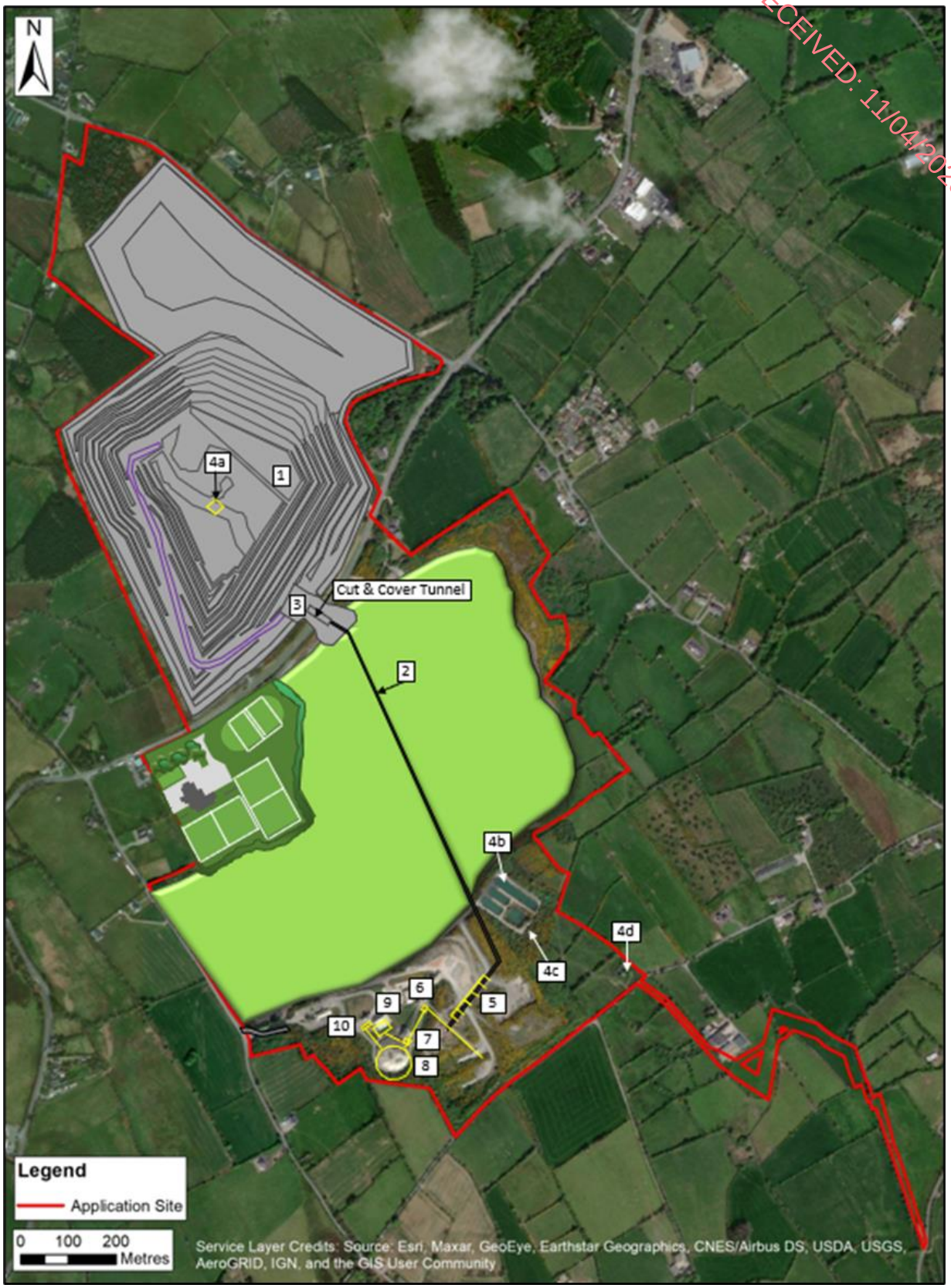


Figure 3.20: Plan showing location of main infrastructure associated with the mining of gypsum from Knocknacran West

Stockpile and Blending (5 to 10)

The single drum tripping conveyor will load gypsum into stockpile bins (**5**) for blending purposes. A reclaim conveyor will be installed below the stockpile bins which allow for the transfer of gypsum, via the existing UC3 belt, into the existing crusher (**6**). The -150 mm rock will be crushed down to 100% passing 75 mm. The secondary crushed gypsum will be transferred by conveyor to a sampling unit (**7**) before either transferring to the homogeniser (if gypsum) (**8**) or to the rock shed (if high grade anhydrite rock) (**9**).

Following homogenisation, the gypsum rock will be transferred to a lorry load-out shed (**10**) for discharge into trucks for haulage to the plaster manufacturing facility near Kingscourt.

The crushing plant and conveyor system/primary crusher will be controlled by a new Siemens PLC and SCADA to allow for centralised and remote operation of the plant and equipment and efficient shut-down of equipment through interlocking process control. The items of infrastructure described above are shown on Figure 3.21.

Figure 3.21: Proposed operational infrastructure within existing Processing Plant Area

The main support infrastructure to mining activities are presented below and shown on Figure 3.22.

Administration Building (11)

Management, production, safety, survey, gypsum sampling laboratory, engineering and environmental personnel are accommodated in the existing administration building over two levels. This building is 15 m by 9 m by 6 m high and is constructed of concrete blocks. Interior floors are of reinforced concrete construction, with internal partitions of concrete block or plaster board on steel studs. All stairs are of concrete construction.

All exits and escape routes are equipped with battery-powered automatic emergency lighting to ensure safe evacuation of the building in the event of a power failure.

The building also includes mine changing locker rooms with shower facilities, toilets, lunch room and meeting room facilities. Up to 40 personnel are provided for in these facilities.

Workshops and Storage Buildings (12)
A workshop and storage areas, as well as offices and welfare facilities are included in this building which is located in the main Plant Site yard (hardstand area). The building measures 15 m by 10 m and is a concrete block structure with a metal-clad roof.

Domestic Sewage (13)
All domestic sewage arising on-site is treated by an existing proprietary treatment system located to the east of the Administration Building.

Main Substation (14)
The main substation consists of a concrete block building containing the ESB's metering equipment and the site's high voltage distribution switchgear, and is enclosed by a 2.5 m high security fence. Access to the area is strictly controlled. The switchgear building has been constructed in accordance with best practice for such facilities in terms of security.

Mine Rescue Station (15)
A customised mine rescue station consisting of a portacabin type structure is located adjacent to the main entrance of the site.

Figure 3.22: Plan showing location of support infrastructure at Knocknacran Plant Site

3.7.1 Site Services

Access to the Knocknacran Processing Plant site, and around the main site buildings, is by an asphalt road. The road surface is crowned to adjacent drains to permit retention of any run-off water within the Knocknacran Processing Plant site. Employee and visitor parking will continue to be provided adjacent to the Administration Building. The carpark can accommodate approximately 40 cars. All vehicles visiting the site

will be parked within the curtilage of the site. Other site roads on the site are constructed with crushed, well-graded gravel, laid on a sub-base. Yard and laydown areas provided around the Knocknacran Processing Plant site are of a gravel surface. Complete access to all surface buildings is available for fire-fighting purposes.

3.7.2 Health and Safety

The existing mine at Knocknacran and adjacent facilities operate in accordance with the following accreditations:

- ISO45001 - Management standard for Occupational Health and Safety;
- ISO9001 - Quality Management System (QMS); and
- ISO14001 - Environmental Management System (EMS).

A strong emphasis on safety training and safety awareness is in place at the site and appropriate safety equipment and practices are rigorously employed in all aspects of the operation. A first aid room is provided.

Wearing of safety equipment, including safety hats and boots, is mandatory in all operational areas with wearing of safety glasses, gloves and hearing protection being required in specific locations.

Training of employees is provided and is an essential part of the site safety programme, including the continuous training of an emergency response team in case of emergencies onsite.

3.7.3 Maintenance

Maintenance of all facilities is carried out by electrical, mechanical and general engineering personnel. Routine maintenance and servicing of mobile mining equipment takes place on surface in a designated workshop area.

When required, off-site repair services are utilised. Such services include motor rewinding, tyre rethreading and specialist machine work. Maintenance and upkeep of other facilities (land, grounds, fencing, building exteriors and landscaping) is also carried out as necessary.

3.7.4 Waste Disposal

As part of the construction phase of the Mine Development one residential house, a 1980s bungalow will be demolished and three unoccupied houses and sheds will also be demolished.

A specialist demolition contractor will be appointed by the Applicant to demolish the structures on site as part of the proposed Mine Development.

A Resource Waste Management Plan (RWMP) had been prepared for the proposed Mine Development (Appendix 3.6). This plan has replaced the 'Construction and Demolition Plan and By-Products Management Plan' in accordance with the 'Best Practice Guidelines for the Preparation of Resource & Waste Management Plans for Construction and Demolition Projects' (EPA 2021). The RWMP will be revised and updated once a demolition waste contractor has been appointed subject to approval by the relevant authorities.

Hazardous and non-hazardous waste generated by the operation are deposited into specially designed skips located at prescribed locations on the Knocknacran Processing Plant site. These are collected for off-site disposal at a licenced waste facility by a private contractor. Packaging for reagents, which cannot be recycled, are disposed of through a licenced waste disposal contractor who collects all such materials on a regular basis for off-site destruction. Non-reusable metal reagent drums are also collected by a licenced waste disposal contractor. A Waste Management Plan for the proposed Knocknacran Open-Cast West Mine is provided in

Appendix 3.9. This plan will be incorporated into an overall waste management plan for the entire site (including Knocknacran and Drummond Mines).

The current sewage collection system located adjacent to the Administration Building will continue to be maintained, with solid material being disposed of off-site by a licenced contractor on a regular basis. It is proposed to install a second waste water (sewage) system to meet the needs of the 4 to 5 operatives of the proposed Knocknacran West Open-Cast Mine (Appendix 3.2 provides a Site Suitability Assessment) on the Knocknacran West site.

A waste oil storage tank is located adjacent to the workshop for collection and storage of used engine oil and oil products removed from oil/water separators. This is regularly collected for recycling by a licenced oil recycling operator.

An Extractive Waste Management Plan for the proposed Knocknacran Open-Cast West Mine is provided in Appendix 3.10. This plan will be incorporated into an overall extractive waste management plan for the entire site (including Knocknacran and Drummond Mines).

3.7.5 Security

A security fence will be constructed around the entire perimeter of the Knocknacran West Mine site. In addition, a security fence will be erected around the edge of the waterbody which will be formed on cessation of mining in Knocknacran West. The security fencing currently in place around the remainder of the mine sites will continue to be maintained. Vehicular entry to the mine sites will continue to be controlled by a barrier across the weighbridge adjacent to the Administration Building. This barrier is activated by company-issued access fobs and via remote control.

The existing perimeter security fence will continue to be checked on a regular basis. The mine has a remotely monitored CCTV system installed, with cameras monitoring the entrance gates to the site.

A security fence separates the employee car park from the operating facilities. All employees are required to check-in on entering the offices and mine area. Vehicle access to all areas of the surface facilities is strictly controlled. Within the Knocknacran Processing Plant site, additional security fencing is installed around the existing substation area. Security fencing is also provided around the water ponds.

3.7.6 Site Lighting

Site lighting is provided to enable safe surface operations on the Knocknacran Processing Plant site and to ensure that site security can be maintained after dark. This consists, largely, of lighting along the entrance roadway, exterior light fittings at strategic locations on the principal buildings and operational lighting at such installations as the main entrance, the gatehouse, the fuel dispensing bays, the water ponds and the mine portal areas.

3.8 Emergency Plan

Emergency plans are in place to deal with serious safety incidents that may arise within the operation. These specifically address the following potential situations:

- Surface or underground fires;
- Power failure;
- Flooding;
- Major accidents either on or off site;

- Significant chemical spillages on or off-site; and
- Ground failure (including subsidence).

Emergency plans are reviewed annually, or in the immediate aftermath of an emergency, and routine emergency exercises are carried out every year in accordance with regulations.

Hand-held fire extinguishers of the appropriate category are strategically placed in all areas of the surface.

An addressable fire alarm system is provided, with its annunciator located in the Administration Building.

Manual fire alarm points are also provided at strategic locations around the site.

Emergency escape provisions are provided for in all areas of the mine requiring a personnel presence. Multiple entrance and exit points for all principal surface buildings are provided with emergency exit direction and location signs.

Appendix 3.11 provides a copy of the Emergency Plan for operations at the current mine site.

3.8.1 Mine Closure and Restoration (CRAMP)

A preliminary Closure, Restoration and Aftercare Management Plan (CRAMP) for the Knocknacran West Project is provided in Appendix 3.3. This will be developed into a fully costed document and agreed with the EPA as part of a revised Industrial Emissions (IE) Licence for the overall mine sites.

The overall objective of Mine Closure is to achieve stable physical and chemical environmental conditions and a land use compatible with the adjacent countryside. Specifically, it is SGMI's intention that:

- The mine and fixed plant infrastructure will be decommissioned;
    - Most plant and equipment will be removed for scrap or resale. All services will be removed from the length of the Cut-and-Cover Tunnel, and it will be sealed off and filled with clean demolition rubble;
- The mine's plant site will be decommissioned and rehabilitated to a state where it can be developed and used for other enterprises by;
    - Cleaning and removing plant;
    - Removal of certain infrastructure/services;
- Removal of waste materials and residues off-site to a licenced facility; and
- Monitoring on a phased basis (i.e., active, and passive, leading to long-term aftercare monitoring and securing of a mine closure certificate).

Figure 3.17 presents the proposed restoration plan for the site once mining has ceased and the watertable has rebounded.

The existing Closure, Restoration & Aftercare Management Plan (CRAMP) for the Knocknacran and Drummond Mines will be adapted to incorporate the Knocknacran West Mine and agreed with the EPA prior to the development of the Knocknacran West Mine.

3.8.2 Existing Knocknacran Mine

A phased restoration approach will be implemented to minimise the extent and duration of the final restoration works. Following restoration ground levels will be restored to near original levels.

Phased restoration allows vegetation to become established during the course of the development, thereby reducing the overall impact of the development. During construction (earthworks phases), material from the proposed Knocknacran West Mine site will be brought to and used in the phased restoration of the existing Knocknacran Mine site to the south. The existing Knocknacran Mine will be restored during the operational lifetime of Knocknacran West Mine depending on operational conditions.

The restoration and closure plan will be updated annually.

3.8.3 Proposed Knocknacran West Mine

A phased restoration approach will be implemented to minimise the extent and duration of the final restoration works. Final restoration will include a waterbody, gently sloping grassland, and planting of native scrub and tree species (Figure 3.17).

Progressive restoration allows vegetation to become established during the course of the development, thereby reducing the overall impact of the development. Temporary stockpiles of topsoil, overburden and interburden formed from stripping during the latter stages of gypsum extraction will be used in the final restoration of Knocknacran West Mine. These stockpiles will be located on the Knocknacran West Mine site adjacent to the L4900, and will hold up to 10.5 Mt of material during the latter phases of the development (in Phases 5 and 6).

3.8.4 Processing Plant

The administration building, canteen building, workshop, access road to these buildings and carpark will remain in place. Production buildings such as the homogeniser building, structures and large fixed plant will be deconstructed, sold and removed from the site following decontamination.

3.9 Monitoring

Environmental monitoring of the site will continue to occur, with regular monitoring of noise, vibration, dust, water quality and water discharge to ensure that they remain within permitted levels for the life of the mine, pending future IE Licence agreement with the EPA for the Knocknacran West Mine site.

3.10 Planning Context

3.10.1 Planning Permission and Licenses of the Site

The first available record of mining activity which received planning permission was for a leaching plant (associated with the former Drumgoosat Mine) which was granted in February 1966 (Pl. Re. Ref. No. 65/176). This plant was located within the north of the Site (south of the village of Drumgoosat). The original planning for the development of the Knocknacran Mine was submitted to Monaghan County Council in December 1983 (Pl. Ref. No: 83461), with permission granted in July 1985.

An application was made in 2003 for the development of the underground mine at Drummond, extension of the period of use of the existing processing plant and construction of ancillary facilities. Permission was granted in July 2004 and this application was accompanied by an EIS.

An application to extend the extraction area (including associated earthworks) of the 1985 permission from 32.3 ha to 54.86 ha was submitted in March 2007 (Pl. Ref. No: 07/430). An EIS was submitted with this application. Permission was granted in September 2007.

An application (Pl. Ref. No: 17/217) to continue the extraction of gypsum from the open pit previously permitted under Pl. Ref. No: 07/430 was granted in June 2017. An EIS was submitted with this application in April 2017.

The former sports and community facilities which were located within the proposed Knocknacran West Mine site, originally obtained planning for the erection of a pavilion in September 1974 (Pl. Ref. No: 74/249). Subsequent permission was granted in October 1993 (Pl. Ref. No: 93/214) for the erection of a stand, toilet, storerooms and boundary wall. In October 1995, a decision was made to grant permission for the erection of dressing rooms and adequate sewerage facilities under Pl. Ref. No: 95/393. In January 2003 permission was granted to demolish an existing extension to the side of the Community Centre building and to erect a new single storey extension comprising an entrance hall, toilet facilities and meeting room in the same location (Pl. Ref. No: 02/823).

Table 3.4 below provides a summary of the planning applications and consents associated with developments at the Site in County Monaghan.

Table 3.4: Planning Applications and Consents associated with the Proposed Development

Ref.	Description	Grant Date
22/34	Permission for a development consisting of (1) excavation of the former (Drumgoosat) underground mine by open cast mining methods for the purposes of gypsum extraction at Knocknacran (East & West) and Drumgoosat, Co. Monaghan. Development will include the construction of a Cut-and-Cover Tunnel under the Carrickmacross to Kingscourt regional road (R179) for the transport of gypsum (by haulage truck and covered conveyor) to the existing processing plant area at Knocknacran, and for the transport of overburden and interburden (by haulage truck) to the existing Knocknacran Open-Cast Mine site for ongoing restoration purposes. (2) The continued ongoing restoration of the existing Knocknacran Open-Cast Mine. (3) The continuation of use and refurbishment of the existing Knocknacran Processing Plant area. (4) The further development of a Community Sports Complex (permitted under Reg. Ref. 20/365).	Withdrawn
21/698	Permission to erect two advertisements on structures at entrance of approved development under reg. ref. 20/365.	29/03/2021
20/365	Permission for the constructiuon of a new playing pitch, goalposts, ballstops, dugouts, pitch fencing, single story dressing rooms and toilets, parking area, wastewater treatment system, percolation and attenuation areas, boundary fencing, new entrance onto the R179, and all assocites works.	22/02/2021
17/217	Permission for the continuation of extraction of gypsum from a permitted open cast mine previously permitted under planning 07/430 to 2033 over an area of 54.86 hectares including progressive restoration and all associated site works. This application is accompanied by an Environmental Impact Statement (EIS).	22/06/2017
07/430	Extend the extraction area of the existing permitted opencast gypsum mine to allow for extraction and associated works within the company's property boundary to the permitted date of 2018 (Ref. No. 83/461). The proposed development area extends to 54.86 hectares (135.56 acres), which includes the permitted extraction area, the proposed extraction area and earthworks associated with this application. An Environmental Impact Statement has been submitted with this application.	05/09/2007
05/1245	Erect a gypsum rock storage shed, adjacent to existing quarrying facility in Drummond, Magheracloone.	21/02/2006
03/578	Underground gypsum mine.	20/07/2004

02/823	Demolish existing extension to side of Community Centre Building, and to erect a new single storey extension, comprising entrance hall, toilet facilities and meeting room, in same location	08/01/2003
95/393	Erection of dressing rooms and adequate sewerage facilities at Knocknacran West.	18/10/1995
93/214	Erection of stand, toilet/store, rooms and boundary wall m.o.p. 366/93.	27/10/1993
93/225	Retention of temporary entrance m.o.p. 270/93.	24/09/1993
90/372	Retention of temporary entrance m.o.p. 530/90.	10/01/1991
88/373	Provision of temporary entrance m.o.p. 393/88.	28/10/1988
86/415	Erection of processing facilities for opencast gypsum mine at Knocknacran East, Knocknacran West, Derrynascobe, Drummond, Enaghderrynaglagh and Clontrain.	09/04/1987
83/461	Development of opencast gypsum mine in townlands of Knocknacran West, Knocknacran East, Derrynascobe, Drummond, Derrynalagh and Enagh. Extension of time for issuing decision agreed until Oct.16 1984. m.o.p 328/84.	25/07/1985
83/248	Erect a house m.o.p. 278/83.	29/07/1983
83/158	Erect a house m.o.p. 248/83	08/07/1983
82/319	Erect a house m.o.p. 464/82	18/10/1982
74/249	Erection of a pavilion m.o.p. 354/74	16/09/1974
72/498	Extension to house m.o.p. 36/73	09/03/1973
65/176	Erection of leaching plant.	28/02/1966

3.10.2 Concurrent Permits

The mining activity within this EIAR is an activity that will be regulated under multiple statutes besides planning permission. The current gypsum mine holds the requisite Mining Lease and IE Licence.

The Mining Lease, reference number M139, was issued in November 2002. An application will be made to the Department of Communications, Climate Action and Environment (DCCAE) for an extension to the Mining Lease term as the current Mining Lease expires on 11th November 2032.

The Proposed Development has an estimated life of mine of at least 30 years production based on an extraction rate of ca. 300,000 t/yr from an assessed ca. 9 Mt of commercially available gypsum reserve.

The mining operations at the Knocknacran and Drummond Mines are the subject of IE Licence Reg. No. P0519-04 which applies to the townlands of Lisnabow, Kilmainham, Kells, County Meath, and in the townlands of Knocknacran, Magheracloone, Drummond, Derrynascobe, Derrynaglah, Ballycartlan, Enagh, Carrickmacross, Co. Monaghan.

Currently the IE Licence for the Site (IE Licence P0519-04) reflects the mining and processing activities to the south of the R179.

The Proposed Development will be required to be incorporated into the IE Licence. A licence review process will be undertaken with the EPA to incorporate the Proposed Development into the licence. This process can only be initiated, at the earliest once a planning application has been lodged with the planning authority for consideration.

The current IE Licence Reg. No. P0519-04 is an update of P0519-01 obtained in July 2002, P0519-02 obtained in February 2005 and P0519-03 obtained in July 2015 in relation to the mine extensions at Knocknacran and Drummond mines respectively. IE Licence P0519-04 was obtained in December 2021.

A copy of the proposed IE Licence outline is provided on a map in Appendix 3.12.

3.10.3 Monaghan County Development Plan Context

The Site lies inside the administrative boundaries of Monaghan County Council. The current Development Plan for the County is for the period 2019 to 2025. Relevant sections of the Monaghan County Development Plan include Economic Development, Community, Heritage, Conservation and Landscape and Environment, Energy and Climate Change.

The Monaghan County Development Plan 2019 - 2025 acknowledges that the extractive industry makes an important contribution to the economy and that it is important that "*these significant natural resources…are safeguarded for future use whilst also ensuring that impacts on the environment and communities are acceptable*". To address this the Council notes that planning applications must account "*for issues relating to noise, dust, vibration, visual intrusion, water pollution, traffic generation, etc".*

Monaghan County Council has set out the following mineral extraction specific policies:

> ***"ERP 1:*** *To safeguard for future extraction all identified locations of major mineral deposits in the County.*
>
> ***ERP2:*** *To promote development involving the extraction of mineral reserves and their associated processes, where the Planning Authority is satisfied that any such development will be carried out in a sustainable manner that does not adversely impact on the environment or on other land uses. Consideration in this regard shall be given to the impact of the development on the local economy.*
>
> ***EIP 1:*** *To require all applications for extractive development to submit the following as part of the planning applications;*
>
> *a) Map detailing total site area, area of excavation, any ancillary proposed development and nearest dwelling and/or any other development within 1km of the application site.*
>
> *b) Description of the aggregate to be extracted, method of extraction, any ancillary processes (crushing etc), equipment to be used, stockpiles, storage of soil and overburden and storage of waste materials.*
>
> *c) Total and annual tonnage of extracted aggregates, expected lifetime of the extraction, maximum extent and depth of working and a phasing programme.*
>
> *d) Details of water courses, water table depth and hydrological impacts, natural and cultural heritage impacts, traffic impact and waste management.*
>
> *e) Assessment of cumulative impact when taken with any other extractive operations in the vicinity.*
>
> *f) Likely environmental effects, proposed mitigation measures and restoration and after- care proposals.*
>
> ***EIP 2:*** *To prohibit extractive development within an area of primary or secondary amenity, Special Protection Area (SPA's), Special Area of Conservation (SAC's), Natural Heritage Area/pNHA (NHA's),*

Architectural Conservation Area (ACA's) or on or near protected structures unless in exceptional circumstances where the Planning Authority is satisfied that the need for the resource outweighs the environmental impact.

***EIP 3:** To restrict development proposals located in close proximity to existing extractive sites of significant resource potential where such developments would limit future exploitation.*

***EIP 4:** To restrict extractive developments that may have a detrimental impact on the natural or built environment or matters of acknowledged public importance including the use of public rights of way."*

The Council refers to the *National Guidelines on Quarries and Ancillary Activities for Planning Authorities* (DOEHLG, 2004), Guidelines for Environmental Management in the Extractive Sector (EPA, 2006), Guidance on Biodiversity in the Extractive Industry (NPWS, 2016), GSI's Geological Heritage Guidelines for the Extractive Industry (GSI, 2008), the Archaeological Code of Practice (National Monuments Service, 2017) and the Irish Concrete Federation Environmental Code (2005) and any other relevant superseding policy guidance as the guiding documents for these developments.

Section 15.30 (Appropriate Assessment) states the following:

***"AAP 1:** All projects and plans arising from this plan[4] will be screened for the need to undertake Appropriate Assessment under Article 6 of the Habitats Directive. A plan or project will only be authorised after the competent authority has ascertained, based on scientific evidence, Screening for Appropriate Assessment, and a Stage 2 Appropriate Assessment where necessary, that:*

1. The Plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any European site (either individually or in combination with other plans or projects); or

2. The Plan or project will have significant adverse effects on the integrity of any European site (that does not host a priority natural habitat type/and or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of the Natura 2000 network; or The Plan or project will have a significant adverse effect on the integrity of any European site (that hosts a natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of the Natura 2000 network.

[4]Such projects include but are not limited to those relating to: agriculture; amenity and recreation; contaminated sites; electricity transmission; flood alleviation and prevention; forestry; mineral extraction; renewable energy projects; roads; telecommunications; tourism; wastewater and discharges; and water supply and abstraction."

It is also acknowledged in the County Development Plan (Section 8.3) that the extractive industry is one of a number of pressures on water quality in the County.

Under Tables 9.2 and 9.3 (Land Use) the Council has identified that quarrying/extractive industry is a 'not permitted use' with the following land uses:

- Town Centre;
- Existing Residential;
- Strategic Residential Reserve;
- Industry, Enterprise and Employment;
- Existing Commercial;
- Community Services;
- Recreation and Amenity; and
- Landscape Protection/Conservation.

Whereby 'not permitted use' is defined as a "*use that would be contrary to the zoning objectives and sustainable development. Extensions to existing non-conforming uses within any zoned area will be considered on their merits.*"

Additional policies in the County Development Plan which relate to the proposed developments include restrictions on destroying vegetation on uncultivated land between the 1st March and the 31st August each year, and policy TWP 1 which states the following in Section 6.15:

> ***"TWP 1:*** *To minimise loss of tree(s) and hedgerow associated with any development proposal and encourage the retention of existing mature trees, hedgerows and woodlands in new developments. Where removal is unavoidable consideration should be given to transplanting trees and/or providing compensatory planting on the site."*

The Council also has obligations to protect and enhance the water environment in the County as outlined in the following policies:

> ***"WPP 16:*** *To support the implementation of the relevant recommendations and measures as outlined in the relevant River Basin Management Plan, and associated Programmes of Measures, or any such plans that may supersede same during the lifetime of the plan. Proposals for development should not have an unacceptable impact on the water environment, including surface waters, groundwater quality and quantity, river corridors and associated woodlands. Also, to have cognisance of, where relevant, the EU's Common Implementation Strategy Guidance Document No. 20 which provides guidance on exemptions to the environmental objectives of the Water Framework Directive.*
>
> ***WPP 17****: To contribute towards the protection of existing and potential water resources, and their use by humans and wildlife, including rivers, streams, groundwater and associated habitats and species in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended), the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI No. 272 of 2009), the Groundwater Directive 2006/118/EC and the European Communities Environmental Objectives (groundwater) Regulations, 2010 (S.I. No. 9 of 2010) and other relevant EU Directives, including associated national legislation and policy guidance (including any superseding versions of same). To also support the application and implementation of a catchment planning and Monaghan County Development Plan 2019-2025 Water Protection*

Policies management approach to development and conservation, including the implementation of Sustainable Drainage System techniques (SUDS) for new development."

In relation to the Community Sports Complex, the CDP acknowledges that the county has a strong sporting tradition and that physical recreation "*is an important part of everyday life and wellbeing*". Sports Facilities Policy CFP 6 sets out the following:

> *"**CFP 6:** To promote the provision, improvement and expansion of sports facilities within the County, subject to normal planning criteria and the proper planning and sustainable development of the County."*

3.10.4 County Development Plan Designations and Context

In addition to the above extraction policies and objectives of the County Development Plan, the Plan's provisions in relation to land use zoning, landscape, natural and built designations and development management guidance will inform the EIAR.

3.10.5 Policies

National, regional and local planning policies relevant to the Proposed Development include:

- National Spatial Strategy for Ireland 2002 - 2020;
- Regional Planning Guidelines for the Border Region 2010 - 2022;
- Regional Spatial and Economic Strategies 2020 - 2032;
- Project 2040 National Planning Framework;
- Monaghan County Development Plan 2019 - 2025;
- River Blackwater Local Management Area Information Leaflet; and
- Neagh Bann River Basin Management Plan (2015 - 2021).

3.11 References

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Appendix 3.1
Final Remediation (CQA) Report for the former GAA Grounds

Remediation of Disturbance Zone Magheracloone GAA Grounds

Construction Quality Assurance (CQA) Validation Report

Submitted to:

Saint-Gobain Construction Products (Ireland) Ltd
Mine Office
Knocknacran
Magheracloone
Co. Monaghan
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19120130.R06.B0

July 2020

Distribution List

SGCPI Ltd - 1 copy (pdf)

Golder Associates Ireland Ltd - 1 copy (pdf)

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1.0 INTRODUCTION

This document presents the Construction Quality Assurance (CQA) Validation Report for the Remediation of the Disturbance Zone at the Magheracloone GAA Grounds, Co. Monaghan.

Golder Associates Ireland Limited (Golder) was appointed by Saint-Gobain Construction Products Ireland Limited (SGCPI) to provide design consultancy services, prepare the Tender Documents, provide construction supervision, CQA and on-going assessment during the works, and prepare the Construction Quality Assurance (CQA) Validation Report.

Tender Documents (Golder 2019A) were prepared in May 2019 and a Design Stage Safety and Health Plan (Golder 2019B) was prepared in August 2019, prior to the start of the remediation works (the Works).

The Works commenced on 19 August 2019 and were substantially completed during a 10-week period up to the end of October 2019. All of the demolition works, and the bulk of the earthworks were completed at this time and final grading and seeding works were outstanding. A hiatus was agreed as these works were unable to progress due to the on-going unsuitable weather conditions from September 2019 to March 2020. The re-mobilization to Site in March 2020 was further delayed by the COVID-19 restrictions and works recommenced in mid-May 2020. A new sinkhole had opened in the remaining works area during April 2020. The infilling of this sinkhole and the landscaping works were completed during a 2-week period and a site walkover was conducted on 02 June 2020. A snag list was prepared, and these items were considered closed-out on 25 June 2020.

1.1 Definitions

For clarification, the following definitions are given:

Construction Quality Assurance (CQA) - A planned and systematic pattern of all means and actions designed to provide confidence that items or services meet contractual and regulatory requirements.

Construction Quality Assurance refers to means and actions employed to assure conformity of the construction of the works to the technical specification and to this CQA plan.

Construction Quality Control (CQC) - Those actions which provide a means to measure and regulate the characteristics of an item or service to contractual requirements.

Construction Quality Control refers to those actions taken by manufacturers, installers, contractors, and the project managers for the construction to ensure that the materials and the workmanship meet the requirements of the plans and specifications.

Project Supervisor for the Design Process (PSDP)

The role of the PSSP is to ensure co-ordination of the work of designers throughout the project with the objective of identifying the hazards and where possible, eliminating and/or reducing the risk.

Project Supervisor for the Construction Stage (PSCS) & Contact Person

The role of the PSCS is to manage and co-ordinate health and safety matters during the construction stage.

1.2 Project Team

The principal organizations involved in the Works are listed below:

- **Client:** Magheracloone GAA Club and Magheracloone Community Centre are the owners of the grounds and infrastructure. Permission had been consented to SGCPI to manage the works on the site and act as the Client for the duration of these remediation works.

- **Stakeholders:** Magheracloone GAA Club, Magheracloone Community Centre, Monaghan County Council (MCC), Environmental Protection Agency (EPA) and the Department of Communications, Climate Action & Environment (DCCAE).
- **Mine Owner:** SGCPI is the Mine Owner.
- **Engineer and PSDP:** Golder was the appointed Engineer and PSDP by the Client.
- **Main Contractor and Design Engineering Team (Contractor) and PSCS:** Eoin Smith Limited trading as SEM Construction Limited (SEM) were appointed as the Contractor, Designer and PSCS for the Works.
- **Sub-Contractor(s):** The following specialist Sub-Contractor(s) were appointed by the Contractor
  - **Asbestos Survey:** About Safety Limited
  - **Demolition:** M&I Contracts Limited
  - **Demolition Waste:** McElvaney's Waste & Recycling Limited
  - **HSSE:** Oriel Health and Safety Consultancy Limited
  - **Surveying and Environmental Consultant:** ATC Building Surveying & Engineering Consultancy Limited
  - **Tree Flailing / Mulching:** SEM Construction Limited
- **CQA:** Golder and SGCPI provided CQA attendance during the Works. SGCPI typically conducted daily site visits and Golder typically conducted half-day site visits 1 to 2 times per week.

2.0 PROJECT BACKGROUND

2.1 Site Location

The Magheracloone GAA Grounds (the Site) is located in the townlands of Knocknacran West and Magheracloone, Co. Monaghan. The Site is bounded to the south by the R179, a Regional Route which runs between Carrickmacross, Co. Monaghan and Kingscourt, Co. Cavan and to east by the L4900, a Local Route. The Site and sections of these Routes are located above the Saint-Gobain Construction Products (Ireland Limited (SGCPI) Drumgoosat Mine Workings (disused since 1989).

The setting is rural with surrounding land use being mainly agricultural with low density residential dwelling. The GAA Field is bordered on its southern boundary by the R179 Kingscourt to Carrickmacross road. Access to the Site was restricted to the Main Gate entrance to Magheracloone GAA Grounds on the north side of the R179, located approximately 7 km from both Carrickmacross and Kingscourt.

The grounds are currently owned by other stakeholders and permission was consented to SGCPI to manage the works on the site and act as the Client for these remediation works.

2.2 Site Adjoining Land Uses

The Site is located on the north side of the R179, and prior to the subsidence event on 23 September 2018, the Site was utilized as a Community Centre and GAA Club comprising playing fields, parking and ancillary facilities. The lands surrounding the Site are used for agriculture with low density residential dwellings. An active open-pit and underground gypsum mine and plant are located on the south side of the R179 and are owned by Saint-Gobain Mining (Ireland) Limited (SGMI). A filling station is located to the South-west of the Site along the R179.

2.3 Background

The existence of the gypsum deposits in the Kingscourt-Carrickmacross area have been known for over a century. Historical records indicate that extraction began in 1871, when a short-lived open pit mine at Knocknacran provided the first recorded gypsum output in the area. A number of underground gypsum mines (Lisnaboe, Drumgill and Cormey) were opened nearby before Drumgoosat was developed in 1958, which underlay a portion of Knocknacran. Exhaustion of reserves resulted in the closure of Drumgill and Drumgoosat in 1989, with production being replaced by open-pit mining at the Knocknacran Pit and underground mining at Drummond Mine (since 2006).

The Magheracloone GAA Grounds overlie the Drumgoosat Mine workings on the north side of the R179. These underground workings have been used in recent years as limited attenuation storage for surface water from the Knocknacran Pit and for water pumped from the underground Drummond Mine when discharge was not available due to low flow in the River Bursk or during times of excess rainfall. The underground workings were generally confined to the upper 50 m to 100 m below ground level (1005 mMD to 955 mMD), utilizing the room and pillar mining method and typically having 6 m high rooms and water storage levels were typically between 950 mMD and 970 mMD.

2.4 Subsidence Event

During June 2018, the Drummond Mine intersected a fault in the workings which led to significant water ingress. The water surplus to the discharge limits was pumped into the Drumgoosat Mine workings leading to a significantly elevated water table (approximately 995 mMD) within the workings.

On Sunday 23 September 2018, there was collapse of a portion of the Drumgoosat Mine workings affecting the facilities of the Magheracloone GAA Grounds when ground subsidence occurred at approximately 1055 mMD. The failure occurred over a sector of the workings that contained a group of 10 no. 12 m high pillars, which have their base at approximately 980 mMD. The 12 m high pillars collapsed causing a domino effect leading to the collapse of 6 m high pillars locally. The subsidence area was then contained by larger static pillars.

The event resulted in development of a zone of compression at the centre of the depression where the material has ‘bunched’ together. The ground then slopes upwards to a perimeter tension zone containing wide fissures and cracks on the surface, up to 2 m wide and 3.5 m to 4.0 m deep. Localized surface cracks were formed, and the clubhouse and adjacent buildings/infrastructure were substantially damaged and were subsequently assessed to be unstable. Additionally, two large crown holes / sinkholes were formed with depths of approx. 7.5m. Drone surveys of the disturbance zone have shown a drop in original ground elevation of approx. 5.8m at the centre of the depression. Initially, the disturbance zone was extended in an oval shape (longer in the E-W direction) measuring approximately 262 m x 160 m. Further subsidence was experienced in the western flank after two weeks and the disturbance zone measured approximately 350 m x 160 m. The subsidence area was largely stable since the initial movements and remained so for the duration of the remediation works.

SGCPI fenced-off the disturbance zone for approximately 50 m beyond the extent of the tension cracks and the Site was closed for access due to the level of disturbance. The utilities were disconnected, and regular aerial surveys were conducted (initially fortnightly and then monthly) to assess the continuing stabilization.

2.5 Pre-Remediation Works Assessment

Following a back-analysis assessment and an independent review (both by third parties), the failure has been attributed to the interaction of three unique conditions at this location:

- 12 m high underground pillars;
- A thin gypsum floor beam (< 2 m depth); and

- Increaser water elevation submerging the pillars.

If any of these conditions was missing, then a failure of this nature would not have occurred.

It has been considered that the extent of mine collapse has already occurred with the failure of the 12 m pillars, the failure of the adjacent 6 m pillars and the collapse of the gypsum roof beam. The presence of large static pillars to the south-east and north-west are considered to have effectively stopped the propagation of the failure in these directions. There are no other known locations where 12 m high pillars occur.

The analysis and independent review of the 6m high pillars concluded that their stability is not adversely affected by being submerged by water. The assessment of the subsidence modelling concluded that:

- It is very unlikely that any further significant surface movement will occur;
- The area of the major collapse has extended as far as it is likely to go, and the support of the R179 and L4900 is intact and robust;
- Some tension does exist at the surface created by the collapse which may continue to affect the surface outside of the collapsed area with smaller settlement movement, of the order of millimetres, over a period of time; and
- Owing to the bulking effect of the underlying materials, it is considered that there will be a continuation of consolidation as the Site settles.

De-watering of the Drumgoosat Mine workings was on-going prior to and during the remediation works, dropping at an average rate of 0.02 m day or approximately 0.6 m / month.

The subsidence event has disrupted the drainage for the GAA Grounds and had led to ponding of water at the centre of the depression and within the crown holes / sinkholes. Access to the site was restricted, the surface cracks and fissures are beginning to be obscured by grass growth, thus making the site hazardous to traverse, particularly if unaccompanied by personnel experienced with the hazard locations.

3.0 PROJET TIMELINE AND OBJECTIVES

3.1 Project Timeline

The project was tendered for a 12-week duration, starting in mid-August 2019 and completing in early November 2019. The key dates for the completed project are summarized below:

- **Start Date: 19 August 2019**
- Substantial Completion: 25 October 2019 (10-weeks of site works).
- Boundary fencing removed: 14 January 2002
- **Substantial Completion Certificate**: **Issued on 15 January 2020**
- Hiatus for unsuitable weather conditions: 28 October 2019 to 20 March 2020
- Hiatus for COVID-19 restrictions: 23 March 2020 to 15 May 2020
- Infill new sinkhole and final grading and landscaping: 18 May to 29 May 2020
- Snag list: 02 June 2020
- **Sign-off**: **25 June 2020**

3.2 Project Objectives

The Client's requirements for the completion of the Works and in the short-term post-works (min. 5 years) were provided in the Tender Documents and are reproduced below.

- Project safety objectives were zero incidents and open communication with Safety, Health and Welfare throughout the project and to progressively improve Health, Safety and Environmental (HSE) standards on the Site.
- Demolish the clubhouse, the adjacent buildings and infrastructure within the disturbance zone by a method that allows for the recovery of the maximum amount of goods and equipment from within the buildings and dispose of the demolition material via appropriate and authorized waste handlers;
- Remove all the surface infrastructure and furniture from site allowing for the recovery of the maximum amount of equipment and disposal of scrap material via authorized waste handlers;
- Return salvaged goods and equipment to the respective stakeholders;
- Discharge ponded water in the subsidence area via a sedimentation and/or treatment system in compliance with relevant standards.
- Make all surfaces, cracks and sinkholes within the disturbance zone safe to traverse by foot and plant in the short term (minimum of 5 years). It was required that all deep excavations, surface cracks and trip hazards be remediated; and
- Re-profiling, grading and restoration of the subsidence area and borrow areas, and construction of a passive gravity drainage system, connecting to the existing drainage system at the site boundary.

Golder conducted a detailed survey of the Site prior to the works and prepared detailed inventories of the site infrastructure and furniture and the internal goods and equipment requested to be retrieved. The recovery of the internal goods and equipment were provisional on the Contractor attaining safe access.

All surplus infrastructure, furniture, goods and equipment were segregated during the demolition process for waste recycling or disposal.

4.0 SEQUENCE OF WORKS AND CQA ACTIVITIES

The Tender Documents provided a proposed sequence of works for the project and identified the site hazards. SEM developed a Construction Stage Safety and Health Plan, developed specific RA-MS for particular tasks (demolition works, tree felling, discharge of surface waters etc..) and submitted the HSA required documentation prior to the start of the Works.

The following details the sequence of the major items for the Works and the CQA activities.

- **Mobilization:** Establishment of safe access routes, compound area, parking areas and storage areas. Set-up of site compound, welfare facilities, storage areas / structures and mobilization of plant took place during Week 1 and 2 and was completed by 30 August 2019
- **Asbestos Survey:** The asbestos survey of the buildings scheduled to be demolished, to the extent available for safe access, was conducted on 29 August 2019 and is provided in Appendix B.

  Visual inspections through external doors and windows were conducted for buildings where no safe access could be arranged. No confirmed asbestos was identified during the site inspection and 3 no. internal locations were identified for investigation by a competent contractor prior to disposal (1 x vinyl floor tiling

area and 2 x boiler locations). These locations were subsequently assessed by competent contractors during the demolition and disposal works and assessed not to contain asbestos.

Two samples of roof slate and one sample of roofing felt were taken for laboratory testing and all returned NADIS outcomes (no asbestos detected in sample).

- **Dewatering and Sedimentation system for Discharge**: Dewatering of the ponding in the subsidence area commenced in Week 3 and continued throughout September and October 2019.

  Initially, the two large ponds areas, next to the Main Pitch and next Training Area, were pumped down in order to gain access to these areas. These two areas had undergone the greatest level of subsidence, up to 6m drop in elevation , and surface water was ponding over the vegetation. The surface water was pumped through a 'Siltbuster' mobile silt trap and then into the existing drain between the West Field and the Training Area to discharge via the previous draining point for the Site. The water in fissures and crown holes were pumped down and discharge in a similar fashion during Week 4 and 5, prior to being backfilled.

  As the weather deteriorated from Week 6 and the final re-profiling was in progress, the water quality of the ponding in the central portion of the Site was exacerbated by the larger expanse of the Site that had been stripped of vegetation and topsoil, thus leading to greater sediment loads. Additional discharge silt traps were constructed, and a flocculant dosing system was introduced to ensure that the discharge water quality was maintained, and that the Works could be progressed.

  By Week 9, a hiatus was agreed with the remaining works scheduled to be completed in March 2020. The central portion of the site was profiled to pond and settle the surface water flows during the hiatus and only permitted discharge via an overtopping bund into the channel leading to the previous draining point for the Site for an extreme event i.e. the pond level need to reach a depth of circa 1.5m. The channel leading to the draining point had a number of silt traps constructed along route comprising dams of filter geotextile wrapped drainage stone.

  The performance of the various systems was monitored during the Works and during the hiatus and no instances of non-compliance were identified or reported. The management of surface waters was no longer an issue when the Works resumed on 18 May 2020 as it followed an 8-week spell of dry weather.

- **Vegetation, Topsoil and Restoration:** The stripping of the topsoil and vegetation commenced during Week 2 and the Tree Felling / Mulching Contractor mobilized during Week 3.

  The tree flailing and mulching was required along the western extent of the Main Pitch and the southern extent of the Training Pitch and was completed in a 2-week period from Week 3 to Week 5.

  Vegetation and topsoil were stripped and stockpiled for re-use from an area much greater than the subsidence zone in order to gain material for re-profiling. These works commenced during Week 2 wand were largely completed by Week 5. The stockpiled were located along the eastern extent of the Main Pitch and the southern extent of the Junior Pitch.

  Circa 70% of the topsoil had been placed and spread, in a minimum 150mm depth layer, over the re-profiled surface by Week 8. The unsuitable weather conditions and ponding water prevented the central portion of the Site being prepared for placement and plant traffic over the topsoil dressed areas.

  Following the resumption of the works on 18 May 2020, the central portion of the Site was reprofiled and the remaining 30% of the topsoil was spread. The entire Site was then graded, harrowed and grass seeded.

- **Removal of Site Infrastructure and Furniture:** In addition to the inventory list supplied with the Tender Documents, the relevant stakeholders provided inventory lists of the goods and equipment they wished to

be recovery during the Works. These items were recovered and stored appropriately at the compound area. The removal and recovery works commenced during Week 2 and progressed until Week 7.

Items that could be safely removed from the lesser damaged buildings i.e. changing rooms and equipment store, group water scheme office etc.. were returned to Magheracloone GAA Club and other stakeholders during Week 2 to Week 7. The LPG storage tank was also removed by Calor Gas during Week 3.

The demolition of all the buildings and sorting of the materials was completed during Week 6 and the transfer of the site infrastructure and furniture and items recovered from the buildings was arranged. An initial load of items salvaged was transported to Magheracloone GAA Club during Week 4 and the remaining items were transported during Week 7.

Sign-off for all items salvaged and returned during the Works is provided in Appendix C.

Items recovered that were damaged and/or not required by the stakeholders were disposed of via the waste recycling and disposal system.

- **Demolition of Buildings:** The Demolition Contractor mobilized to site during Week 3 and had completed the demolition and segregation of wastes within a 3-week period. The inert materials comprising concrete, blockwork and rock fill were separated and stockpiled for re-sue as backfill for the crown holes. Timber was segregated on site into separate skips and all other wastes were placed in a combined skip for segregation back at the waste handling facility. A total of 5 no. skips were collected from the Works comprising 4 x timber skips weighing 16,580 kg and 1 x bulky waste skip weighing 15,000 kg.

  The certificate for the waste skips removed and the individual skip dockets are provided in Appendix D.

  Note: The abandoned farmhouse and sheds, located at the western extent of the Site, were not required to be demolished at the time of tender award and these items were removed from the project contract.

- **Backfilling of Fissures and Crown Holes**: The backfilling of the fissures on Main Pitch, the Training Pitch, the Junior Pitch and the West Field was resolved by the vegetation and topsoil removal and the subsequent re-profiling of these areas to gain material for infilling of the subsidence area meant that the cut was typically greater than the fissure depth. Similarly, the fissures in the car park area were resolved during the demolition works and subsequent regrading of the gravel surface.

  The crown holes were pumped down, and the bases were infilled and compacted in layers of approx. 0.5m depth with the inert material recovered from the demolition of the buildings. The inert material was then overlain with soil material sourced from the re-profiling works and placed and compacted in approx. 0.35m depth layers to surface.

  A new sinkhole opened in April 2020, during the COVID-19 hiatus. Following a 4-week assessment and monitoring period, this sinkhole was pumped down and infilled with quarry blast rock fill (approx. 150 m^3) sourced from Carrickamore Quarry, Co. Monaghan. The blast rock fill was placed to within ≈1.5m of the surface, overlain with a filter and separation geotextile and the restoration was completed with soil material sourced from the re-profiling works and placed and compacted in approx. 0.35m depth layers to surface.

- **Re-Profiling, Grading and Drainage:** The re-profiling and grading works commenced during Week 4 and were largely completed by Week 9. A stockpile of soil material was stored nearby the remaining central portion of the Site to complete this area following the hiatus. This soil material was spread, compacted and graded following the resumption of the Works on 18 May 2020.

  A re-profiling design for the Site was provided with the Tender Documents. SEM proposed an alternate design which involved stripping the vegetation and topsoil from a wider area and lessening the grades towards the proposed drainage channel. The alternate design was approved for the Works.

The Site has originally drained to the north via a ditch located between the Training Area and the West Field. A new drainage channel was constructed along a similar route but at a higher elevation corresponding to the re-profiled Site and the previous discharge point was at a suitable elevation to be restored.

The re-profiled Site now drains to the central portion and subsequently flows passively by gravity via the new drainage channel to the previous draining point at the northern boundary.

A comparison of the pre- and post-work surveys estimated a cut of 38,114 m^3 for the re-profiling works with 17,1892 m^3 filled in areas that were previously covered by ponded water following the subsidence event and 20,222 m^3 filled in areas above the ponded water.

- **Boundary Fencing:** SGCPI had fenced-off the disturbance zone, for approximately 50 m beyond the extent of the tension cracks, following the subsidence event in September 2018.

  SEM completed the removal and stockpiling of the heras fencing (approx. 1,150m) on 14 January 2020 and the material was stockpiled at a designated location on the Drummond Mine Plant.

  Following the appearance of a new sinkhole in April 2020, SGCPI arranged for the wire and post fencing with warning signage at an offset of circa 100m from the sinkhole. This fencing and signage remained post-works.

  Note: No permanent security fencing of the site boundary or the security gates were required at the completion of the Works and these items were removed from the project contract.

- **Demobilization:** The bulk of the demobilization occurred in Week 10 at the end of October 2019. SEM remobilized to Site with a smaller work crew and plant on 18 May 2020 and demobilized again during the week beginning 01 June 2020.

  A site walkover and snag list were conducted on 02 June 2020 and the snag items were considered closed-out on 25 June 2020.

  An aerial survey of the completed Site was conducted on 09 June 2020 and the aerial image is shown on the report cover. SEM conducted a walkover topographic survey on 15 June 2020, and this is provided with the drawing set in Appendix A.

5.0 ADDITIONAL WORKS

During the Works, the water connection to the buildings was disconnected. This disconnection also resulted cutting off the supply to one of the neighbouring houses (Raferty's).

Following consultation with the Magheracloone Group Water Scheme, a new 2" connection was agreed to be installed to the neighbouring house and a new stop-valve and chamber were installed just inside the former entrance gate to the Magheracloone GAA Club.

6.0 PLANT

The levels of plant and personnel varied throughout the project. The list below is indicative of the peak project activity during Week 3 and Week 4 of the project.

- 1 x 22.5 tonne Doosan Long-Reach Excavator
- 2 x 14 tonne Doosan Excavators

- 1 x 13 tonne Komatsu Excavator with Flail / Mulcher
- 1 x 5 tonne Bob Cat Excavator
- 1 x Hitachi Back-hoe
- 2 x Komatsu PX 65 Dozers
- 1 x 10 tonne Vibromax 1405 vibrating Roller
- 1 x Case Teleporter
- 1 x New Holland Teleporter
- 2 x Volvo A25C Dump Trucks
- 1 x 9 tonne Twaites Dumper
- 1 x New Holland 235 Tractor;
- 1 x 6" Super Wispa 100 submersible pump; and
- 1 x 'Siltbuster' silt trap

7.0 DRAWINGS

A full set as-built drawings have been prepared and are provided in Appendix A.

Table 1: List of Drawings

Drawing Number	Title
101	Site Location Plan (March 2019) and Drawing List
102	Existing Contours (March 2019)
103	Plans and Elevations of Demolished Buildings – Sheet 1 of 2
104	Plans and Elevations of Demolished Buildings – Sheet 2 of 2
105	Existing and As-Built Sections A to E (June 2020)
106	As-built Contours (June 2020)
107	As-built Contours with background Aerial (June 2020)

8.0 CONSTRUCTION SUPERVISION AND CQA MANAGEMENT

The construction supervision and CQA hierarchy for the project is shown below.

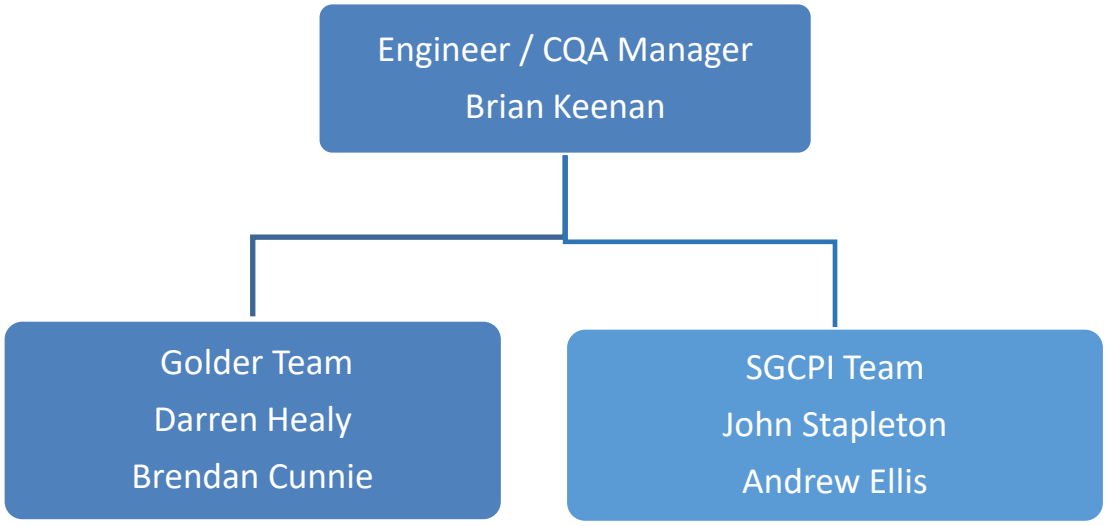

Figure 1: Construction Supervision and CQA Hierarchy

During the construction Works, a member of the Golder Team typically attended site twice weekly and a member of the SGCPI Team attended site daily.

Progress meetings were conducted weekly and SEM provided a weekly update on progress, staffing, plant and proposed activities.

SEM conducted Safety Inspections / Walkovers on a weekly basis and issued a summary of observations and action items. SGCPI conducted a safety audit of the Works and SEM compound during September 2019.

There were no occurrences of safety or environmental incidents or near-misses during the Works.

8.1 CQA Compliance Statement

It is the opinion of the Engineer / CQA Manager and the SGCPI Team that the Works carried out for the Remediation of the Disturbance Zone: Magheracloone GAA Grounds were carried out and completed in accordance with the project objectives and the tender documents.

9.0 REFERENCES

Golder 2019A, Tender Documents, Remediation of the Disturbance Zone, Magheracloone GAA Grounds, 19120130.R01.A0, Instructions to Tenderers, 19120130.R02.A0, Volume A: Works Requirements, Specifications and Drawings, 19120130.R03.A0, Volume B: Form of Tender, 19120130.R04.A0, Volume C: Bill of Quantities, 19120130.R0.B0, Golder Associates Ireland Limited, May 2019

Golder 2019B, Remediation of the Disturbance Zone, Magheracloone GAA Grounds, 19120130.R06.A0, Design Stage Safety and Health Plan, Golder Associates Ireland Limited, August 2019

SIGNATURE PAGE

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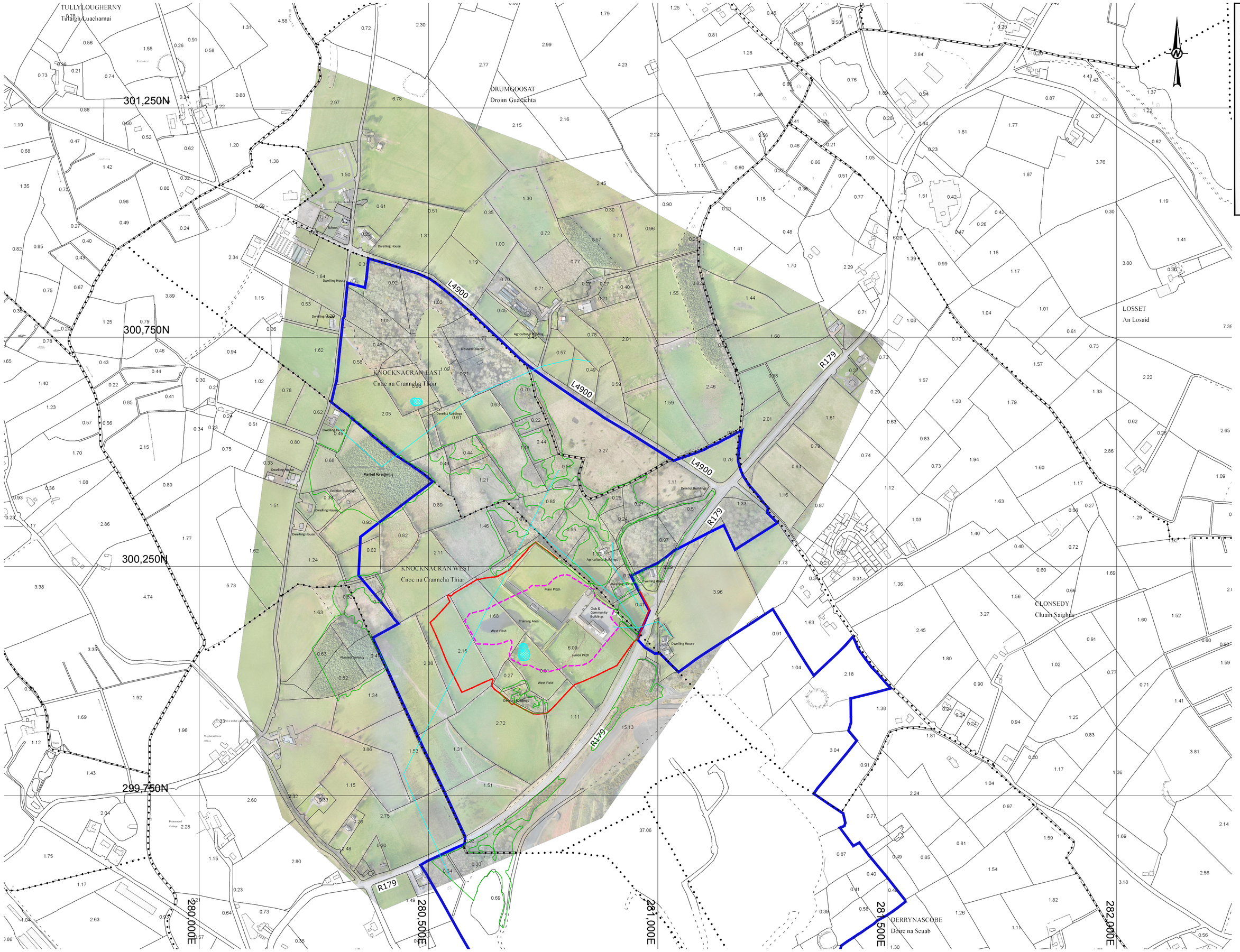
APPENDIX A

Drawings



OSI Map Series:
Raster 1
1:5000

1687
REVISION DATE = 14-Jun-2009
SURVEY DATE = 31-Jul-2000

1670
REVISION DATE = 14-Jan-2014
SURVEY DATE = 31-Jul-2000

1704
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1705
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1626
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1:2500

1686-B
REVISION DATE = 27-Mar-2015
SURVEY DATE = 17-Dec-2003

1687-A
REVISION DATE = 27-Mar-2015
SURVEY DATE = 15-Jan-2004

1687-B
REVISION DATE = 27-Mar-2015
SURVEY DATE = 15-Jan-2004

1687-C
REVISION DATE = 30-Mar-2016
SURVEY DATE = 31-Aug-2003

1686-D
REVISION DATE = 30-Mar-2016
SURVEY DATE = 31-Oct-2002

Projection:
Irish National Grid

DRAWING No.:	DRAWING TITLE:
101	SITE LOCATION PLAN & DRAWING LIST
102	EXISTING CONTOURS (MARCH 2019)
103	PLANS & ELEVATIONS OF DEMOLISHED BUILDINGS- SHEET 1 OF 2
104	PLANS & ELEVATIONS OF DEMOLISHED BUILDINGS- SHEET 2 OF 2
105	EXISTING AND AS-BUILT SECTIONS A TO E (JUNE 2020)
106	AS-BUILT CONTOURS (JUNE 2020)
107	AS-BUILT CONTOURS WITH BACKGROUND AERIAL (JUNE 2020)

LEGEND:
- LANDS UNDER CONTROL OF APPLICANT
- FENCED AREA
- DISTURBANCE ZONE
- CROWN HOLE
- POWER LINES

OSI Licence No.:
AR 0056019

NOTES:

GRID REFERENCES ARE IN METRES & TO IRISH NATIONAL GRID

DIMENSIONS ARE IN METRES.

DRONE BACKGROUND IMAGE AS SUPPLIED BY ASM (Mar. 19)

0 200 400 600m
1:5,000

RECEIVED: 11/04/2023

CLIENT
SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

CONSULTANT
GOLDER

YYYY-MM-DD	2020-Jul-03
PREPARED	POB
DESIGN	BK
REVIEW	DH
APPROVED	BK

PROJECT
CQA REPORT: REMEDIATION OF DISTURBANCE ZONE MAGHERACLOONE GAA GROUNDS

TITLE
SITE LOCATION PLAN (MARCH 2019) & DRAWING LIST

PROJECT No.	DRAWING No.	Rev.	SCALE
19120130	101	A	1:5,000 A1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A1
25 mm
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Path: C:\Users\bkeenan\Documents\Golder\Saint-Gobain_Gyproc Ireland\Magheraveelcone GAA\Drawings\CQA Report\ | File Name: 101 - Site Location Plan & Drawing List.dwg

KNOCKNACRAN WEST
Cnoc na Cranncha Thiar

LOW LEVEL PITCH
PALADIN FENCING

MAIN PITCH

SCOREBOARD /
ADVERTISEMENT
HOARDING

STORAGE
SHED

CHANGING
ROOMS

SPECTATOR
STAND

WEST FIELD

TRAINING
AREA

CAR PARK
(GRAVEL)

MONUMENT

HAND BALL
ALLEY

COMMUNITY
CENTRE

CROWN HOLE

CROWN HOLE

JUNIOR PITCH

CONCRETE P&W
FENCING

EXISTING
ENTRANCE

R179

WEST FIELD

ABANDONED
FARMHOUSE

ABANDONED
FARM SHED

CONCRETE P&W ROAD
BOUNDARY FENCING

TEMPORARY SITE
BOUNDARY HERAS
FENCING

R179

A 107 · A' 107 · B 107 · B' 107 · C 107 · C' 107 · D 107 · D' 107 · E 107 · E' 107

0 40 80 120m
1:1,000

RECEIVED: 11/04/2023

LEGEND:

- LANDS UNDER CONTROL OF APPLICANT
- TEMPORARY HERAS FENCING
- OVERHEAD POWER LINES
- 1050 EXISTING GROUND CONTOUR (Mine Datum)
- DISTURBANCE ZONE OUTLINE
- SURFACE CRACKING
- FISSURE
- GATES
- GOALS - Fixed
- GOALS - Mobile
- BALL STOP

SURFACE HATCHING:

- CONCRETE
- GRASS
- GRAVEL
- PONDING
- CROWN HOLE
- STRUCTURES
- VEGETATION

SERVICES:

- EP ELECTRICITY POLE
- FP FLAG POLE
- FL FLOOD LIGHT
- IC INSPECTION COVER
- MH MANHOLE COVER
- WM WATER METER COVER

NOTES:

GRID REFERENCES ARE IN METRES & TO IRISH NATIONAL GRID.

LEVELS ARE IN METRES & TO MINE DATUM.

DIMENSIONS ARE IN METRES.

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
PREPARED	POB
DESIGN	BK
REVIEW	DH
APPROVED	BK

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MACHERACLOONE GAA GROUNDS

TITLE

EXISTING CONTOURS (MARCH 2019)

PROJECT No.	DRAWING No.	Rev.	SCALE
19120130	102	A	1:1,000 A1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A1

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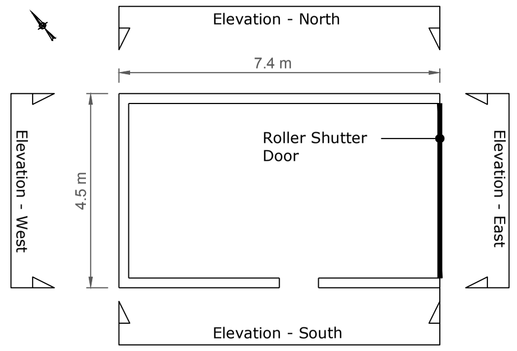
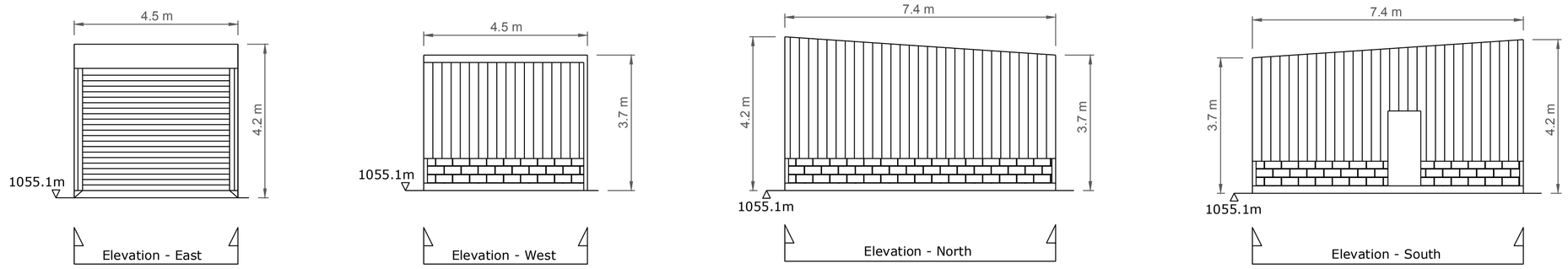
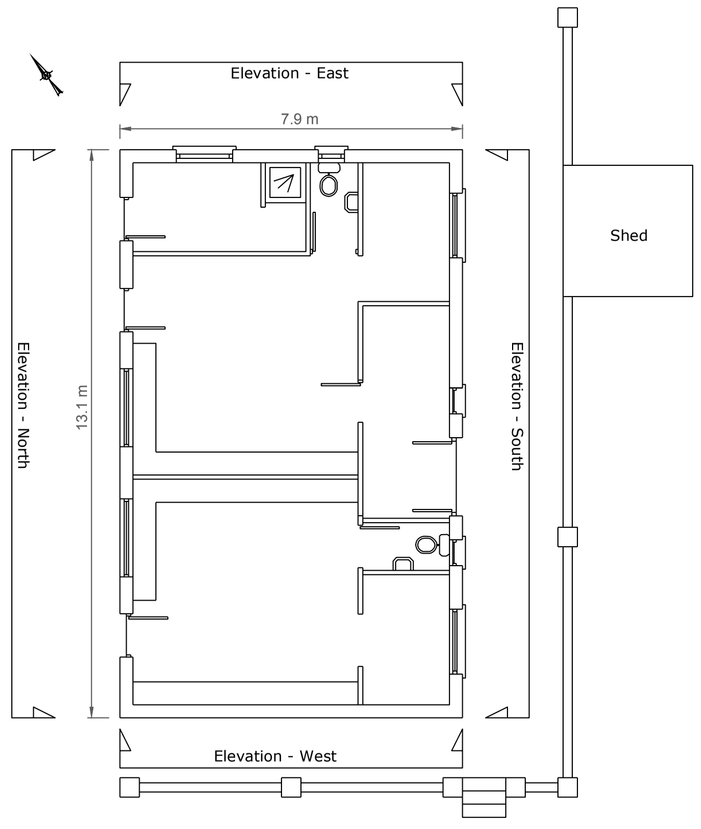
Path: C:\Users\tkeenan\Documents\Golder\Saint-Gobain_Cyprus Ireland\Magheracloone GAA\Drawings\CQA Report\ | File Name: 102 - Existing Contours.dwg



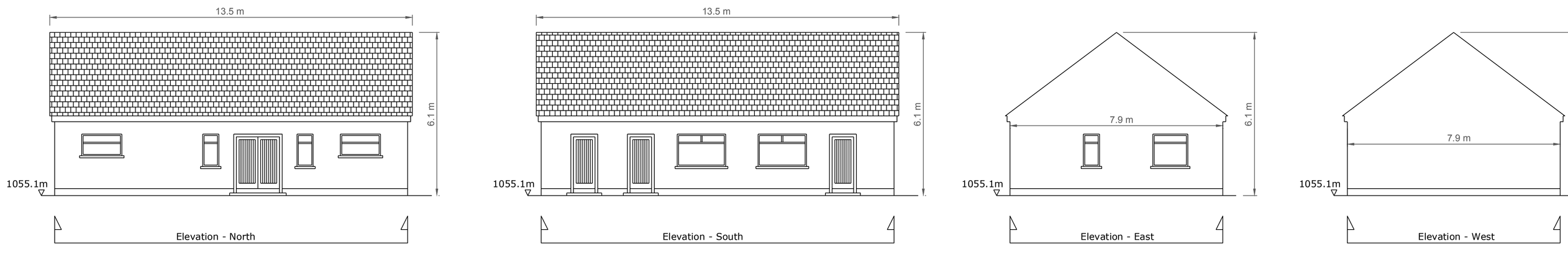
STORAGE SHED - Plan
(Scale: 1/100)



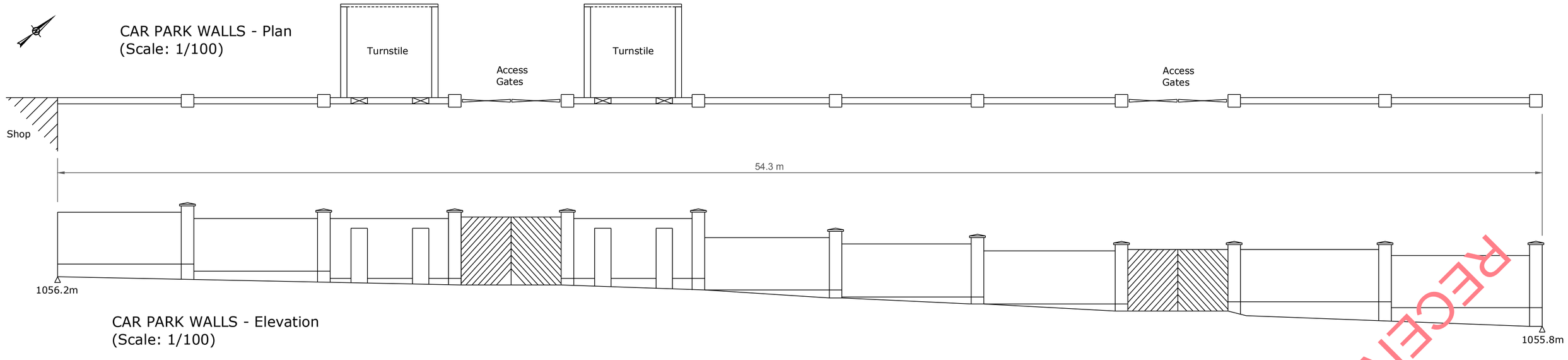
STORAGE SHED - Elevations
(Scale: 1/100)



CHANGING ROOMS - Plan
(Scale: 1/100)



CHANGING ROOMS - Elevations
(Scale: 1/100)



CAR PARK WALLS - Plan
(Scale: 1/100)

CAR PARK WALLS - Elevation
(Scale: 1/100)

0 4 8 12m
1:100

NOTES:

LEVELS ARE IN METRES & TO MINE DATUM.

DIMENSIONS ARE IN METRES.

CLIENT

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CONSULTANT

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PREPARED	POB
DESIGN	BK
REVIEW	DH
APPROVED	BK

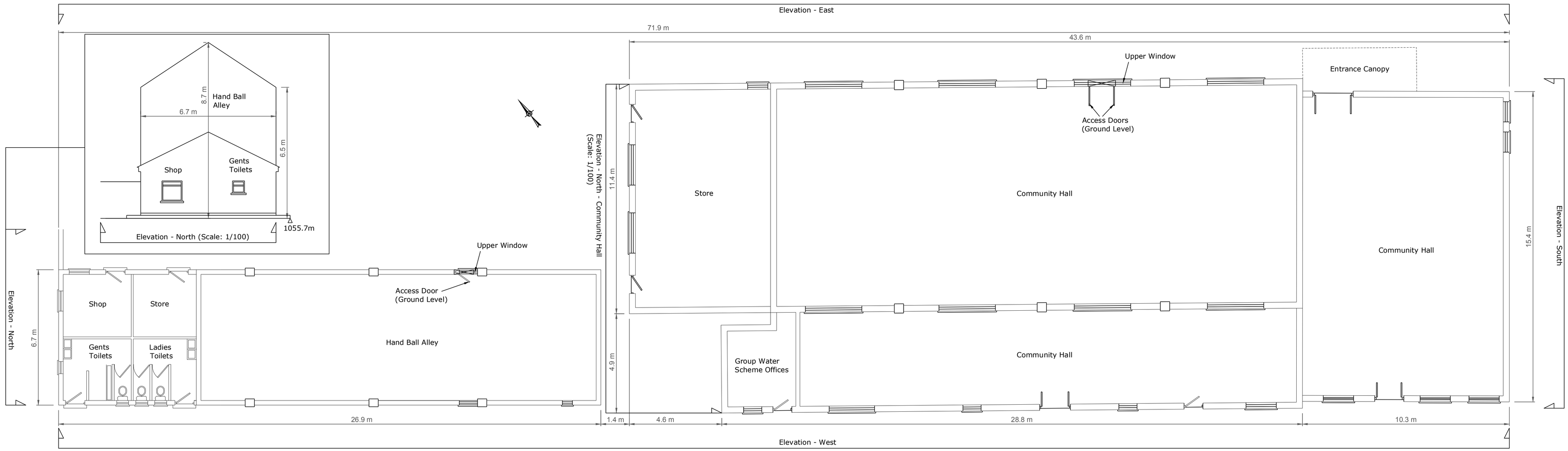
PROJECT

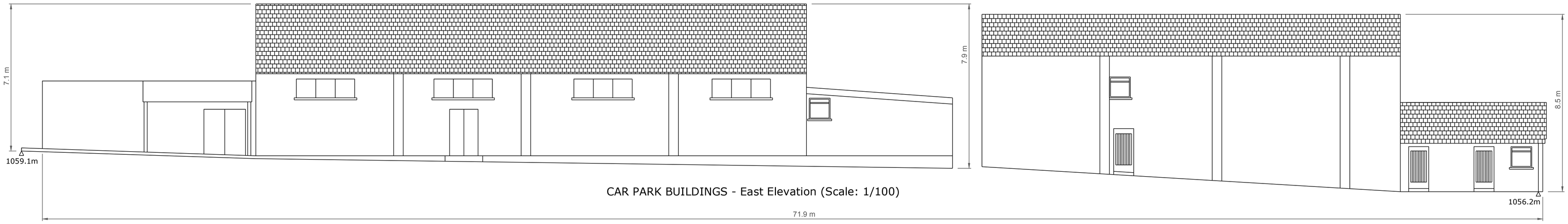
CQA REPORT: REMEDIATION OF DISTURBANCE ZONE MAGHERACLOONE GAA GROUNDS

TITLE

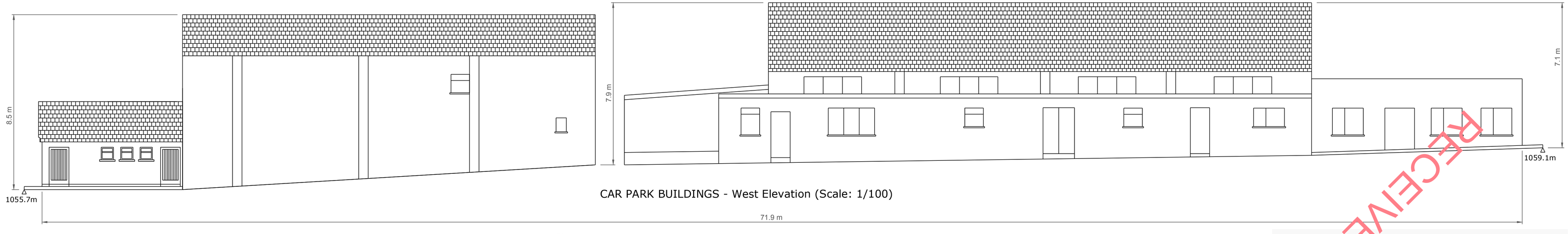
PLANS & ELEVATIONS OF DEMOLISHED BUILDINGS SHEET 1 OF 2

PROJECT No.	DRAWING No.	Rev.	SCALE
19120130	103	A	1:100 A1

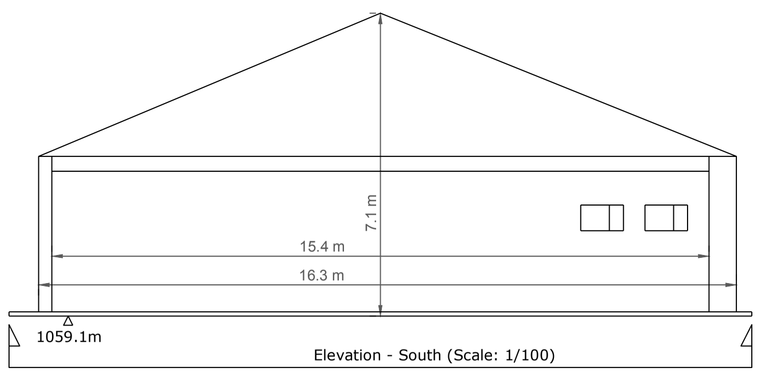


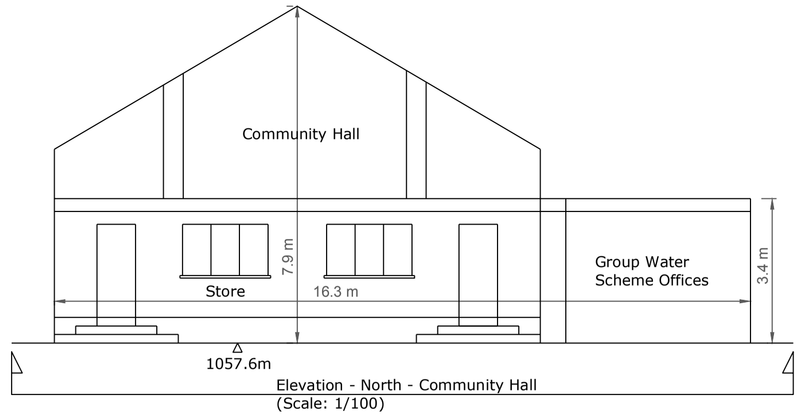


CAR PARK BUILDINGS - East Elevation (Scale: 1/100)



CAR PARK BUILDINGS - West Elevation (Scale: 1/100)





NOTES:

LEVELS ARE IN METRES
& TO MINE DATUM.

DIMENSIONS ARE IN METRES.

0 4 8 12m

1:100

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SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
PREPARED	POB
DESIGN	BK
REVIEW	DH
APPROVED	BK

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

TITLE

PLANS & ELEVATIONS OF DEMOLISHED BUILDINGS SHEET 2 OF 2

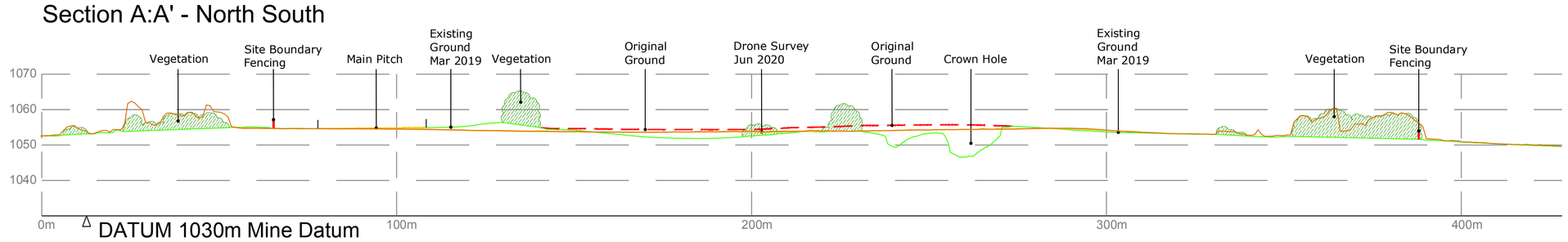
PROJECT No.	DRAWING No.	Rev.	SCALE
19120130	104	A	1:100 A1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A1

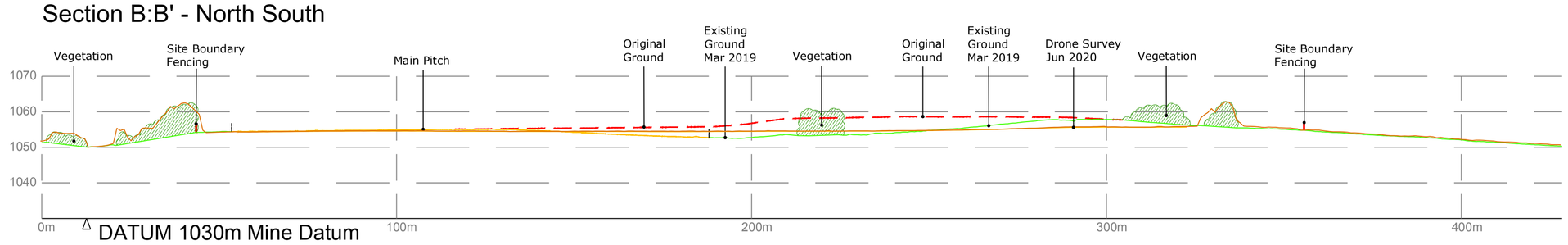
0 25 mm

Path: C:\Users\bkeenan\Documents\Golder\Saint-Gobain_Gyproc Ireland\Magheracloone GAA\Drawings\CQA Report\ | File Name: 103 and 104 -Building Plan & Elevations.dwg

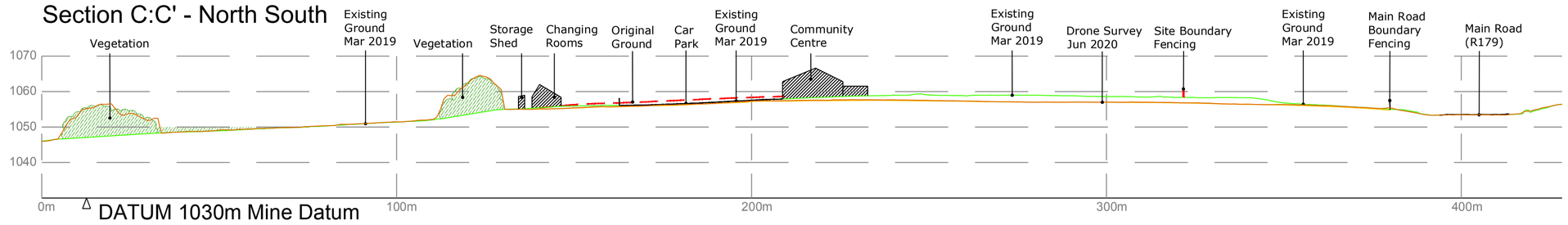
Section A:A' - North South



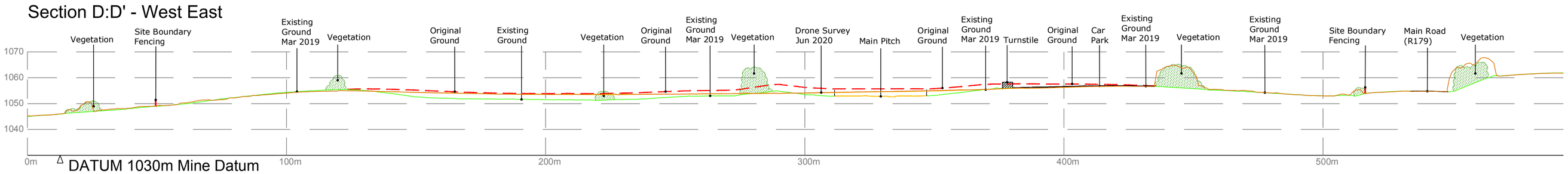
Section B:B' - North South



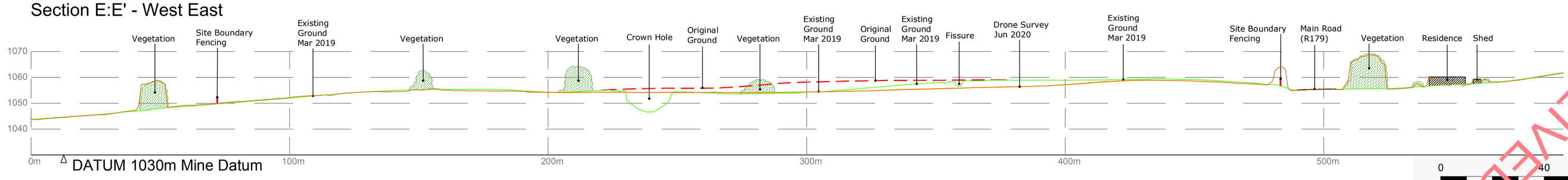
Section C:C' - North South



Section D:D' - West East



Section E:E' - West East



0 40 80 120m
1:1,000

RECEIVED: 11/04/2023

NOTES:

GRID REFERENCES ARE IN METRES & TO IRISH NATIONAL GRID.

LEVELS ARE IN METRES & TO MINE DATUM.

DIMENSIONS ARE IN METRES.

SEE DRAWING 102 FOR CROSS SECTION PLAN LOCATIONS

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
PREPARED	POB
DESIGN	BK
REVIEW	DH
APPROVED	BK

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

TITLE

EXISTING & AS-BUILT SECTIONS A to E

PROJECT No.	DRAWING No.	Rev.	SCALE
19120130	105	A	1:1,000 A1

Path: C:\Users\bkeenan\Documents\Golder\Saint-Gobain_Cyprus Ireland\Magheracloone GAA\Drawings\CQA Report\ | File Name: 105 - Existing and As-Built Sections.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A1

25 mm

0

KNOCKNACRAN WEST
Cnoc na Cranncha Thiar

NEW DRAINAGE CHANNEL

DISCHARGE POINT

PREVIOUS SUBSIDENCE ZONE (TENSION CRACKS)

NEW BOUNDARY POST AND WIRE FENCE

NEW SINKHOLE APRIL 2020 (INFILLED)

PREVIOUS CROWN HOLE LOCATION

ABANDONED FARMHOUSE

ABANDONED FARM SHED

Agricultural Buildings

Dwelling House

Dwelling House

Dwelling House

R179

SITE ENTRANCE (EXISTING GATES)

NEW 2" WATER CONNECTION TO DWELLING HOUSE

A 107 — A' 107
B 107 — B' 107
C 107 — C' 107
D 107 — D' 107
E 107 — E' 107

0 40 80 120m
1:1,000

LEGEND:
- LANDS UNDER CONTROL OF APPLICANT
- BOUNDARY FENCE: POST AND WIRE
- OVERHEAD POWER LINES
- 1050 EXISTING GROUND CONTOUR (Mine Datum)
- DISTURBANCE ZONE OUTLINE
- INFILLED CROWN HOLE OUTLINES

NOTES:

GRID REFERENCES ARE IN METRES & TO IRISH NATIONAL GRID.

LEVELS ARE IN METRES & TO MINE DATUM.

DIMENSIONS ARE IN METRES.

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
PREPARED	POB
DESIGN	BK
REVIEW	DH
APPROVED	BK

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

TITLE

AS-BUILT CONTOURS (JUNE 2020)

PROJECT No.	DRAWING No.	Rev.	SCALE
19120130	106	A	1:1,000 A1

RECEIVED: 11/04/2023

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A1

25 mm

0

Path: C:\Users\bkeenan\Documents\Golder\Saint-Gobain_Cyprus Ireland\Magheracloone GAA\Drawings\CQA Report\ | File Name: 106 - As-Built Contours.dwg

NEW DRAINAGE CHANNEL

PREVIOUS SUBSIDENCE ZONE (TENSION CRACKS)

DISCHARGE POINT

KNOCKNACRAN WEST
Cnoc na Cranncha Thiar

NEW BOUNDARY POST AND WIRE FENCE

Agricultural Buildings

Dwelling House

Dwelling House

R179

SITE ENTRANCE (EXISTING GATES)

Dwelling House

NEW 2" WATER CONNECTION TO DWELLING HOUSE

NEW SINKHOLE APRIL 2020 (INFILLED)

PREVIOUS CROWN HOLE LOCATION

ABANDONED FARMHOUSE

ABANDONED FARM SHED

R179

A 107 — A' 107
B 107 — B' 107
C 107 — C' 107
D 107 — D' 107
E 107 — E' 107

0 40 80 120m
1:1,000

LEGEND:

- LANDS UNDER CONTROL OF APPLICANT
- BOUNDARY FENCE: POST AND WIRE
- OVERHEAD POWER LINES
- 1050 EXISTING GROUND CONTOUR (Mine Datum)
- DISTURBANCE ZONE OUTLINE
- INFILLED CROWN HOLE OUTLINES

NOTES:

GRID REFERENCES ARE IN METRES & TO IRISH NATIONAL GRID.

LEVELS ARE IN METRES & TO MINE DATUM.

DIMENSIONS ARE IN METRES.

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
PREPARED	POB
DESIGN	BK
REVIEW	DH
APPROVED	BK

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

TITLE

AS-BUILT CONTOURS WITH BACKGROUND AERIAL (JUNE 2020)

PROJECT No.	DRAWING No.	Rev.	SCALE
19120130	107	A	1:1,000 A1

APPENDIX B

Asbestos Survey

ABOUT SAFETY LTD.

ASBESTOS | LEAD BASED PAINT | MOULD | SILICA DUST | HAZMAT
SURVEYING & TESTING
RISK MANAGEMENT | PROJECT MANAGEMENT

Refurbishment & Demolition Asbestos Survey

Location: *Magheracloone GAA Grounds*
Magheracloone
Co. Monaghan

Client: *Eoin Smith Ltd T/A SEM Construction,*
Carlanstown, Kells
Co.Meath
Ireland

Instructing Party: *SEM Construction*

Survey Date: *29th,August 2019*

Prepared by: *John Kelleher*

Job Reference: *RD924101*

TABLE OF CONTENTS

Executive Summary

A Refurbishment and Demolition Asbestos Survey was carried out for the above property. Due to subsidence and unstable condition the buildings are to be demolished.
Below is a summary of the survey.

Ref:	Confirmed Asbestos [Requires removal and disposal as asbestos waste by a competent asbestos contractor prior to works likely to cause disturbance.]
	No visible asbestos containing materials identified in the areas inspected.

Ref:	Presumed/Strongly Presumed Asbestos & Non-Accessed Areas [Requires investigation by a competent contractor prior works likely to cause disturbance.]
9	Main Hall end room has vinyl floor tiles which were not accessible during the inspection. The floor tiles should be inspected and samples taken following demolition to ascertain whether asbestos containing.
13, 21	Integral areas of oil fire boilers are presumed to contain asbestos until proven otherwise.
General	Asbestos is presumed to be in buildings not accessible during the inspection. The buildings should be monitored by a competent person during the demolition process for materials suspected of containing asbestos.

Names and Addresses

Client Name:
Eoin Smith Ltd T/A SEM Construction,
Carlanstown, Kells
Co.Meath
Ireland

Contact:
Phone:

Instructing Party:
Eoin Smith Ltd T/A SEM Construction,
Carlanstown, Kells
Co.Meath
Ireland

Contact: **Ronan Keating**
Phone:

Site Full Name:
Magheracloone GAA Club
Magheracloone
Co. Monaghan

Report Author:
About Safety Limited
24 Oceancrest
Arklow
Co. Wicklow

Contact: **John Kelleher**
Phone:

Asbestos Surveyor: John Kelleher

British Occupational Hygiene Society (BOHS) Asbestos Proficiency Certification

S301:	Asbestos and other Fibres
P401:	Identification of Asbestos in Bulk Samples (PLM)
P402:	Building Surveys and Bulk Sampling for Asbestos
P403:	Asbestos Fibre Counting
P404:	Air Sampling and Clearance Testing of Asbestos
P405:	Management of Asbestos in Buildings (Safe Removal & Disposal)

iosh Chartered Safety and Health Practitioner

Introduction

About Safety Ltd. was instructed to carry out a Refurbishment and Demolition Asbestos Survey of the above property. The survey and sampling was carried out taking cognizance of the requirements of the Health and Safety Executive (UK) document, *HSG 264, Asbestos: The Survey Guide.*

Objectives

The objectives of this survey were to:

To carry out a survey to ascertain the presence of asbestos based materials.
To carry out a survey to locate and describe, as far as reasonably practicable, all asbestos containing materials prior to refurbishment/demolition.
To gain access to all areas, as necessary, to determine the extent of any asbestos that may be present.
To sample and estimate the extent and volume of any asbestos materials that may be present.
To generate asbestos material assessments where the period between the survey and event is significant i.e. more that 3 months.
To produce a report identifying areas containing asbestos to be used as a basis for tendering their removal.
To instigate asbestos removal works prior to refurbishment/demolition.

NB: The extent of asbestos containing materials if identified in this report are only approximate and should not be relied upon as a basis for tendering removal works. Contractors tendering works are expected to satisfy themselves by site visit and measurement the exact nature and extent of any works which is proposed.

Scope of Works & Site Description

General Information	***Scope of Works:***	**Demolition of buildings**
	Date of Construction:	**Various**
External Aspects:	***Roofs:***	**Concrete tiles on pitched roofs. Felt on flat roofs.**
	Facades:	**Plaster finishes.**
Internal Aspects:	***Walls:***	**Cavity block walls.**
	Ceilings:	**Plasterboard**
	Floors:	**Concrete floors generally, timber flooring in assembly hall.**
	Insulation:	**MMMF in attics**
Services:	***Heating Systems:***	**Wall mounted gas heaters in assembly hall.**
	Other:	**Oil fire central heating boilers in the Handball Alley and bottom dressing room building.**
Reservations:	***Access restrictions:***	**Due to the precarious nature of the buildings access was prohibited internally. Survey was based on a visual inspection through doors and wall opes.**

Survey Limitations

All areas accessed for proposed refurbishment works were subjected to a survey taking cognisance of the requirements of HSG 264, Asbestos: The Survey Guide. The investigation consisted of an inspection of each room and area to be impacted by the works.
No report has been made on any concealed spaces, which may exist within the fabric of the building where the extent and presence of these is not evident due to inaccessibility, lack of building drawings or insufficient knowledge of the structure of the building at the time of the survey.

Inaccessible Areas: Electrical equipment such as, boiler units, water heaters, storage heaters, fuse or switch boards. Within floor or wall structures, behind wall or ceiling cladding or within blocked up chimneys. Within internal areas of fire doors unless asbestos observed from keyhole or other damaged areas. Care should always be exercised when working on any electrical equipment in particular the older styles as asbestos-containing materials may be present.

Asbestos Refurbishment & Demolition Survey: Definition

A refurbishment and demolition survey is needed before any refurbishment or demolition works is carried out. This type of survey is used to locate and describe, as far as reasonably practicable, all ACM's in the area where the refurbishment works will take place or in the whole building if demolition is planned. The survey will be fully intrusive and involve destructive inspection, as necessary, to gain access to all areas, including those that may be difficult to reach. A refurbishment and demolition survey may also be required in other circumstances, e.g. when more intrusive and maintenance and repair work will be carried out or for plant removal and dismantling.
Where the refurbishment or demolition works may not take place for a significant period after the survey (e.g. three months), then the information required for a management survey should be obtained.

Asbestos Contaminated Soils (ACS)

The first point of contact with soil or ground contaminated with asbestos will be during site investigations and exploratory ground works. This may be defined as asbestos operative related work and applies where there is a potential for sporadic or low intensity exposure. People directly involved in these preliminary works, geotechnical engineers and ground workers, should receive formal training enabling them to work safely where asbestos could be present in the ground as a consequence of legacy use issues with the land. In principle, the general tiered approach to the assessment and management of potential risks posed by ACS is the same as that for any other contaminant. However, the unique nature of asbestos means that different methods of analysis, exposure estimation and risk estimation are required. Importantly, soil and air analysis methods need to be more detailed than those currently and commonly used to demonstrate compliance with the Asbestos Regulations.

Material Assessment

No condition assessment is normally necessary for refurbishment and demolition surveys but, where the period between survey and the event is significant, e.g. more than 3 months, then a material assessment should be conducted and interim management arrangements put in place.

Material Assessment Algorithm

In the material assessment process, the main factors influencing fibre release are given a score which can then be added together to obtain a material assessment rating. The four main parameters which determine the amount of fibre released from an ACM when subject to disturbance are:

- **Product Type**

- **Extent of damage or deterioration**
- **Surface Treatment; and**
- **Asbestos type**

Each parameter is scored between 1 and 3. A score of 1 equivalent to a low potential for fibre release, 2 = medium and 3 = high. Two parameters can also be given a nil score (equivalent to a very low potential for fibre release). The value assigned to each of the four parameters is added together to give a total score of between 2 and 12. Presumed or strongly presumed ACM's are scored as Crocidolite (i.e. score = 3) unless there is strong evidence to show otherwise.

Materials with assessment scores of 10 or more are rated as having a high potential to release fibres, if disturbed. Scores of between 7 and 9 are regarded as having a medium potential, and between 5 and 6 a low potential. Scores of 4 or less have a very low potential to release fibres.

Analytical Techniques

Asbestos Bulk Sample Analysis is conducted by using Polarised Light and Dispersion Staining Techniques. Dispersion Staining is used to describe the colour effects produced when a transparent colourless particle or fibre is immersed in a liquid having a refractive index near to that of the particle or fibre, and is viewed under a microscope using transmitted white light (based on HSE Publication, HSG 248).

Samples were returned to About Safety Ltd. Laboratory for Analysis. Photographs were taken at all of the sample locations (unless otherwise stated).
Materials of a similar type were only occasionally sampled and it was assumed that other materials visually inspected to where the sample was taken, were of a similar composition.
Each area was viewed for suspect materials thought or known to contain asbestos and samples taken where it was considered necessary.

General Caveat

This report is based on a Refurbishment & Demolition survey of unoccupied buildings.

During the course of the survey all reasonable efforts were made to identify the physical presence of materials containing asbestos. It is known that asbestos materials are frequently concealed within the fabric of buildings or within sealed building voids so that it is not possible to regard the findings of any survey as being definite. <u>It must remain a possibility that asbestos containing materials may be found during demolition activities. For reasons set out in this report, the results cannot give an assurance that all asbestos materials have been found and must not be thought to do so.</u>

This report has been written with reference to the various Guidance Notes etc, issued, and current at the date of this report and describes circumstances at the site on the date the survey took place.

Specific Notes

Legislation and Codes of Practice

The Safety, Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 to 2010, apply to work where there is or may be asbestos fibres present. These regulations apply in particular to any person or employer working with or removing asbestos.

In addition, Safety, Health and Welfare at Work (Construction) Regulations 2013 (SI 291 of 2013) also apply to any building, installation, repair, demolition and asbestos removal work.

Information about working with material containing asbestos cement is containing in Health and Safety

Authority's document " Guidelines on Working with Materials Containing Asbestos Cement".

Provision of information

It is recommended that this report is brought to the attention of any person likely to be involved in refurbishment/demolition works.

Once asbestos materials have been identified it is essential that appropriate remedial measures be introduced prior to any structural alterations, refurbishment or demolition works commencing. All the asbestos removal works should be carried out by a competent asbestos removal contractor in accordance with Asbestos at Work Regulations 2006 to 2010. Statutory notification requirements of 14 days are required under the provisions of the Asbestos Regulations for certain works involving asbestos. The contractor appointed for removal works is responsible for deciding if a 14 day notification is required and for drawing up a plan of work for any removal works.

Appendix A – Asbestos Bulk Identification Report

ASBESTOS BULK IDENTIFICATION REPORT

Report on:
Identification of asbestos content of suspected asbestos containing materials (ACM's) sampled from the following location/site:

Magheracloone GAA Club

TEST RESULT

SAMPLE NO	LAB. REF.	SAMPLE LOCATION	MATERIAL DESCRIPTION	ASBESTOS TYPE IDENTIFIEID
Jkb19082901	**1924101**	**Main Hall Building Flat roof to side over Strammit board**	**Roofing felts**	**NADIS**
Jkb19082902	**1924102**	**Handball Alley single storey gable end**	**Slate over facia board**	**NADIS**
Jkb19082903	**1924103**	**Lower Changing rooms at pitch**	**Slate over facia board**	**NADIS**

Glossary

*NADIS = No Asbestos Detected in Sample Chrysotile (white asbestos) Amosite (brown asbestos) Crocidolite (blue asbestos)
VFT = Vinyl Floor Tile

Analyst: John Kelleher

Appendix B – Schedule of Survey Sheets

Ref No.	Building	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
1	Main Hall	Roof		Concrete tiles to roof		NAD							
2	Main Hall	Assembly Area		Timber flooring throughout		No visible asbestos containing materials identified							
3	Main Hall	Assembly Area		Plasterboard		No visible asbestos containing materials identified							
4	Main Hall	Roofs		Natural quarry slate over facia board.		NAD							

Key	Confirmed Asbestos
NAD = No asbestos detected AIB = Asbestos insulation board AC = Asbestos cement VFT = vinyl floor tile NQ = Not Quantified/Quantifiable SM = Square Meters LM = Linear Meters	Presumed/Strongly presumed ACM Or Non Accessed Area

Material Assessment Score	Risk
≤ 4	Very Low
5 - 6	Low
7 - 9	Medium
≥ 10	High

No condition assessment is normally necessary for refurbishment and demolition surveys but, where the period between survey and the event is significant, e.g. more than 3 months, then a material assessment should be conducted and interim management arrangements put in place.

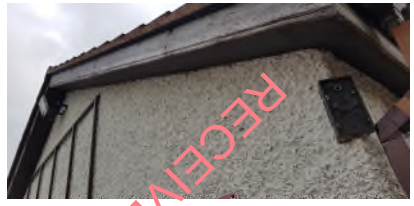
Ref No.	Building	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
5	Main Hall	Extension		Constructed circum 2000.		NAD							
6	Main Hall	Old single storey wing	1924101	Felts over Strammit board		NAD							
7	Main Hall	Boiler room		Modern gas boiler installation		No visible asbestos containing materials identified							
8	Main Hall	Office		Modern lino to floor		No visible asbestos containing materials identified							

Key
NAD = No asbestos detected
AIB = Asbestos insulation board
AC = Asbestos cement
VFT = vinyl floor tile
NQ = Not Quantified/Quantifiable
SM = Square Meters
LM = Linear Meters

Confirmed Asbestos
Presumed/Strongly presumed ACM Or Non Accessed Area

Material Assessment Score	Risk
≤ 4	Very Low
5 - 6	Low
7 - 9	Medium
≥ 10	High

No condition assessment is normally necessary for refurbishment and demolition surveys but, where the period between survey and the event is significant, e.g. more than 3 months, then a material assessment should be conducted and interim management arrangements put in place.

Ref No.	Building	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
9	Main Hall	End Room		VFT and adhesive		Presumed to contain asbestos						Investigation by a competent contractor following demolition and access.	
10	Main Hall	Foundations		Plastic DPC		NAD							
11	Handball Alley Bld.	Gable end		Slate over facia board		NAD							
12	Handball Alley Bld.	Gable end	1924102	Slate over facia board		NAD							

Key		Material Assessment Score	Risk
NAD = No asbestos detected AIB = Asbestos insulation board AC = Asbestos cement VFT = vinyl floor tile NQ = Not Quantified/Quantifiable SM = Square Meters LM = Linear Meters	Confirmed Asbestos	≤ 4	Very Low
		5 - 6	Low
		7 - 9	Medium
		≥ 10	High
	Presumed/Strongly presumed ACM Or Non Accessed Area	No condition assessment is normally necessary for refurbishment and demolition surveys but, where the period between survey and the event is significant, e.g. more than 3 months, then a material assessment should be conducted and interim management arrangements put in place.	

Ref No.	Building	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
13	Handball Alley Bld.	Boiler room		Integral areas of boiler		Presumed to contain asbestos gaskets						Investigation by a competent contractor prior to disposal.	
14	Handball Alley Bld.	Tank room				No visible asbestos containing materials identified							
15	Handball Alley Bld.	WC's				No visible asbestos containing materials identified							
16	Handball Alley Bld.	WC's				No visible asbestos containing materials identified							

Key
NAD = No asbestos detected
AIB = Asbestos insulation board
AC = Asbestos cement
VFT = vinyl floor tile
NQ = Not Quantified/Quantifiable
SM = Square Meters
LM = Linear Meters

Confirmed Asbestos
Presumed/Strongly presumed ACM Or Non Accessed Area

Material Assessment Score	Risk
≤ 4	Very Low
5 - 6	Low
7 - 9	Medium
≥ 10	High

No condition assessment is normally necessary for refurbishment and demolition surveys but, where the period between survey and the event is significant, e.g. more than 3 months, then a material assessment should be conducted and interim management arrangements put in place.

Ref No.	Building	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
17	Handball Alley Bld.	Kit room				No visible asbestos containing materials identified							
18	Handball Alley Bld.	Store room				No visible asbestos containing materials identified							
19	Handball Alley Bld.	Hallway				No visible asbestos containing materials identified							
20	Dressing Room Bld. by Pitch	Gable ends	1924103	Slate strip over facia board		NAD							

Key	Confirmed Asbestos
NAD = No asbestos detected AIB = Asbestos insulation board AC = Asbestos cement VFT = vinyl floor tile NQ = Not Quantified/Quantifiable SM = Square Meters LM = Linear Meters	Presumed/Strongly presumed ACM Or Non Accessed Area

Material Assessment Score	Risk
≤ 4	Very Low
5 - 6	Low
7 - 9	Medium
≥ 10	High

No condition assessment is normally necessary for refurbishment and demolition surveys but, where the period between survey and the event is significant, e.g. more than 3 months, then a material assessment should be conducted and interim management arrangements put in place.

Ref No.	Building	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
21	Dressing Room Bld. by Pitch	Boiler room		Integral areas of boiler		Presumed to contain asbestos gaskets						Investigation by a competent contractor prior to disposal.	
22	Dressing Room Bld. by Pitch	Shower room				No visible asbestos containing materials identified							
23	Dressing Room Bld. by Pitch	Dressing room				No visible asbestos containing materials identified							

Key		Material Assessment Score	Risk
NAD = No asbestos detected AIB = Asbestos insulation board AC = Asbestos cement VFT = vinyl floor tile NQ = Not Quantified/Quantifiable SM = Square Meters LM = Linear Meters	Confirmed Asbestos	≤ 4	Very Low
		5 - 6	Low
		7 - 9	Medium
		≥ 10	High
	Presumed/Strongly presumed ACM Or Non Accessed Area	No condition assessment is normally necessary for refurbishment and demolition surveys but, where the period between survey and the event is significant, e.g. more than 3 months, then a material assessment should be conducted and interim management arrangements put in place.	

APPENDIX C

Sign-off for Returned Items

Itemised collection record for Magheracloone GAA

All items leaving the site must be recorded and GAA representative to sign once received

Item no.	Description	
1	Balls	34
2	Jerseys	23
3	Hats	4
4	Training bags	3
5	Water bottles	10
6	Flag Poles	3
7	Trampoline	1
8	Medic bag	2
9	Stretcher	1
10	Nets	2
11	bibs	17
12	Burco boiler	1
13	flagpoles	37
14	Balls	25
15	Training Cones	22
16	Plaque	1
17	Trophy	1
18	Security Cameras	3
19	National lottery Plaque	1
20	Monaghan Gaa Photo.	1
21	1 Pitch development Sign	1
22	Defibrillator	1
23		
24		
25		
Date		
	Signed GAA reprersenative	GAA
	Signed Site Foreman	Mark Lafferty.

Return Record to John Stapleton, Mine Site

Itemised collection record for Magheracloone GAA

All items leaving the site must be recorded and GAA representative to sign once received

Item no.	Description	Qty
1	Fence panels	180
2	Ball stop poles + Nets	8
3	Score board + remote controle	1
4	Dugout	2
5	Gates for Fence panel	4
6	Legs for fence panel	183
7	Cross members for fence panel	96
8	[redacted]	1
9	Tracys hotel Sponsor Sign	1
10	Arch over Main gate	1
11	Goal posts + Nets	2
12		
13	BBQ	1
14	[redacted]	1
15	2 Wall plaques	2
16	Box for defib.	1
17		
18		
19		
20		
21		
22		
23		
24		
25		
Date		
	Signed GAA reprersenative	
	Signed Site Foreman	

Return Record to John Stapleton, Mine Site

Itemised collection record for Magheracloone GAA	
All items leaving the site must be recorded and GAA representative to sign once received	
Item no.	Description
1	Paint
2	Flags
3	Fence panels
4	Signs
5	ladder x 2
6	Fence posts
7	lawn mower
8	Tractor and mower
9	Transport box
10	Small Goals x 4
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
Date	
	Signed GAA reprersenative
	Signed Site Foreman
Return Record to John Stapleton, Mine Site	

Itemised collection record for Magheracloone GAA	
All items leaving the site must be recorded and GAA representative to sign once received	
Item no.	Description
1	Reed chairs QTY 50
2	Black chairs Cusions " 13
3	plastic chairs " 49
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
Date	
	Signed GAA reprersenative Mattie Carroll Community Centre
	Signed Site Foreman
Return Record to John Stapleton, Mine Site	

Itemised collection record for Magheracloone GAA	
All items leaving the site must be recorded and GAA representative to sign once received	
Item no.	Description
1	Bowls Stop Ends — 10
2	Bags of bowls —
3	Bowling Mats —
4	2 gas Cookers —
5	Floor Polisher —
6	Chairs — 40
7	Sheets of ply. 4
8	Steel box for bowls
9	gas Meter
10	Water tank
11	Hot Plate
12	Dish Washer Storages
13	Tables 12
14	Fire Extin 3
15	Mats 4
16	Emerengay lights
17	Lengths of timber
18	
19	
20	
21	
22	
23	
24	
25	
Date	
	Signed GAA reprersenative Community Centre
	Signed Site Foreman
Return Record to John Stapleton, Mine Site	

RECEIVED: 11/04/2023

APPENDIX D

Waste Recycling and Removal

MC ELVANEY'S
Waste & Recycling
Your Recycling Partner

Scotch Corner Recycling Centre
T: (047) 80888
E: info@mcelvaneywaste.com

McElvaney's Waste & Recycling,
Scotch Corner Recycling Centre,
Annyalla,
Castleblayney,
Co. Monaghan

RE: M&I Contracts Ltd, Magheracloone GFC, Carrickmacross, Co. Monaghan

Certificate of Waste & Recycling for September 2019

This is to confirm that the above company has collected the following rates of materials from Site at Riverside Road, Carrickmacross, Co Monaghan.

Total Number of Skips Collected by McElvaneys: 5

Total weight of all material in Kilograms: 31580 Kg's

Material/EWC Code	Skips	Weight Kg's
Timber EWC 200138	4	16580
Bulky Waste EWC 200307	1	15000
Total	5	31580

Waste Collection Permit No. NWCPO-12-06461

MC ELVANEY'S
Waste & Recycling

Your Recycling Partner

ISO 9001 CERTIFICATION EUROPE™

ISO 14001 CERTIFICATION EUROPE™

Scotch Corner Recycling Centre, Annyalla, Castleblayney, Co. Monaghan, A75 P267

T: (047) 80888 / (042) 9744230 Waste Collection Permit:NWCPO-12-06461 Vat Reg No: IE-4564291V

F 05 - S Duty of Care Note / Waste Transfer

Job No: 15317 **Job Type:** **Exchange-Link** **Lift No. : 15290**

Customer M&I Contracts Ltd : 1015761

Address Magheracloone GFC, Magheracloone, Carrickmacross,

Phone 0044792829303 Marty

Tipping Site Haggardstown L.A Louth Co. Co.

Job Date: 19/09/2019

Skip Type
20 Cubic Yard Roll On

Waste Type
~~Bulky Waste~~ Timber

EWC Code
200307

Order No.

Driver
Richard McChesney

Reg. No.
192MN268

Skip Position
Unassigned

DriverSignature: ..... Customer Signature: .....

Skip Price:

Amt Due

Payment ☐ Cheque ☐ Cash ☐ Credit Card €

Notes
4020 kgs

RECEIVED: 11/04/2023

MC ELVANEY'S
Waste & Recycling
Your Recycling Partner

ISO 9001 CERTIFICATION EUROPE™ ISO 14001 CERTIFICATION EUROPE™

Scotch Corner Recycling Centre, Annyalla, Castleblayney, Co. Monaghan, A75 P267

(047) 80888 / (042) 9744230 Waste Collection Permit:NWCPO-12-06461 Vat Reg No: IE-4564291V

QEF 05 - S Duty of Care Note / Waste Transfer

Job No: 15316 **Job Type: Exchange-Link** **Lift No. : 15291**

Customer M&I Contracts Ltd : 1015761

Address Magheracloone GFC, Magheracloone, Carrickmacross,

Phone 0044792829303 Marty

Tipping Site Scotch Corner MRF

Job Date: 19/09/2019

Skip Type
40 Cubic Yard Roll On/Ro

Waste Type
Timber

EWC Code
200138

Order No.

Driver
Richard McChesney

Reg. No.
192MN268

Skip Position
Unassigned

DriverSignature: RMC **Customer Signature:** Imelda Kelly

Skip Price:

Amt Due

Payment ☐ Cheque ☐ Cash ☐ Credit Card €

Notes

4340 kgs

RECEIVED: 13/04/2023

MC ELVANEY'S
Waste & Recycling
Your Recycling Partner

ISO 9001 CERTIFICATION EUROPE™ ISO 14001 CERTIFICATION EUROPE™

Scotch Corner Recycling Centre, Annyalla, Castleblayney, Co. Monaghan, A75 P267

T: (047) 80888 / (042) 9744230 Waste Collection Permit:NWCPO-12-06461

QEF 05 - S Duty of Care Note / Waste Transfer

Job No: 15316 Job Type: Lift Lift No. : 15291

Customer M&I Contracts Ltd : 1015761

Address Magheracloone GFC, Magheracloone, Carrickmacross, Co Monaghan

Phone 0044792829303 Marty

Tipping Site Scotch Corner MRF

Job Date: 23/09/2019

Skip Type
40 Cubic Yard Roll On/Ro

Waste Type
Timber WASTE

EWC Code
200138

Order No.

Driver
Richard McChesney

Reg. No.
192MN268

Skip Position
Unassigned

DriverSignature: ..... Customer Signature: .....

Skip Price:

Amt Due

Payment ☐ Cheque ☐ Cash ☐ Credit Card €

Notes
15000kgs

RECEIVED: 11/04/2023

MC ELVANEY'S
Waste & Recycling

Your Recycling Partner

ISO 9001 CERTIFICATION EUROPE™

ISO 14001 CERTIFICATION EUROPE™

cotch Corner Recycling Centre, Annyalla, Castleblayney, Co. Monaghan, A75 P267

T: (047) 80888 / (042) 9744230 Waste Collection Permit:NWCPO-12-06461 Vat Reg No: IE-4564291V

QEF 05 - S Duty of Care Note / Waste Transfer

Job No: 15357 **Job Type: Exchange-Link** **Lift No. : 15317**

Customer M&I Contracts Ltd : 1015761

Job Date: 23/09/2019

Order No.

Skip Type
20 Cubic Yard Roll On

Driver
Richard McChesney

Address Magheracloone GFC, Magheracloone, Carrickmacross,

Waste Type
~~Bulky Waste~~ Timber

Reg. No.
192MN268

Phone 0044792829303 Marty

EWC Code
200307

Skip Position
Unassigned

Tipping Site Haggardstown L.A Louth Co. Co.

DriverSignature: ..... Customer Signature: .....

Skip Price:

Amt Due

Payment ☐ Cheque ☐ Cash ☐ Credit Card €

Notes

RECEIVED: 11/04/2023

23980 kgs

MC ELVANEY'S
Waste & Recycling
Your Recycling Partner

ISO 9001 CERTIFICATION EUROPE™ ISO 14001 CERTIFICATION EUROPE™

Scotch Corner Recycling Centre, Annyalla, Castleblayney, Co. Monaghan, A75 P267

T: (047) 80888 / (042) 9744230 Waste Collection Permit:NWCPO-12-06461

QEF 05 - S Duty of Care Note / Waste Transfer

Job No: 15357 Job Type: Lift Lift No. : 15317

Customer M&I Contracts Ltd : 1015761

Address Magheracloone GFC, Magheracloone, Carrickmacross, Co Monaghan

Phone 00447928293030 Marty

Tipping Site Haggardstown L.A Louth Co. Co.

Job Date: 25/09/2019

Skip Type
20 Cubic Yard Roll On

Waste Type
~~Bulky Waste~~ Timber

EWC Code
200307

Order No.

Driver
Richard McChesney

Reg. No.
192MN268

Skip Position
Unassigned

DriverSignature: ..... Customer Signature:.....

Skip Price:

Amt Due

Payment ☐ Cheque ☐ Cash ☐ Credit Card €

Notes

4240 kgs.

RECEIVED: 11/04/2023

APPENDIX E

Plates

Plate 1:Disturbance Zone (June 2019)

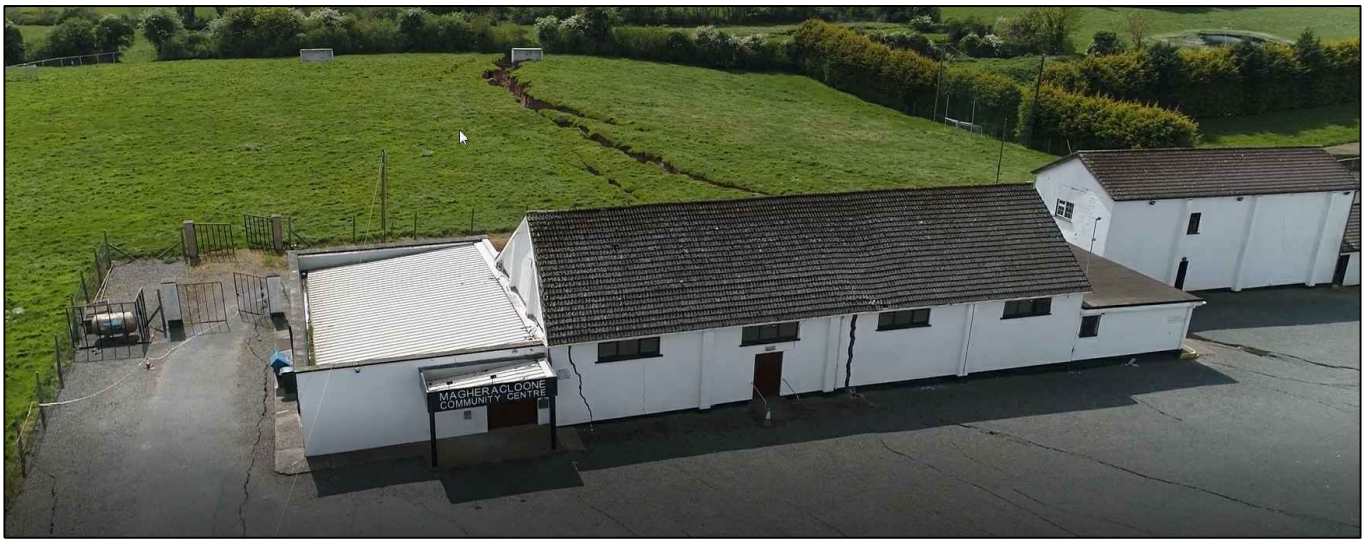


Plate 2:Magheracloone Buildings (June 2019)

Plates 3 and 4:Stripping of Vegetation and Topsoil (August 2019)

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
DESIGNED	BK
PREPARED	BK
REVIEWED	DH
APPROVED	BK

TITLE

REMEDIATION WORKS: PHOTOGRAPHIC RECORD
Plates 1 to 4

PROJECT NO.	SCALE	REV.	DRAWING
19120130	N/A	A	P1

Plates 5 and 6:Pumping and discharging ponded water (Sept 2019)

Plates 7 and 8:Tree Flailing and Mulching (Sept 2019)

Plates 9 and 10:Removal of Surface Infrastructure & Furniture (Sept 2019)

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
DESIGNED	BK
PREPARED	BK
REVIEWED	DH
APPROVED	BK

TITLE

REMEDIATION WORKS: PHOTOGRAPHIC RECORD
Plates 5 to 10

PROJECT NO.	SCALE	REV.	DRAWING
19120130	N/A	A	P2

Plate 11:Project Progress - Extent of Soil Stripping (11 Sept 2019)

Plate 12:Project Progress - Extent of Soil Stripping (11 Sept 2019)

Plates 13 and 14: Demolition of Buildings (11 Sept 2019)

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
DESIGNED	BK
PREPARED	BK
REVIEWED	DH
APPROVED	BK

TITLE

REMEDIATION WORKS: PHOTOGRAPHIC RECORD
Plates 11 to 14

PROJECT NO.	SCALE	REV.	DRAWING
19120130	N/A	A	P3

Plates 15 and 16:Demolition and Waste Segregation (16 Sept 2019)

Plates 17 and 18:Re-profiling and grading (Sept 2019)

Plates 19 and 20:Pumping down Crown Holes and Infilling (Sept 2019)

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
DESIGNED	BK
PREPARED	BK
REVIEWED	DH
APPROVED	BK

TITLE

REMEDIATION WORKS: PHOTOGRAPHIC RECORD
Plates 15 to 20

PROJECT NO.	SCALE	REV.	DRAWING
19120130	N/A	A	P4

Plates 21 and 22:Demolition and Waste Segregation (23 and 26 Sept 2019)

Plates 23 and 24:Water Ponding - deteriorating weather (30 Sept 2019)

Plate 25: Silt Removal System

Plate 26: Spreading Topsoil

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
DESIGNED	BK
PREPARED	BK
REVIEWED	DH
APPROVED	BK

TITLE

REMEDIATION WORKS: PHOTOGRAPHIC RECORD
Plates 21 to 26

PROJECT NO.	SCALE	REV.	DRAWING
19120130	N/A	A	P5

Plates 27 and 28:Infilling Crown Hole (21 Oct 2019)

Plates 29 and 30:Grading and sealing surface prior to hiatus (23 Oct 2019)

Plates 31 and 32: Final seeded surface and Drainage Channel (June 2020)

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
DESIGNED	BK
PREPARED	BK
REVIEWED	DH
APPROVED	BK

TITLE

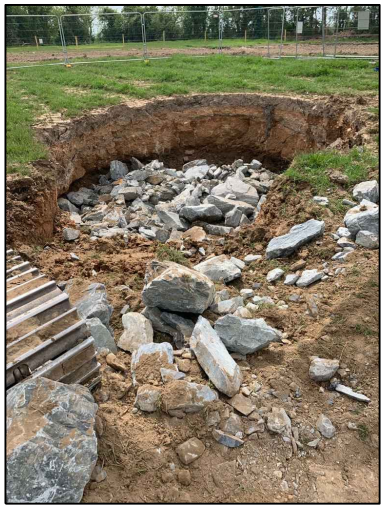
REMEDIATION WORKS: PHOTOGRAPHIC RECORD
Plates 27 to 32

PROJECT NO.	SCALE	REV.	DRAWING
19120130	N/A	A	P6

Plate 33: Discharge Point (June 2020)

Plate 34: Boundary Fence (June 2020)

Plates 35 and 36:Graded surface at location of former buildings (June 2020)



Plates 37 and 38: New sinkhole and infilling (May 2020)

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
DESIGNED	BK
PREPARED	BK
REVIEWED	DH
APPROVED	BK

TITLE

REMEDIATION WORKS: PHOTOGRAPHIC RECORD
Plates 33 to 38

PROJECT NO.	SCALE	REV.	DRAWING
19120130	N/A	A	P7

Plate 39: Completed Works (July 2020)

Plate 40: New Drainage Channel

Plate 41: Completed Works (July 2020)

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

PROJECT

CQA REPORT: REMEDIATION OF DISTURBANCE ZONE
MAGHERACLOONE GAA GROUNDS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-Jul-03
DESIGNED	BK
PREPARED	BK
REVIEWED	DH
APPROVED	BK

TITLE

REMEDIATION WORKS: PHOTOGRAPHIC RECORD
Plates 39 to 41

PROJECT NO.	SCALE	REV.	DRAWING
19120130	N/A	A	P8

golder.com

Appendix 3.2

Site Suitability Assessment for Knocknacran West Mine Welfare Facilities

HYDROCARE ENVIRONMENTAL LTD

Environmental Consultants
Cooperhill Rd., Beamore,
Drogheda, Co. Meath

Tel: 0419842378 Mob: 0877905155 / 0872208633 Email: info@hydrocare.ie

Job Ref: 19-567

19/01/2022

Planning/Environmental Dept,
Monaghan County Council,
Glen Rd,
Killygowan,
Co. Monaghan

Re: Proposed Site Characterisation Report for new Mining Development

Applicant: Saint-Gobain Mining Ltd.

Site Address: Knocknacran West, Co. Monaghan.

Planning Agent: Golder Associates Ireland Ltd., Town Centre House, Dublin Road, Naas, Co. Kildare

To Whom it Concerns,

This is to state that Hydrocare Environmental Ltd have carried out a percolation test per EPA guidelines on 14th November 2019. As expected in the locality the percolation value was very slow with T values in excess of 90.

The topsoil rate was also slow but had a better percolation value than the subsoil. It is therefore proposed to take a "belt and braces" approach by inclusion of a secondary WWTS discharging to a large raised distribution bed.

The distribution bed will be built up in a large mound to allow over 900mm depth of imported soil to underlie the sand polishing filter thus offering a high degree of effluent treatment. Refer to layout drawing herewith.

It is noted the loading from this proposed development is low and all targets can be adequately protected.

Wastewater Treatment Plant Loading:

The loadings to this development are calculated as follows as per the EPA Manual for Wastewater Treatment Manual for Small Communities Businesses, Leisure Centres and Hotels, 1999:

Normal usage would be up to 22 persons per day.

Loadings for 22 staff per day:

22 people x 40 litres/day = 880 litres/day

22 people x 25g BOD5/day= 550g BOD5/day.

1 P.E = 60gBOD

Total PE = 9.16PE

Total PE= 10 PE

HYDROCARE ENVIRONMENTAL LTD

Environmental Consultants
Cooperhill Rd., Beamore,
Drogheda, Co. Meath

Tel: 0419842378 Mob: 0877905155 / 0872208633 Email: info@hydrocare.ie

Polishing Filter Sizing

880 litres/day ÷ 60ltrs = 14.7m^2 Sand Polishing Filter bed.

10 PE x 25m^2 = 250m^2 underlying gravel bed.

Please Refer to the Site Characterisation Report included herewith.

I hope the above is to your satisfaction,

Yours sincerely,

Daniel Nolan

Daniel Nolan, BA BAI, Msc Environmental Engineering, FETAC Site Assessor, MIEI

Tel / Fax: (041) 9842378
Mobile : (087) 7905155/0872208633
Vat. No. 3349164IH
E-Mail: info@hydrocare.ie
Website: www.hydrocareenvironmental.ie

SITE CHARACTERISATION REPORT

PER

EPA Code of practice: Wastewater Treatment Systems for Single Houses (2021)

Applicant: Saint-Gobain Mining Ltd.

Site Location: Knocknacran West, Co. Monaghan

Date of Report: 19/01/2022

Prepared by:

HYDROCARE ENVIRONMENTAL LTD

SITE CHARACTERISATION FORM
COMPLETING THE FORM

Note: This form requires the latest version of Adobe Acrobat Reader

and on PC's Windows 7 or later. Windows XP produces errors in calculations

Step 1:

Goto Menu Item **File, Save As** and save the file under a reference relating to the client or the planning application reference if available.

Use the **Clear Form** button to clear all information fields.

Notes:

All calculations in this form are automatic.

Where possible information is presented in the form of drop down selection lists to eliminate potential errors.

Variable elements are recorded by tick boxes. In all cases only one tick box should be activated.

All time record fields must be entered in twenty four hour format as follows: HH:MM

All date formats are DD-MM-YYYY.

All other data fields are in text entry format.

This form can be printed out fully populated for submission with related documents and for your files. It can also be submitted by email.

Section 3.2 In this section use an underline _____ across all six columns to indicate the depth at which changes in classification / characteristics occur.

Section 3.4 Lists supporting documentation required.

Section 4 Select the treatment systems suitable for this site and the discharge route.

Section 5 Indicate the system type that it is proposed to install.

Section 6 Provide details, as required, on the proposed treatment system.

APPENDIX A: SITE CHARACTERISATION FORM

File Reference: 19-567

1.0 GENERAL DETAILS (From planning application)

Prefix: First Name: Saint-Gobain Mining Ltd. Surname:

Address:

Agent: Golder Associates Ireland Ltd., Town Centre House, Dublin Road, Naas, Co. Kildare

Site Location and Townland:

Knocknacran West, Co. Monaghan

Number of Bedrooms: Maximum Number of Residents: 4

Comments on population equivalent

PE= 10
Please refer to cover letter regarding loadings.

Proposed Water Supply:

Mains ☐ Private Well/Borehole ☐ Group Well/Borehole ☐

2.0 GENERAL DETAILS (From planning application)

Soil Type, (Specify Type): Surface water Gleys, Ground water Gleys (acidic)

Subsoil, (Specify Type): Till derived from Lower Palaeozoic sandstones and shales

Bedrock Type: Permo-Triassic Mudstones and Gypsum

Aquifer Category: Regionally Important | Locally Important | Poor PI

Vulnerability: Extreme ☐ High ☐ Moderate ☑ Low ☐

Groundwater Body: Status

Name of Public/Group Scheme Water Supply within 1 km:

Source Protection Area: ZOC ☐ SI ☐ SO ☐ Groundwater Protection Response: R1

Presence of Significant Sites (Archaeological, Natural & Historical): None evident on site or in immediate vicinity

Past experience in the area: Ground conditions usually favour secondary wastewater treatment

Comments:

(Integrate the information above in order to comment on: the potential suitability of the site, potential targets at risk, and/or any potential site restrictions).

Potential suitability of the site: Fair
Potential targets: Groundwater, Local ditch
Potential Site Restrictions: Elevated water table

Note: Only information available at the desk study stage should be used in this section.

3.0 ON-SITE ASSESSMENT

3.1 Visual Assessment

Landscape Position:	Set within relatively flat idle field		
Slope:	Steep (>1:5) ☐	Shallow (1:5-1:20) ☐	Relatively Flat (<1:20) ✔
Slope Comment			

Surface Features within a minimum of 250m (Distance To Features Should Be Noted In Metres)

Houses:

None within 50m from area tested

Existing Land Use:

idle field

Vegetation Indicators:

light patches of rushes

Groundwater Flow Direction: Southerly

Ground Condition:

Firm underfoot at time of testing

Site Boundaries:

Hedging & fencing

3.0 ON-SITE ASSESSMENT

3.1 Visual Assessment (contd.)

Roads:

Public Road is ca. 20m of area tested

Outcrops (Bedrock And/Or Subsoil):

None within 100m of area tested

Surface Water Ponding:

None within 100m of area tested

Lakes:

None within 100m of area tested

Beaches/Shellfish Areas:

None within 100m of area tested

Wetlands:

None within 100m of area tested

Karst Features:

None within 100m of area tested

Watercourses/Streams:*

Ditch drain adjacent to roadside boundary.

***Note and record** water level

3.0 ON-SITE ASSESSMENT

3.1 Visual Assessment (contd.)

Drainage Ditches:*

Ditch drain adjacent to roadside boundary.

Springs:*

None within 100m of area tested

Wells:*

No domestic wells within 100m of area tested

Comments:

(Integrate the information above in order to comment on: the potential suitability of the site, potential targets at risk, the suitability of the site to treat the wastewater and the location of the proposed system within the site).

Potential suitability of the site: Potentially suitable for secondary wastewater treatment system and polishing filter per EPA COP 2021.
Potential targets:Groundwater will require protection per R1 protection response. Ditches requires a 10m separation distance per EPA COP 2021.
Potential suitability of the site to treat wastewater: Potentially suitable for secondary wastewater treatment system and polishing filter per EPA COP 2021
Location of proposed system: Strictly as per layout attached

***Note and record** water level

3.2 Trial Hole (should be a minimum of 2.1m deep (3m for regionally important aquifers))

To avoid any accidental damage, a trial hole assessment or percolation tests should not be undertaken in areas which are at or adjacent to significant sites, (e.g. NHAs, SACs, SPAs, and/or Archaeological etc.), without prior advice from National Parks and Wildlife Service or the Heritage Service.

Depth of trial hole (m): 2.1

Depth from ground surface to bedrock (m) (if present): N/A

Depth from ground surface to water table (m) (if present): 1.2

Depth of water ingress:

Rock type (if present):

Date and time of excavation: 12-Nov-2019 07:46 Date and time of examination: 14-Nov-2019 08:00

Depth of Surface and Subsurface Percolation Tests		Soil/Subsoil Texture & Classification**	Plasticity and dilatancy***	Soil Structure	Density/ Compactness	Colour****	Preferential flowpaths
0.1 m		gravelly SILT/CLAY with humus	threads: 5,5,6 Ribbons: 80mm mildly dilatant	crumb & blocky	firm	brown	rootlets only
0.2 m							
0.3 m							
0.4 m	P1,2,3	SILT/CLAY with high clay contents occ. pebbles & cobbles	threads: 6,7,7 Ribbons: 110mm not dilatant	blocky	firm	red/ orange brown possible mottling at 0.55m BGL or most likely the soils natural coloring	none
0.5 m							
0.6 m							
0.7 m							
0.8 m	T1,2,3						
0.9 m							
1.0 m							
1.1 m							
1.2 m						WTL at 1.2m BGL	
1.3 m							
1.4 m							
1.5 m							
1.6 m							
1.7 m							
1.8 m							
1.9 m							
2.0 m							
2.1 m		END					END
2.2 m							
2.3 m							
2.4 m							
2.5 m							
2.6 m							
2.7 m							
2.8 m							
2.9 m							
3.0 m							
3.1 m							
3.2 m							
3.3 m							
3.4 m							
3.5 m							

Likely Subsurface Percolation Value: 90

Likely Surface Percolation Value: 70

Note: *Depth of percolation test holes should be indicated on log above. ('Enter Surface or Subsurface at depths as appropriate).

** See Appendix E for BS 5930 classification.

*** 3 samples to be tested for each horizon and results should be entered above for each horizon.

**** All signs of mottling should be recorded.

3.2 Trial Hole (contd.) Evaluation:

Trial hole displayed soil and subsoil with elevated CLAY content. Relatively slow percolation expected.

3.3(a) Subsurface Percolation Test for Subsoil

Step 1: Test Hole Preparation

Percolation Test Hole	1	2	3
Depth from ground surface to top of hole (mm) (A)	400	400	400
Depth from ground surface to base of hole (mm) (B)	800	800	800
Depth of hole (mm) [B - A]	400	400	400
Dimensions of hole [length x breadth (mm)]	300 x 300	300 x 300	300 x 300

Step 2: Pre-Soaking Test Holes

		1	2	3
Pre-soak start	Date	13-Nov-2019	13-Nov-2019	13-Nov-2019
	Time	09:04	09:07	09:09
2nd pre-soak start	Date	13-Nov-2019	13-Nov-2019	13-Nov-2019
	Time	21:01	21:04	21:06

Each hole should be pre-soaked twice before the test is carried out.

Step 3: Measuring T_{100}

Percolation Test Hole No.	1	2	3
Date of test	14-11-2019	14-11-2019	14-11-2019
Time filled to 400 mm	08:21	08:23	08:26
Time water level at 300 mm	12:21	11:43	11:22
Time (min.) to drop 100 mm (T_{100})	240.00	200.00	176.00
Average T_{100}			205.33

If T_{100} > 480 minutes then Subsurface Percolation value >120 – site unsuitable for discharge to ground
If $T_{100} \leq 210$ minutes then go to Step 4;
If T_{100} > 210 minutes then go to Step 5;

Step 4: Standard Method (where $T_{100} \leq 210$ minutes)

Percolation Test Hole	1			2			3		
Fill no.	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δt (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δt (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δt (min)
1	12:21	17:29	308.00	11:43	16:19	276.00	11:22	15:58	276.00
2	17:29	00:01	392.00	16:19	22:47	388.00	15:58	22:34	396.00
3	00:01	07:17	436.00	22:47	06:03	436.00	22:34	06:06	452.00
Average Δt Value			378.67			366.67			374.67
	Average Δt/4 = [Hole No.1]		94.67 (t_1)	Average Δt/4 = [Hole No.2]		91.67 (t_2)	Average Δt/4 = [Hole No.3]		93.67 (t_3)

Result of Test: Subsurface Percolation Value = 93.33 (min/25 mm)

3

Comments:

Slow subsoil percolation, not best suited for underlying a polishing filter as per EPA COP 2021.

Step 5: Modified Method (where $T_{100} > 210$ minutes)

Percolation Test Hole No. 1

Fall of water in hole (mm)	Time Factor = T_f	Start Time hh:mm	Finish Time hh:mm	Time of fall (mins) = T_m	$K_{fs} = T_f / T_m$	T – Value = 4.45 / K_{fs}
300 - 250	8.1			0.00		
250 - 200	9.7			0.00		
200 - 150	11.9			0.00		
150 - 100	14.1			0.00		
Average	T- Value		T- Value Hole 1 = (T_1)			0.00

Percolation Test Hole No. 2

Fall of water in hole (mm)	Time Factor = T_f	Start Time hh:mm	Finish Time hh:mm	Time of fall (mins) = T_m	$K_{fs} = T_f / T_m$	T – Value = 4.45 / K_{fs}
300 - 250	8.1			0.00		
250 - 200	9.7			0.00		
200 - 150	11.9			0.00		
150 - 100	14.1			0.00		
Average	T- Value		T- Value Hole 2 = (T_2)			0.00

Percolation Test Hole No. 3

Fall of water in hole (mm)	Time Factor = T_f	Start Time hh:mm	Finish Tim§e hh:mm	Time of fall (mins) = T_m	$K_{fs} = T_f / T_m$	T – Value = 4.45 / K_{fs}
300 - 250	8.1			0.00		
250 - 200	9.7			0.00		
200 - 150	11.9			0.00		
150 - 100	14.1			0.00		
Average	T- Value		T- Value Hole 3 = (T_2)			0.00

Result of Test: Subsurface Percolation Value =

2 0.00 (min/25 mm)

Comments:

3.3(b) Surface Percolation Test for Soil

Step 1: Test Hole Preparation

Percolation Test Hole	1	2	3
Depth from ground surface to top of hole (mm)	0	0	0
Depth from ground surface to base of hole (mm)	400	400	400
Depth of hole (mm)	400	400	400
Dimensions of hole [length x breadth (mm)]	300 x 300	300 x 300	300 x 300

Step 2: Pre-Soaking Test Holes

		1	2	3
Pre-soak start	Date	13-Nov-2019	13-Nov-2019	13-Nov-2019
	Time	09:17	09:20	09:22
2nd pre-soak start	Date	13-Nov-2019	13-Nov-2019	13-Nov-2019
	Time	21:09	21:12	21:14

Each hole should be pre-soaked twice before the test is carried out.

Step 3: Measuring T_{100}

Percolation Test Hole No.	1	2	3
Date of test	14-Nov-19	14-Nov-19	14-Nov-2019
Time filled to 400 mm	08:34	08:36	08:39
Time water level at 300 mm	11:34	11:28	11:23
Time to drop 100 mm (T_{100})	180.00	172.00	164.00
Average T_{100}		3	172.00

If T_{100} > 480 minutes then Surface Percolation value >90 – site unsuitable for discharge to ground
If $T_{100} \leq 210$ minutes then go to Step 4;
If T_{100} > 210 minutes then go to Step 5;

Step 4: Standard Method (where $T_{100} \leq 210$ minutes)

Percolation Test Hole	1			2			3		
Fill no.	Start Time (at 300 mm)	Finish Time (at 200 mm)	ΔT (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	ΔT (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	ΔT (min)
1	11:34	15:14	220.00	11:28	15:24	236.00	11:23	15:31	248.00
2	15:14	19:58	284.00	15:24	20:24	300.00	15:31	20:47	316.00
3	19:58	01:38	340.00	20:24	02:04	340.00	20:47	02:19	332.00
Average ΔT Value			281.33			292.00			298.67

Average ΔT/4 = [Hole No.1] 70.33 (T_1)

Average ΔT/4 = [Hole No.2] 73.00 (T_2)

Average ΔT/4 = [Hole No.3] 74.67 (T_3)

Result of Test: Surface Percolation Value = 72.67 (min/25 mm) 3

Comments:

Adequate topsoil percolation, suited for use as a polishing filter as per EPA COP 2021.

Step 5: Modified Method (where $T_{100} > 210$ minutes)

Percolation Test Hole No. 1

Fall of water in hole (mm)	Time Factor = T_f	Start Time hh:mm	Finish Time hh:mm	Time of fall (mins) = T_m	$K_{fs} = T_f / T_m$	T – Value = 4.45 / K_{fs}
300 - 250	8.1			0.00		
250 - 200	9.7			0.00		
200 - 150	11.9			0.00		
150 - 100	14.1			0.00		
Average	T- Value		T- Value Hole 1 = (T_1)			0.00

Percolation Test Hole No. 2

Fall of water in hole (mm)	Time Factor = T_f	Start Time hh:mm	Finish Time hh:mm	Time of fall (mins) = T_m	$K_{fs} = T_f / T_m$	T – Value = 4.45 / K_{fs}
300 - 250	8.1			0.00		
250 - 200	9.7			0.00		
200 - 150	11.9			0.00		
150 - 100	14.1			0.00		
Average	T- Value		T- Value Hole 2 = (T_2)			0.00

Percolation Test Hole No. 3

Fall of water in hole (mm)	Time Factor = T_f	Start Time hh:mm	Finish Time hh:mm	Time of fall (mins) = T_m	$K_{fs} = T_f / T_m$	T – Value = 4.45 / K_{fs}
300 - 250	8.1			0.00		
250 - 200	9.7			0.00		
200 - 150	11.9			0.00		
150 - 100	14.1			0.00		
Average	T- Value		T- Value Hole 3 = (T_2)			0.00

Result of Test: Surface Percolation Value = 0.00 (min/25 mm) 2

Comments:

3.4 The following associated Maps, Drawings and Photographs should be appended to this site characterisation form.

1. Discovery Series 1:50,000 Map indicating overall drainage, groundwater flow direction and housing density in the area.
2. Supporting maps for vulnerability, aquifer classification, soil, subsoil, bedrock.
3. North point should always be included.
4. (a) Scaled sketch of site showing measurements to Trial Hole location and
   (b) Percolation Test Hole locations,
   (c) wells and
   (d) direction of groundwater flow (if known),
   (e) proposed house (incl. distances from boundaries)
   (f) adjacent houses,
   (g) watercourses,
   (h) significant sites
   (i) and other relevant features.
5. Site specific cross sectional drawing of the site and the proposed layout[1] should be submitted.
6. Photographs of the trial hole, test holes and site including landmarks (date and time referenced).
7. Pumped design must be designed by a suitably qualified person.

[1] The calculated percolation area or polishing filter area should be set out accurately on the site layout drawing in accordance with the code of practice's requirements.

4.0 CONCLUSION of SITE CHARACTERISATION

Integrate the information from the desk study and on-site assessment (i.e. visual assessment, trial hole and percolation tests) above and conclude the type of system(s) that is (are) appropriate. This information is also used to choose the optimum final disposal route of the treated wastewater.

Slope of proposed infiltration / treatment area:	0
Are all minimum separation distances met?	✔
Depth of unsaturated soil and/or subsoil beneath invert of gravel (or drip tubing in the case of drip dispersal system)	0.90

Percolation test result: Surface: 72.67 Sub-surface: 93.33

Not Suitable for Development ☐ **Suitable for Development** ✔

Identify all suitable options

1.	Septic tank system (septic tank and percolation area) **(Chapter 7)**	No
2.	Secondary Treatment System **(Chapters 8 and 9)** and soil polishing filter **(Section 10.1)**	Yes
3.	Tertiary Treatment System and Infiltration / treatment area **(Section 10.2)**	Yes

Discharge Route [1]

Groundwater

5.0 SELECTED DWWTS

Propose to install: Tertiary Treatment System and Infiltration /treatment area

and discharge to: Ground Water

Invert level of the trench/bed gravel or drip tubing (m) 0.90

Site Specific Conditions (e.g. special works, site improvement works testing etc.

An O' Reilly Oakstown Effluent Treatment System Designed, Installed, Commissioned, Certified and Maintained by O' Reilly Oakstown Ltd, Oakstown, Trim, Co. Meath per their EN12566 Cert & per EPA Code of Practice, 2021. All works connected with this installation to be supervised and certified to relevant standards taking into account EPA COP.

The SAND polishing filter shall consist of a minimum area of 14.7square metres underlain by a 250sq.m gravel distribution bed per EPA Code of Practice, 2021. Note SAND must be accredited to EPA sand specification required

Note imported soil must have a T value between 3-30 per EPA COP. Over 900mm of imported soil will be necessary.

[1] A discharge of sewage effluent to "waters" (definition includes any or any part of any river, stream, lake, canal, reservoir, aquifer, pond, watercourse or other inland waters, whether natural or artificial) will require a licence under the Water Pollution Acts 1977-90. Refer to Section 2.4.

6.0 TREATMENT SYSTEM DETAILS

SYSTEM TYPE: Septic Tank Systems (Chapter 7)

Tank Capacity (m^3)

Percolation Area		Mounded Percolation Area	
No. of Trenches		No. of Trenches	
Length of Trenches (m)		Length of Trenches (m)	
Invert Level (m)		Invert Level (m)	

SYSTEM TYPE: Secondary Treatment System (Chapters 8 and 9) and polishing filter (Section 10.1)

Secondary Treatment Systems receiving septic tank effluent (Chapter 8)

Media Type	Area (m^2)*	Depth of Filter	Invert Level
Sand/Soil			
Soil			
Constructed Wetland			
Other			

Packaged Secondary Treatment Systems receiving raw wastewater (Chapter 9)

Type: O'Reilly Oakstown BAF

Capacity PE: 6

Sizing of Primary Compartment: 2.40 m^3

Polishing Filter*: (Section 10.1)

Surface Area (m^2)*: 14.70

Option 1 - Direct Discharge Surface area (m^2):

Option 2 - Pumped Discharge Surface area (m^2):

Option 3 - Gravity Discharge Trench length (m):

Option 4 - Low Pressure Pipe Distribution Trench length (m):

Option 5 - Drip Dispersal Surface area (m^2):

SYSTEM TYPE: Tertiary Treatment System and infiltration / treatment area (Section 10.2)

Identify purpose of tertiary treatment	Provide performance information demonstrating system will provide required treatment levels	Provide design information
Site Constraints	Refer to Sand PF design.	Refer to Sand PF design.

DISCHARGE ROUTE:

Groundwater	✔	Hydraulic Loading Rate * ($l/m^2.d$)	50.00	Surface area (m^2)	250.00
Surface Water **		Discharge Rate (m^3/hr)			

* Hydraulic loading rate is determined by the percolation rate of subsoil

** Water Pollution Act discharge licence required

6.0 TREATMENT SYSTEM DETAILS

QUALITY ASSURANCE:

Installation & Commissioning

The installation of the WWTS & SPF shall be constructed, under supervision, strictly in accordance with EPA COP 2021. All works to be certified by a suitable qualified person.
O'Reilly Oakstown, Oakstown, Trim, Co. Meath. 0469431389

On-going Maintenance

The polishing filter/percolation area should be regularly inspected by a competent person. Regular desludging necessary.
O'Reilly Oakstown, Oakstown, Trim, Co. Meath. 0469431389

7.0 SITE ASSESSOR DETAILS

Company: Hydrocare Environmental Ltd

Prefix: Mr First Name: Daniel Surname: Nolan

Address: Cooperhill Road, Beamore, Drogheda, Co. Meath

Qualifications/Experience: BA BAI Civil/Env Engineering, Masters in Env. Engineering, Fetac qualified site assessor, MIEI

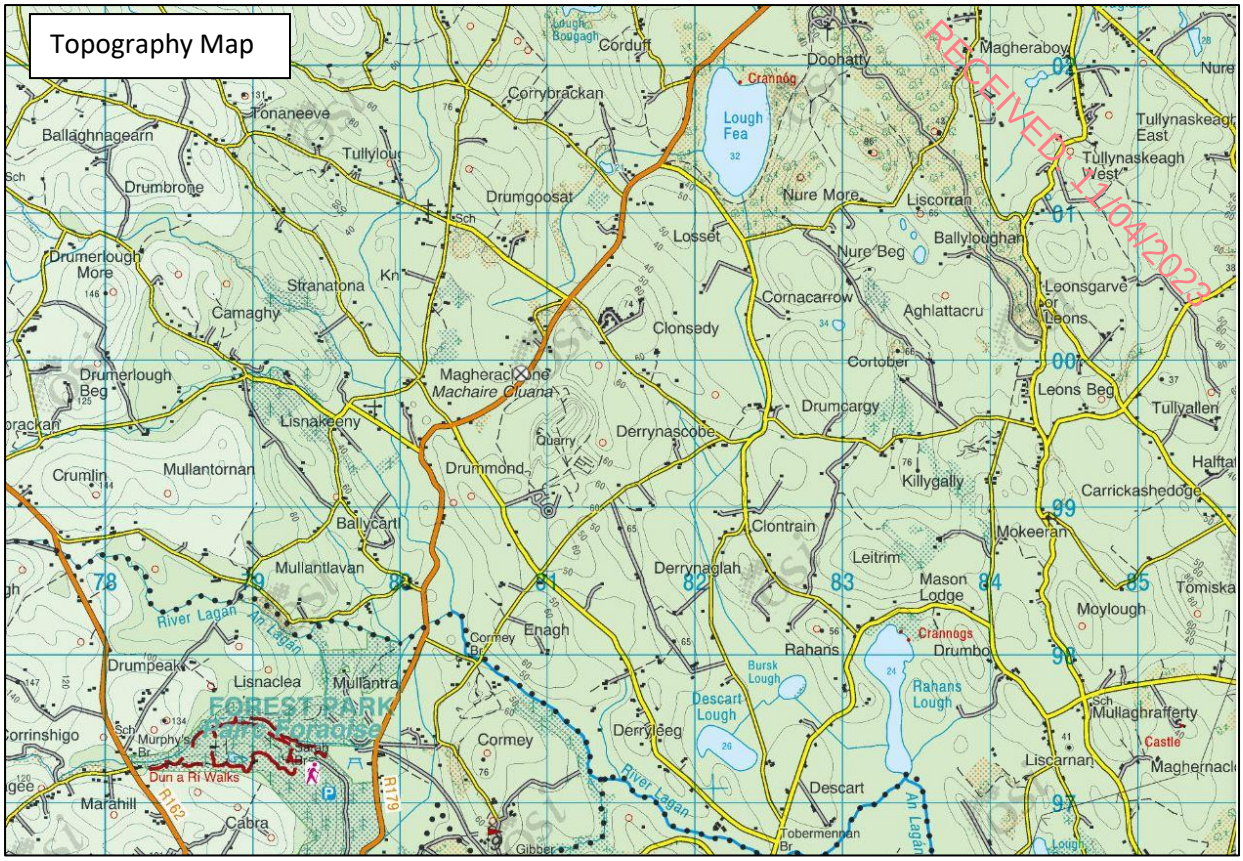
Date of Report: 19-Jan-2022

Phone: 0419842378 / 0877905155 E-mail info@hydrocare.ie

Indemnity Insurance Number: PI19G84259

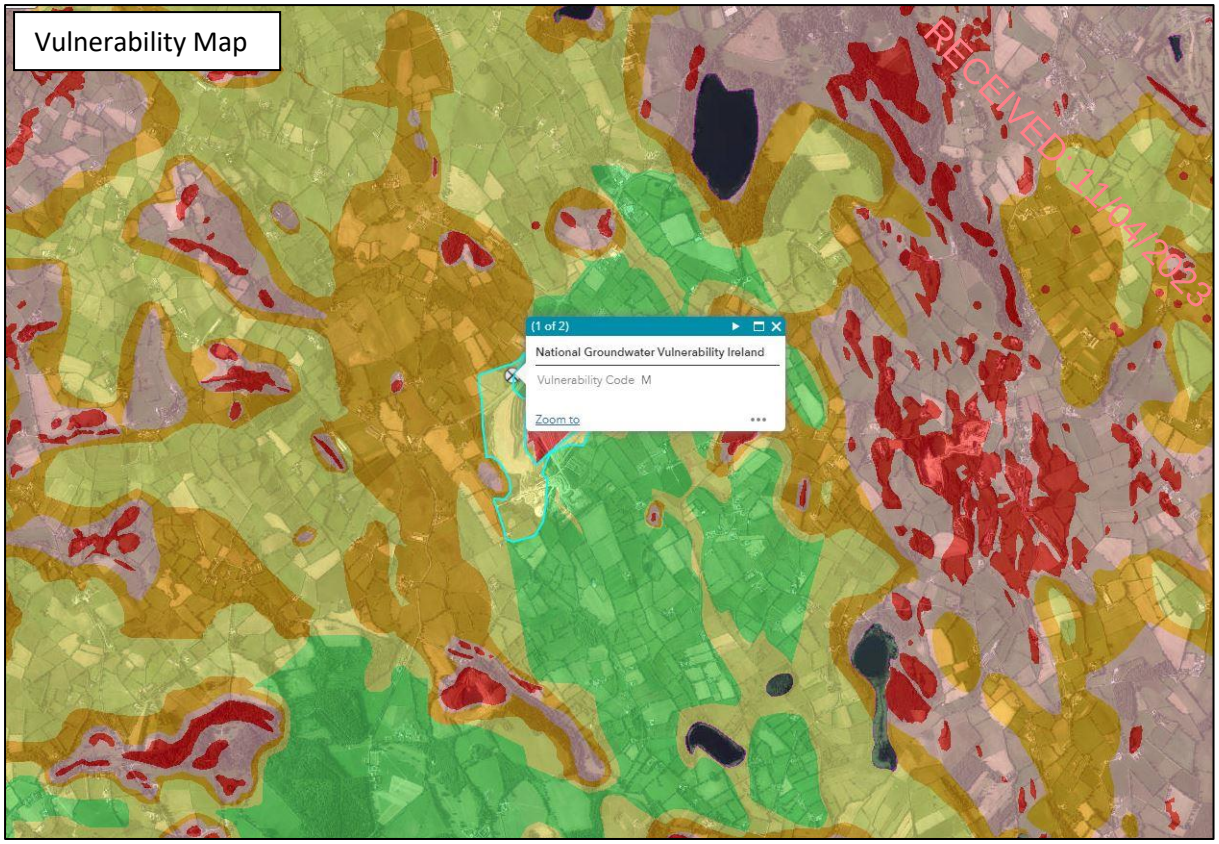
Signature: Daniel Nolan

Topography Map

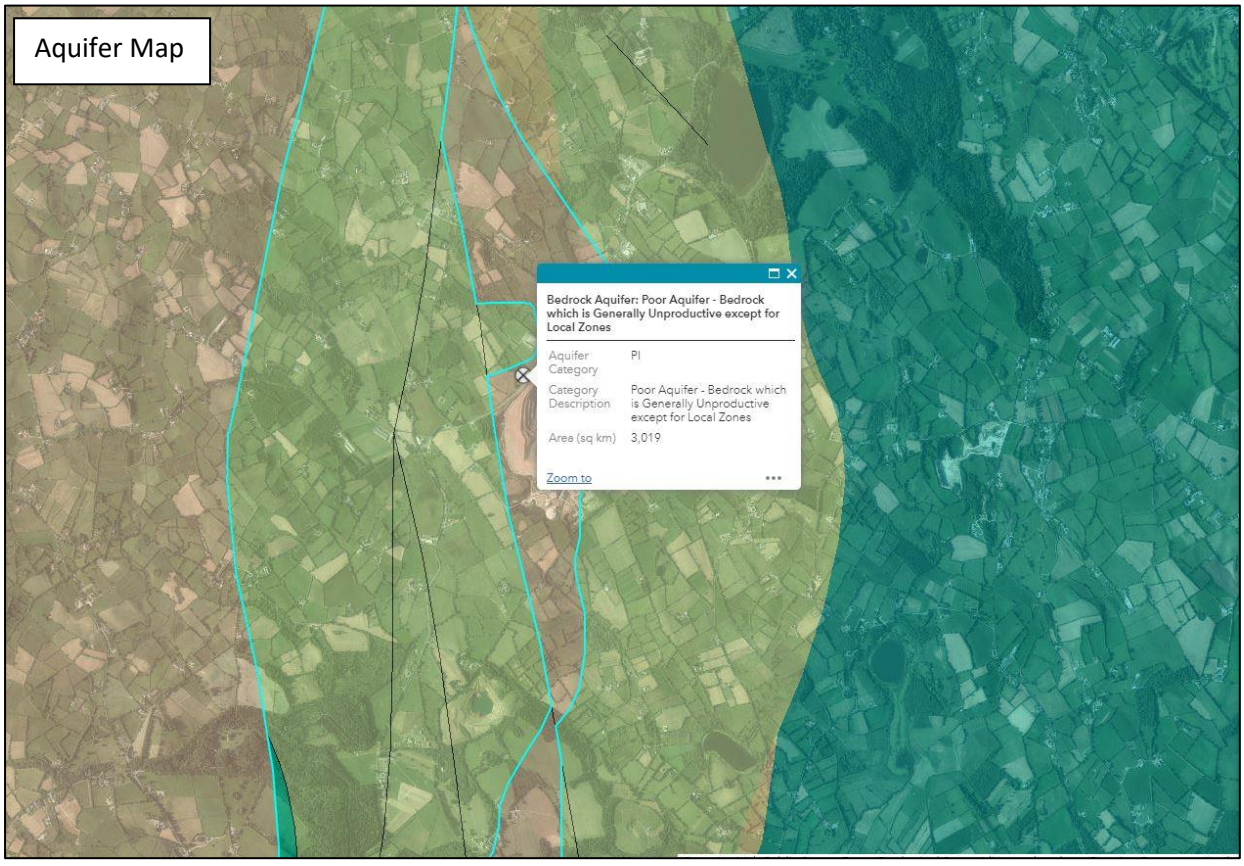


Soils Map

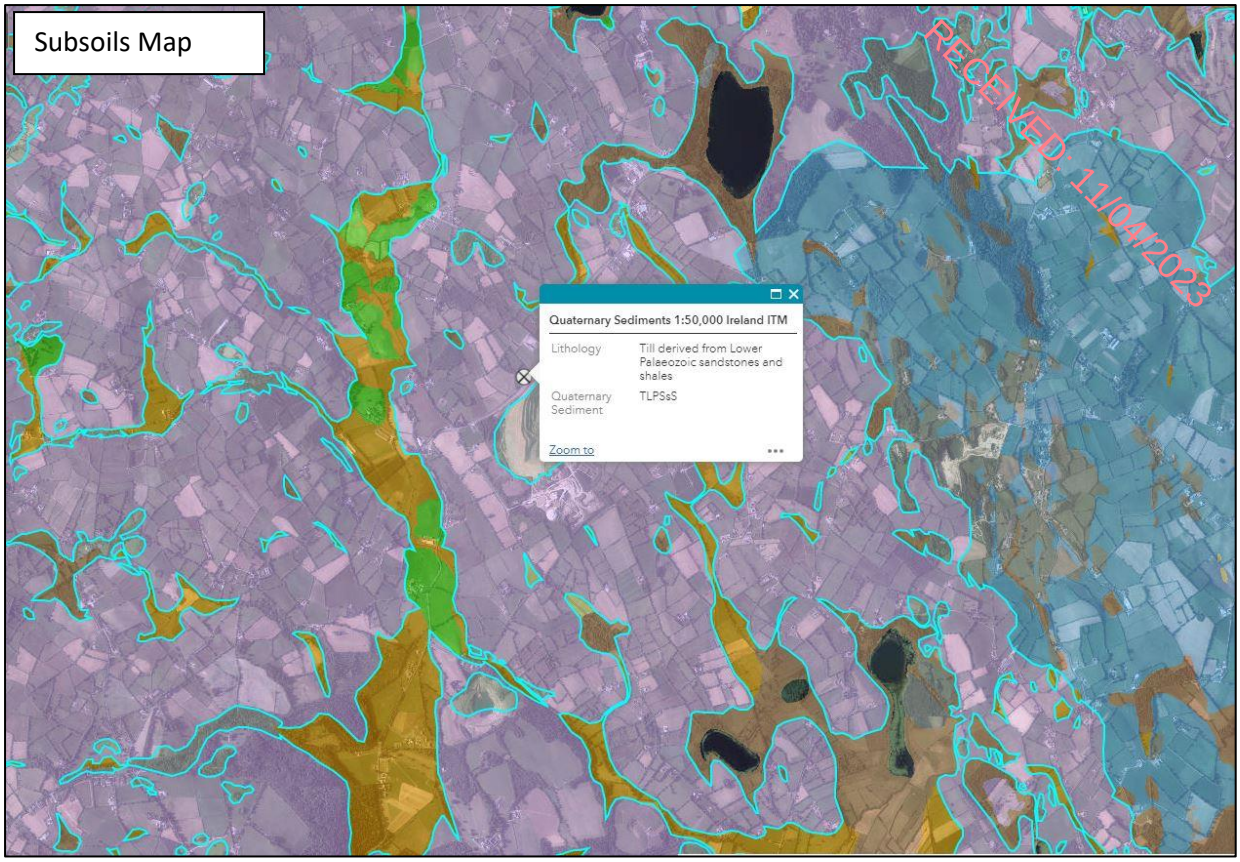
Vulnerability Map



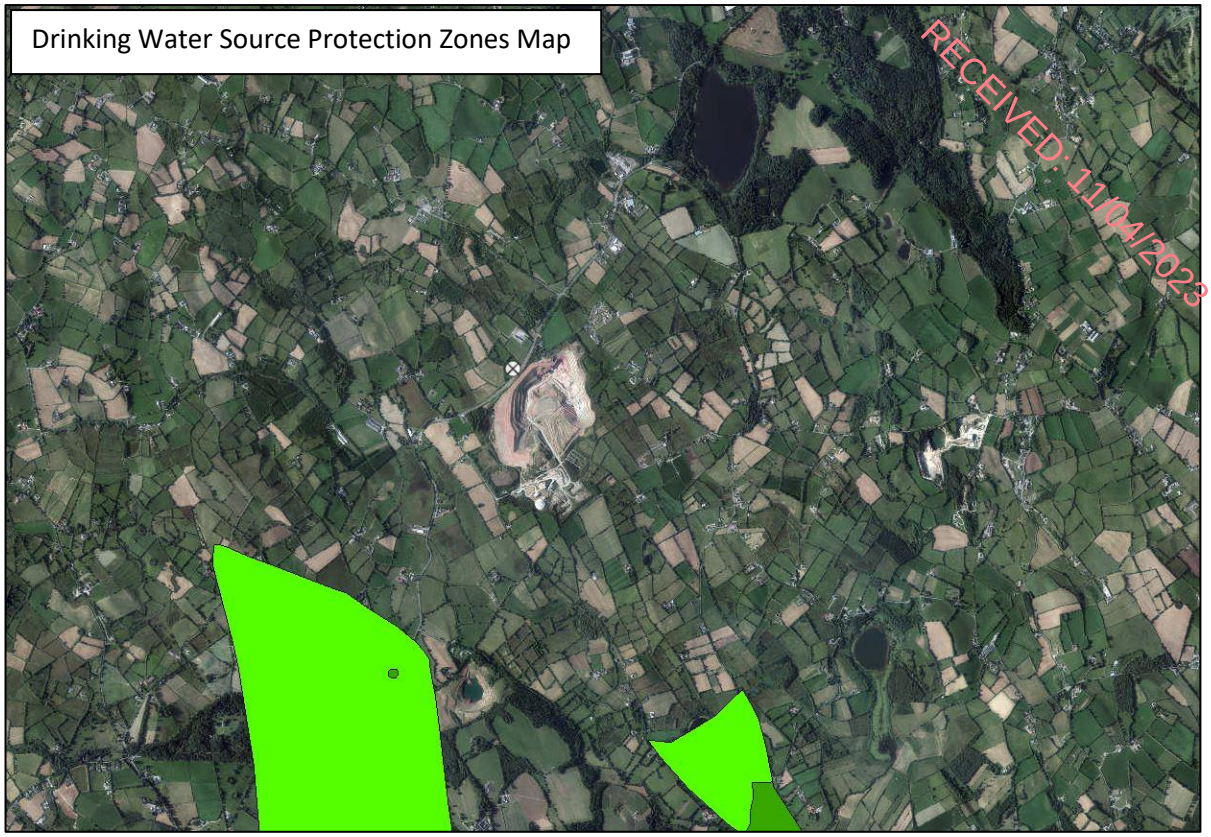
Aquifer Map



Subsoils Map



Bedrock Map


Drinking Water Source Protection Zones Map
RECEIVED: 11/04/2023

Client: Saint-Gobain Mining Ltd.
Location: Knocknacran West, Co. Monaghan

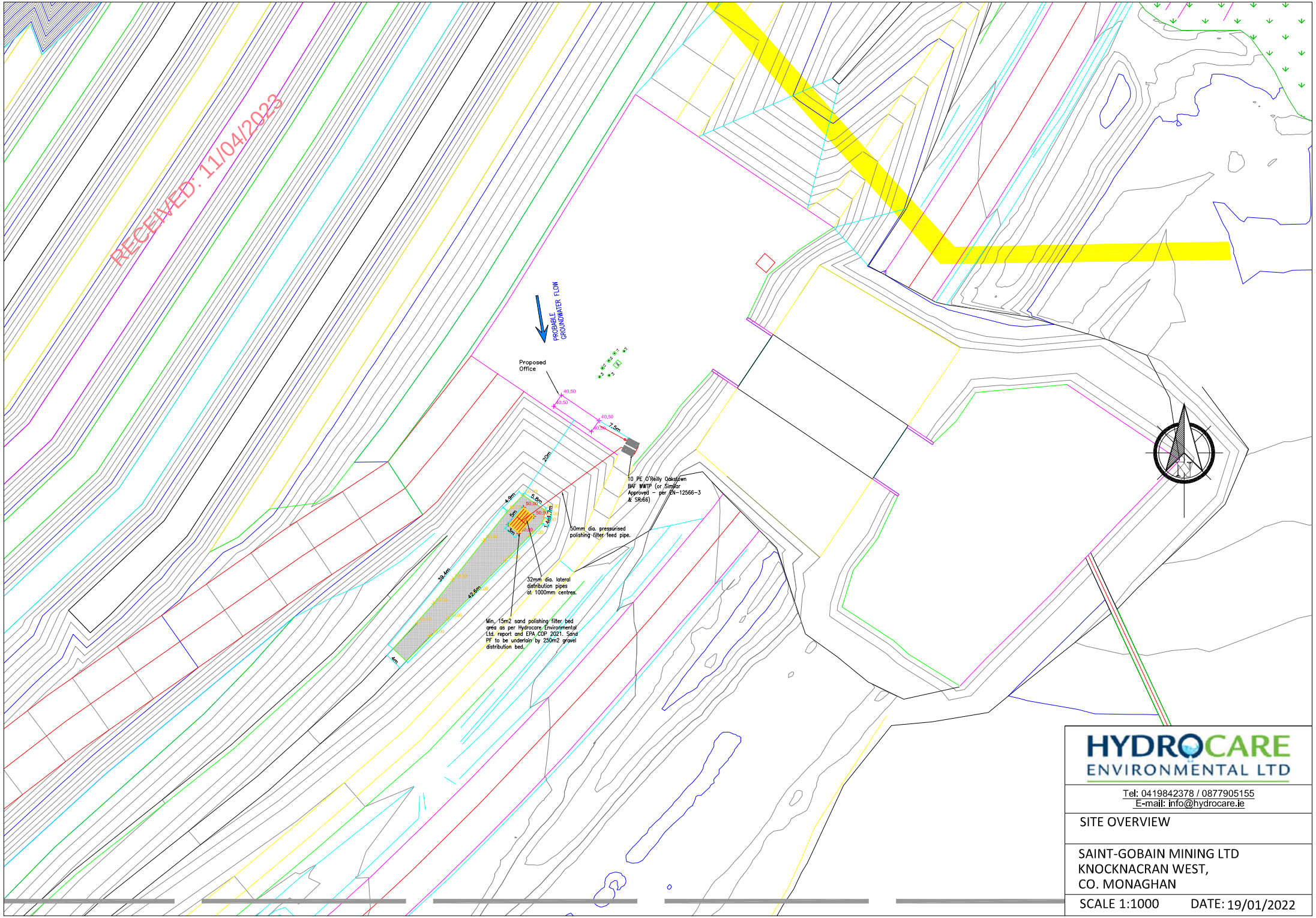
Spoil Heap

Overview

Trial Hole

T2 Test

P1 Test



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SITE OVERVIEW

SAINT-GOBAIN MINING LTD
KNOCKNACRAN WEST,
CO. MONAGHAN

SCALE 1:1000 DATE: 19/01/2022

FOR PLANNING PURPOSES ONLY
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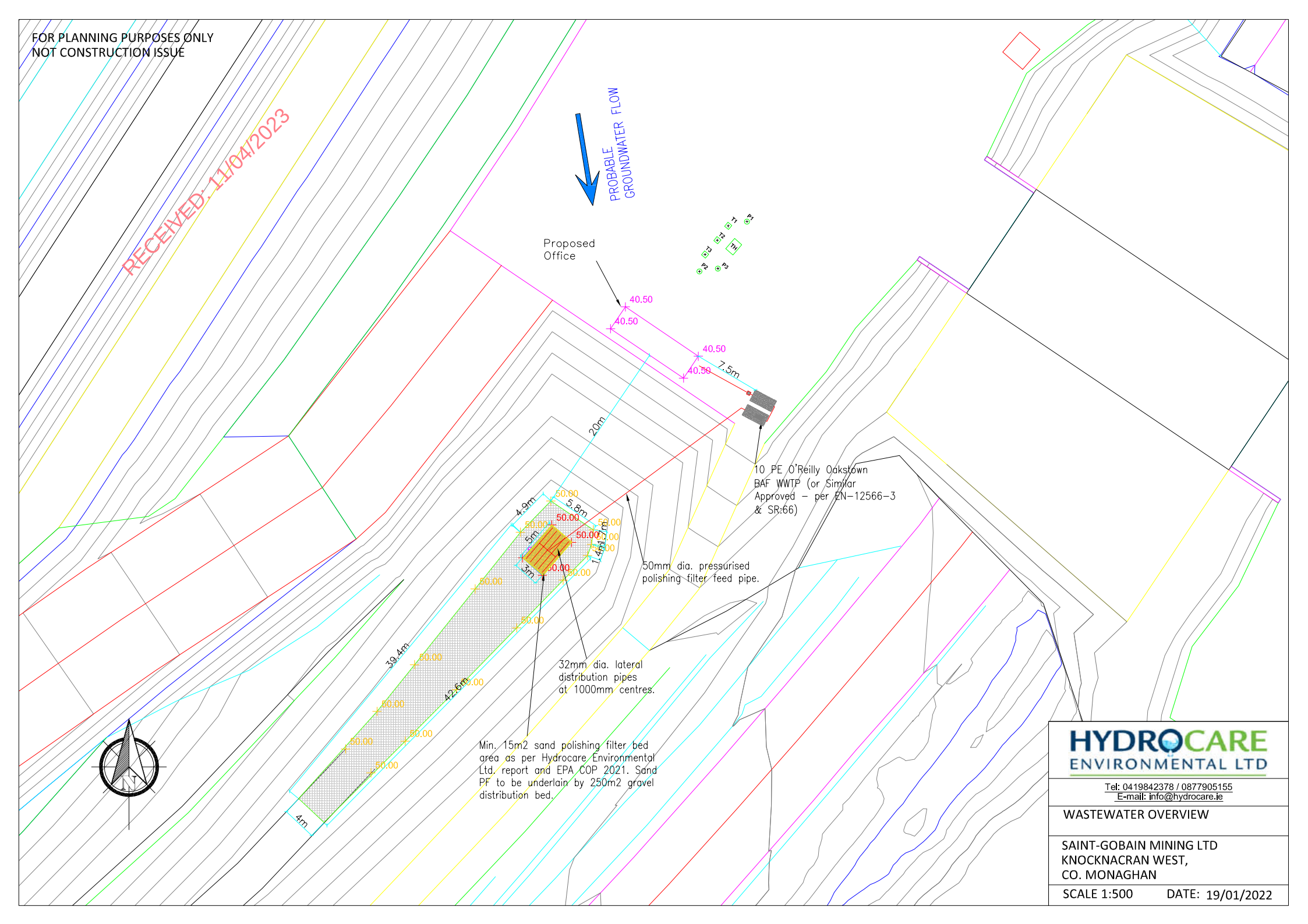

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WASTEWATER OVERVIEW

SAINT-GOBAIN MINING LTD
KNOCKNACRAN WEST,
CO. MONAGHAN

SCALE 1:500 DATE: 19/01/2022

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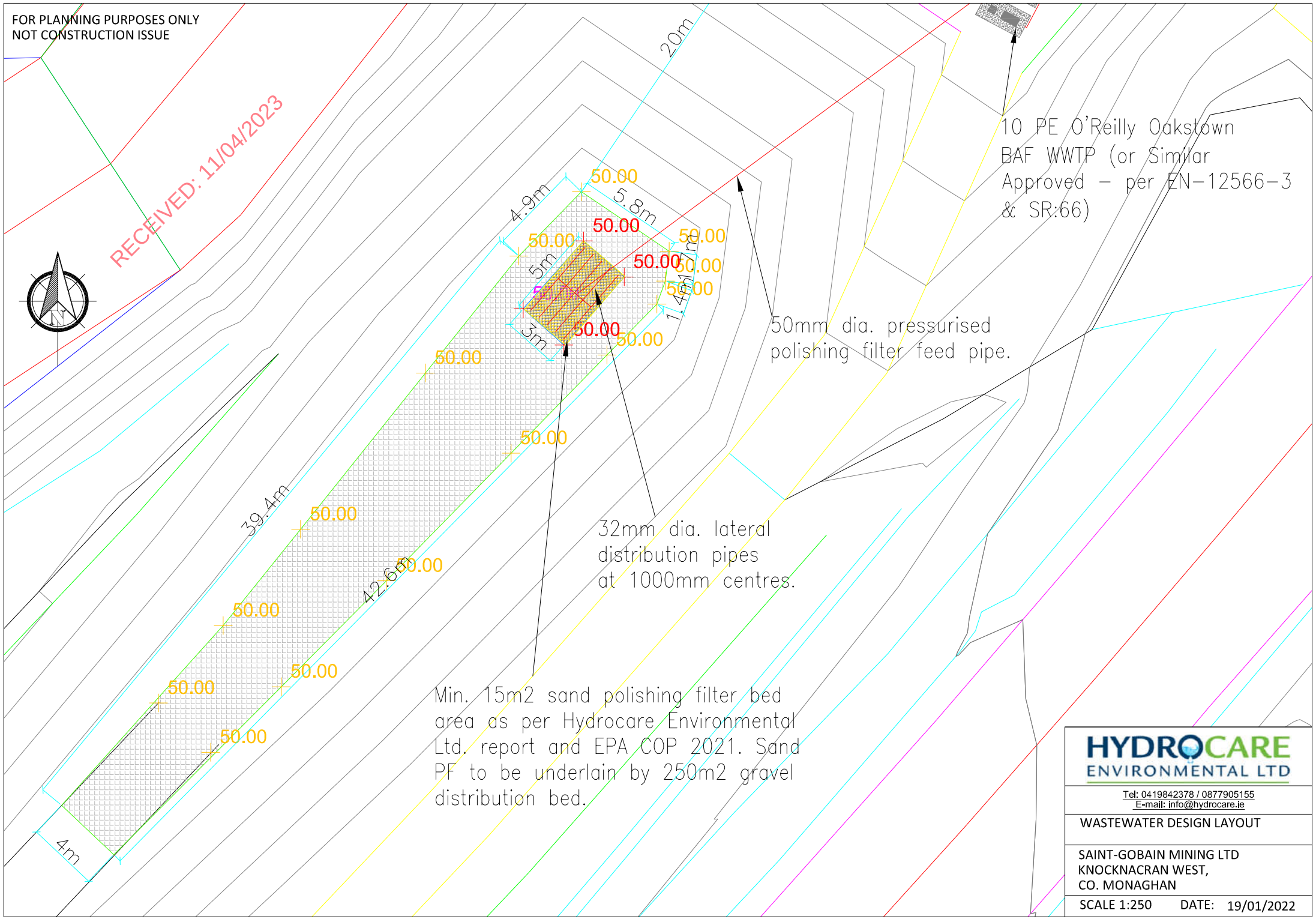

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WASTEWATER DESIGN LAYOUT

SAINT-GOBAIN MINING LTD
KNOCKNACRAN WEST,
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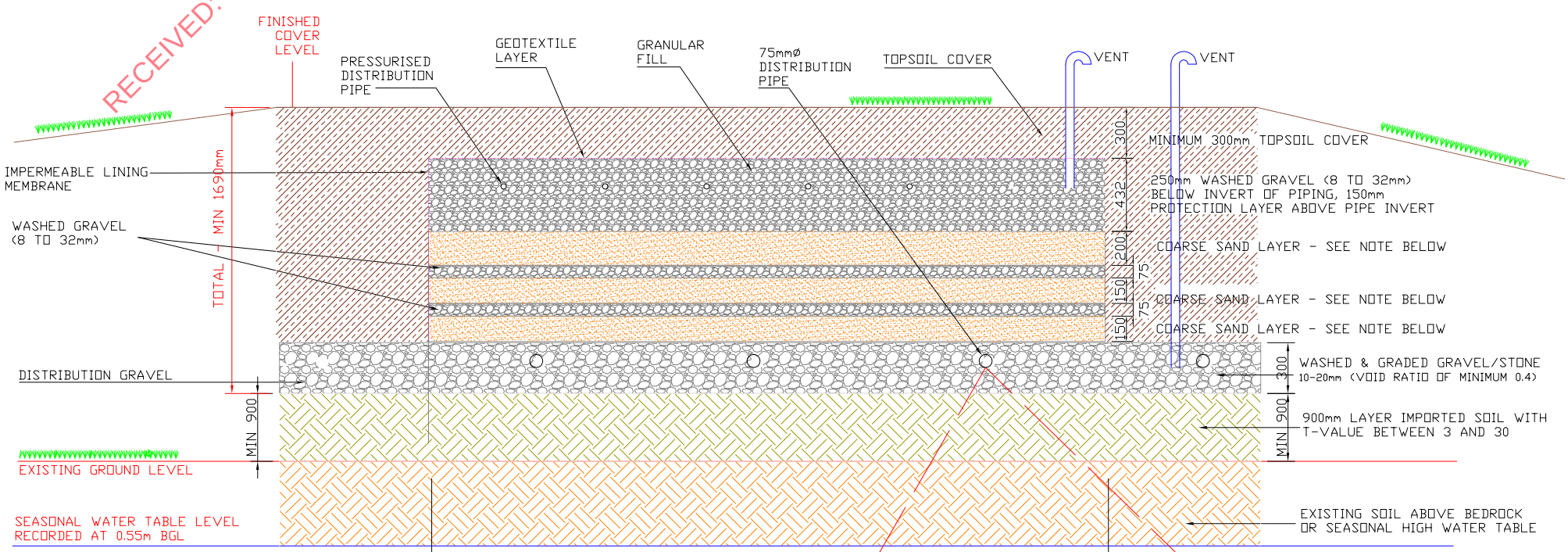
SAND POLISHING FILTER - CROSS SECTION

PER EPA CODE OF PRACTICE 2021: PAGE 49, FIGURE 8.5



NOTE: SAND MUST BE GRADED TO THE DESIGN SPECIFICATIONS OUTLINED BELOW:

COARSE SAND: EFFECTIVE SIZE (D10) 0.25-0.75MM; D60/D10 (Cu) <4

(THE SAND SHOULD BE PROFESSIONALLY CERTIFIED AS FIT FOR PURPOSE)

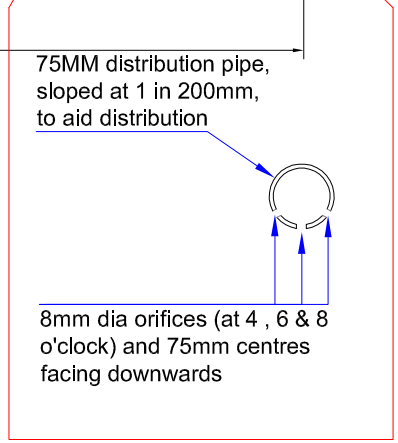
* PLEASE NOTE THAT THIS SPF HAS BEEN DESIGNED IN ACCORDANCE WITH THE CLARIFICATION IN RELATION TO SOIL COVERED SAND POLISHING FILTERS (TERTIARY TREATMENT SYSTEMS)
* ALSO PER THIS CLARIFICATION, THE UNDERLYING DISTRIBUTION AREA IS CALCULATED AS: A = Tvalue x 0.125 x PE

IMPERMEABLE MEMBRANE TO BE LAID ON SIDEWALLS OF FILTER BED

GRAVEL/STONE DISTRIBUTION BASE TO HAVE A VOID RATIO OF MIN. 0.4

ORIFICE DIAMETER, LATERAL DIAMETER AND LATERAL SPACING TO BE CORRECTLY MATCHED TO DISCHARGE RATING OF THE PUMP, MAINTENANCE POINTS TO BE INSTALLED FOR RODDING/SCOURING.

ALL DESIGN SPECIFICATIONS PER EPA COP 2021



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POLISHING FILTER SECTION

SAINT-GOBAIN MINING LTD
KNOCKNACRAN WEST,
CO. MONAGHAN

SCALE NTS DATE: 19/01/2022

Appendix 3.3

Mine Closure Plan (Closure, Restoration and Aftercare Management Plan - CRAMP)

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IPCL Extract

Appendix B:
Mine Closure Cost Estimate

1.0 INTRODUCTION

1.1 Background

The history of gypsum mining in the Monaghan area goes back to the mid 1800's when the mining of gypsum first took place in the area. Gypsum mining continued through the 1900's to the present day. Saint-Gobain Mining (Ireland) Limited[1] (referred to as 'SGMI' or 'Saint-Gobain' or 'the Company' in this document) operates an underground gypsum mine (Drummond Mine) and an open-cast mine (Knocknacran Mine) in Monaghan under licence from the Environmental Protection Agency (EPA) - IPCL 0519-04. The licence also includes the company's manufacturing facility located at Kingscourt, Co. Cavan. Matters relating to the closure, remediation and aftercare management of current mining activities are formally managed under this EPA licence. It places an onus on the company to make annual reassessments and reports to the Agency of closure, restoration and aftercare plans and associated future funding requirements. Saint-Gobain maintain and update a single CRAMP that addresses all its activities in line with the requirements of its EPA licence. Saint-Gobain are submitting a planning application to Monaghan County Council to develop a new area of open-cast mining to replace the current open-cast Knocknacran mine. The proposal includes the retention of current administration, workshop, processing and rock handling facilities that will service the new area of open-cast mining. This document is the Closure, Restoration / Rehabilitation and Aftercare Management Plan (CRAMP) developed for the proposed additional area of open-cast mining. If the planning application is successful, then the existing CRAMP for the overall mine site will be reviewed and amended to incorporate the aspects relating to the additional open-cast mining activities described in this CRAMP.

The existing Saint-Gobain mining site is located in the townlands of Knocknacran (East & West), Drumgoosat, Drummond, Derrynascobe, Enagh, Clontrain and Derrynaglah Co. Monaghan, to the north and south of the R179, a regional road which runs between Carrickmacross and Kingscourt. The Site is accessed via a public road (L4816) which runs south-eastwards from the R179. The town of Kingscourt is located ca. 7 km south of the Site along the R179, and the town of Carrickmacross is located ca. 7 km north of the Site also along the R179. The existing Knocknacran Mine (open-cast) and the adjacent Drummond Mine (underground) produce gypsum as a raw material for the manufacture of an extensive range of plasterboards, plasters and cement rock. The gypsum passes through a series of crushing circuits, before being homogenised and subsequently dispatched from the Site to the company's manufacturing facility at Kingscourt. The mines typically produce between ca. 250,000 and 500,000 tonnes of gypsum (calcium sulphate dihydrate – $CaSO_4$ ($2H_2O$)) per annum, depending on market conditions.

1.2 Proposed New Activity

Due to the depletion of the gypsum resource from the existing Knocknacran open-cast mine, permission is being sought by Saint-Gobain to develop and recover the gypsum remaining in the former Drumgoosat Underground Mine by open-cast mining methods. This new open-cast (also referred to as an open pit) mine is to be known as Knocknacran West Mine, with the existing open pit, Knocknacran, to be referred to as Knocknacran Mine. The Knocknacran West open-cast plans to recover the remaining gypsum resource that was previously mined by underground methods in the Drumgoosat Mine. The Drumgoosat Mine ceased operations in 1989.

[1] previously known as 'Gypsum Industries Limited' also known today as 'Gyproc'.

1.3 Overview of the Proposed New Activity (Knocknacran West Mine)

The development of the new open-cast mine will require the removal of Overburden and Interburden, which will be stripped and transferred to the existing Knocknacran Mine via a purposed built Cut-and-Cover Tunnel, where it will be used for rehabilitation.

Once the Overburden and Interburden are stripped to the level of the gypsum mineral this will allow extraction of the gypsum by standard open-cast mining techniques. The extraction of gypsum will be carried out in a series of benches primarily by blasting. Rock-breakers will be used to carry out secondary breaking of over-size material. The broken rock will be transported by dump truck to a semi-mobile in-pit primary crusher, where it will be crushed to <150 mm particle size. The <150 mm material will then be transferred by covered conveyor or truck, via a Cut-and-Cover Tunnel beneath the R179, to a crusher at the existing Knocknacran Mine (Materials Handling) Plant Site that will crush the gypsum to <75 mm particle size. The <75 mm material will be sampled on a regular tonnage basis, to establish gypsum grade and quality, before being conveyed to the homogenizer and loading bin for transport to the company's plaster and plasterboard facility at Kingscourt. A chute diversion will be installed after the sampler to allow for anhydrite-rich cement quality rock to be conveyed to the existing rock shed for sale into that market.

The development of the Knocknacran West Mine will necessitate the construction of an in-pit sump and water management system (similar to that currently in operation for the Knocknacran Mine).

Infrastructure and equipment proposed at the Knocknacran West Mine will include:

- Office unit and lunchroom;
- Welfare facilities comprising toilet and wash hand basin;
- Water and power supply lines;
- First aid station (including eye-wash);
- Semi-mobile primary crusher;
- A fleet of (50/75 t) excavators, (40 t) ADTs (Articulated Dump Trucks), bulldozers, graders, tractors, bowsers and rollers;
- 1MVA transformer and associated infrastructure within a fenced-off area. The transformer will provide power and lighting to the semi-mobile in-pit crusher and facilities;
- Hardstand area to facilitate parking for up to 40 subcontractor vehicles (earthworks contractor) and receipt of consumables for the earthworks; and
- A temporary compound to accommodate supervisory offices, welfare facilities and plant parking (the location of which will vary throughout the life of the mine as each stripping campaign is undertaken).

Infrastructure and equipment proposed at the existing Knocknacran Mine will include:

- A haul-road routing across the existing Knocknacran open-cast mine;
- Conveyor to the crushing plant and homogeniser at the existing Knocknacran Plant Site; and
- Conveyor stockpile bins and stockpile re-claim conveyor.

An overview of the Site location, and how it relates to the other operations carried out by Saint-Gobain is shown in Figure 1 below (taken from planning application documentation).

Figure 1: Overview of the Site Location

The Life Of Mine (LOM) for Knocknacran West is taken to be up to 35 years. The extraction of the gypsum will necessitate the stripping of ca. 28.5 Mt of Overburden and Interburden (primarily mudstone and dolerite rock) to be used in the phased restoration of the existing Knocknacran Open-Cast Mine and the Knocknacran West Mine subsequently.

The Knocknacran West Mine will be developed and operated in a series of phases, and they are:

Mine Construction
The construction phase of the Mine Development will comprise the erection of perimeter security fencing, the construction of a Cut-and-Cover Tunnel under the R179, and the stripping of superficial materials (including topsoil and overburden) for the construction of screening berms around the perimeter of Knocknacran West. As part of the enabling works for construction of the Cut-and-Cover Tunnel, a temporary diversion of the R179 will be required, this will be in place for ca. 6 to 9 months. This phase of the project is expected to take ca. 12 months.

Mine Operational - Phase 1 (Years 1 and 2)
Phase 1 will comprise the stripping of Overburden and Interburden material within the northern portion of the proposed open-cast to expose gypsum, and the construction of a haul road and conveyor route from the mining area through the tunnel to the existing Knocknacran Materials Handling Plant. Development of the Site by installing all required infrastructure.

Mine Operational - Phase 2 (Years 3 to 5) - Commencement of Gypsum Production
Gypsum extraction commences and is ramped up to ca. 300,000 t/yr (or as market conditions dictate). By the end of Year 5, it is envisaged that ca. 900,000 t of gypsum will have been mined from the northern part of Knocknacran West Mine (depending on market conditions).

Mine Operational - Phase 3 (Years 6 to 10) - Mine Operational
Phase 3 will include advancing the southern face of the northern part of the pit and stripping Overburden and Interburden material to the east of the haul road/conveyor route. Phase 3 will be undertaken during years 6 to 10 of the development.

Mine Operational - Phase 4 (Years 11 to 15) - Mine Operational
Phase 4 will comprise extending the northern pit further and will be undertaken during years 11 to 15 of the development. During this phase, it is estimated that the Knocknacran East Mine void will be restored to near original ground levels. Remaining materials stripped during this phase will be stored within the footprint of the northern part of the Knocknacran West Mine.

Mine Operational - Phase 5 (Years 16 to 20) - Mine Operational
Phase 5 will comprise stripping the Overburden and Interburden within the southern portion of the proposed open pit and will take place during years 16 to 20 of the development.

Mine Operational - Phase 6 (Years 21 to 30) - Mine Operational
Phase 6 will extend the southern pit to the southwest. These activities will be undertaken during this phase of the development (depending on market conditions and operational constraints).

Mine Closure and Restoration
Following cessation of mining at Knocknacran West Mine, all plant and infrastructure will be removed prior to restoration of the Site and disposed of by auction or through a licenced contractor.

1.4 Environmental Setting

According to the National Parks and Wildlife Service's (NPWS) database of designated nature conservation areas, the Site is not located within or immediately adjacent to any designated areas of conservation.

There are no Special Protected Areas (SPAs), Special Areas of Conservation (SACs) or Natural Heritage Areas (NHAs) within at least 15 km of the Site. There are however a number of proposed Natural Heritage Areas

(pNHAs) within 15 km, the closest one being Lough Fea Demesne (000560) ca. 3 km from the Site. Habitats within the Application Site include agricultural grassland, semi-natural grassland, scrub, hedgerows, treelines and waterbodies. There are no sensitive agricultural receptors in the immediate vicinity of the Site. The topography of the surrounding land is dominated by drumlin formations. The hydrology setting is described in Section 4.4.2 of this report. The overall drainage pattern in the area is principally northwest-southeast or north-south as defined by divides set by the local topography. The River Bursk is a nearby waterbody that receives water from the Knocknacran and Drummond mines via a water management system located on the Knocknacran Plant Site. The Bursk is a tributary of the River Glyde. The Glyde flows to the sea at Dundalk Bay and although not a designated a salmonid water, this river is understood to have a salmon run. The River Bursk is reported in current CRAMP (2021) to have a Q rating of Q3 to Q4 indicating fair to doubtful water quality with slight levels of pollution. The general surface water quality in the area is understood to be typically good (or unpolluted), being classed as Q4 to Q5 by the EPA.

The Site is situated in an area of a locally important aquifer, with a moderate aquifer vulnerability rating (GSI).

2.0 STATUTORY REQUIREMENTS AND GUIDANCE

2.1 Statutory Requirements

Mine closure is not specifically provided for in Irish legislation, but a number of statutory instruments contain provisions that are relevant to specific aspects of the closure process such as environmental protection, the regulation of waste management and the protection of valuable biodiversity. The international context is principally defined by European Union Directives. All relevant EU Directives require delivery at member state level by transposition into national law through the creation of appropriate Statutory Instruments. Development and implementation of the Knocknacran West Mine CRAMP will be underpinned by an ongoing review of relevant national legislation from the Irish Statute Book. This will enable a clear understanding of legislative requirements that must be supported through CRAMP delivery. An example of legislation that is of relevance with respect to mine closure planning is SI No. 566/2009 - Waste Management (Management of Waste from the Extractive Industries) Regulations 2009.

To operate a mine in Ireland it is necessary to acquire three permits:

- Planning Permission;
- EPA Licence (either Industrial Emission - IE or Integrated Pollution Control - IPC); and
- A State Mining Licence for privately owned minerals or a Lease for State owned minerals.

Each of these three permits will contain specific conditions in relation to mine closure and will draw from various Statutory Instruments. Generally, the three permits will work in harmony and cross reference where appropriate. Each of the three permits must be received and held at the same time in order to operate a mine. The first permit that is required is a Planning Permission, on the basis that neither of the other two permits may be issued unless the proposed development has Planning Permission. The EPA has issued guidance documents to assist licenced sites to plan for environmental liabilities (including site closure).

2.1.1 Planning Permission

The Knocknacran West project falls into the category of a development under The Planning and Development Act 2000 (as amended) and as such requires planning permission from the relevant Planning Authority. The Site is located within County Monaghan and a planning application will be made to Monaghan County Council. This application will include all required aspects including EIAR and Appropriate Assessment (AA)

Screening. On issuance, the Planning Permission will contain many conditions that must be complied with, in particular with respect to the development and decommissioning of the operation.

2.1.2 State Mining Licence / Lease

In order to extract scheduled minerals, as per the 1940 Minerals Development Act, a mine operator must have permission from the State. Permission can be one of two types; a Licence for privately owned minerals or a Lease for State owned minerals. The Licence / Lease will contain many conditions that must be complied with and include detail on royalties that must be paid on the extracted minerals. The permission will include conditions in relation to mine closure.

2.1.3 EPA Licence

The 1992 EPA Act (SI No. 7 of 1992) as amended amongst other things, provides for the licensing of Scheduled Activities. The First Schedule of the Act, as amended, lists all those activities that must acquire a licence from the EPA.

The existing operations carried out by Saint-Gobain at Knocknacran, and Drummond mines are permitted by an IE Licence P0519-04 held by Saint-Gobain Construction Products (Ireland) Ltd. This is an Industrial Emissions Licence (IE Licence), which also covers the manufacturing activity at their Kingscourt Site, in Co. Meath. The licence is issued for the following activities scheduled under the Environmental Protection Act 1992 as amended:

Class 1.3: The extraction and processing (including size reduction, grading and heating) of minerals within the meaning of the Minerals Development Acts 1940 to 1999, where an activity involves any other operation where either the level of extracted or processed minerals is greater than 200,000 tonnes per annum or the total operational yield is greater than 1,000,000 tonnes, and storage of related mineral waste.

Class 11.1: The recovery or disposal of waste in a facility, within the meaning of the Act of 1996, which facility is connected or associated with another activity specified in this Schedule in respect of which a licence or revised licence under Part IV which a licence under the said Part is or will be required.[2] This activity is carried out at the factory site not at the mine site.

Class 11.5: Landfills, within the meaning of section 5 (amended by Regulation 11(1) of the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 534 of 2008) of the Act of 1996, receiving more than 10 tonnes of waste per day or with a total capacity exceeding 25,000 tonnes, other than landfills of inert waste[3].

As an IE licence already exists for Saint-Gobain, the new mine may be incorporated into the existing license by requesting a change of the scope of the activity by means of a licence review. Or it is possible that the activity could be licensed independently, in which case it will most likely be licensed by an IPC licence under the Environmental Protection Agency Act 1992 as amended. In relation to closure and financial provisions, it is anticipated that conditions for Knocknacran West will be similar to conditions 10 and 12 of current licence held by Saint-Gobain (see Appendix A[4]).

[2] Class 11.1 activity is carried out at the factory site not at the mine site and is not part of the Knocknacran West project.

[3] Class 11.5 activity an historical activity associated with the factory site and is not part of the Knocknacran West project.

[4] Conditions that refer to the closure of the landfill at Saint-Gobain are not relevant to the Knocknacran West project.

2.2 Guidance

There are a number of sources of guidance on mine closure and best practice that have been reviewed by Saint-Gobain and this process will continue throughout the life of the mine.

Guidance includes:

- EPA Guidance:
  - i) EPA Approach to Environmental Liabilities and Financial Provision (2019).
  - ii) Guidance on Financial Provision for Environmental Liabilities (2015).
  - iii) Guidance on assessing and costing environmental liabilities - Unit cost rates for verification (2014).
  - iv) Guidance on assessing and costing environmental liabilities (2014).
  - v) EPA Guidance on Waste Management Regulations (2009).
  - vi) BATNEEC Guidance Note for the Extraction of Minerals (1997).
- The International Council on Mining and Metals (ICMM) has developed a number of tools to assist in planning for mine closure:
  - vii) Integrated Mine Closure: Good practice guide (2nd edition, 2019).
  - viii) Closure Maturity Framework - Tool for Closure User Guide (2020).
- Biodiversity Stewardship in Gypsum Quarrying: Our Best Practices – EuroGypsum (Jan 2021).

3.0 THE CRAMP PROCESS

The term CRAMP is a term adopted by the EPA. Reference to CRAMP is included in Saint-Gobain's IE licence and is also referred to in EPA guidance documents. CRAMP as defined by the EPA stands for Closure, Restoration and Aftercare Management Plan. The difference between restoration and rehabilitation and its relevance to Knocknacran West is discussed further in this chapter in Section 3.4.

3.1 The Scope of the CRAMP

The scope of this CRAMP document is limited to only the proposed Knocknacran Mine West operation. The existing IE licence (P0519-03) contains conditions relating to closure, and these conditions will be used to inform this CRAMP. It is expected similar conditions will apply to the proposed Knocknacran Mine West operation. A CRAMP[5] has been prepared for Saint-Gobain's existing operations and this document has been reviewed prior to the preparation of this CRAMP for Knocknacran West.

3.2 Phases of CRAMP

CRAMP can be considered to be made up of a number of phases, with the main distinction being between closure and aftercare. However, closure can itself be subdivided into two distinct phases of 'Active Closure' and 'Passive Closure'. Aftercare is the phase that follows successful implementation of the closure plan. Within the CRAMP it is possible to have an independent 'Closure Plan' and an independent 'Aftercare Plan'.

[5] Saint-Gobain Mining (Ireland) Ltd., Dublin Road, Kingscourt, Co. Cavan Mine Site Decommissioning, Closure and Aftercare Management Plan (2021)

This becomes more relevant as the CRAMP process progresses as the detail in both plans is quite different. A description of the different phases of CRAMP is provided below:

3.2.1 Active Closure

Active Closure may be considered as the process of carrying out physical closure work, for example knocking buildings, reprofiling land around the open pit. Active closure may be thought of and referred to as 'Physical Closure'.

3.2.2 Passive Closure

Passive Closure is a period that follows Active Closure when the physical closure works are complete. Passive Closure is a period of passive validation, during which time the mining company must carry out monitoring and measurements to demonstrate that the closure works have been successful, and that all environmental metrics for the Site are stable.

3.2.3 Aftercare

Following a successful passive closure period and at a time when monitoring and measurement has demonstrated that the Site is in an environmentally stable state, the mine may seek to transition into an aftercare period. Aftercare is a further period of monitoring and measurement but will be of reduced scope and intensity to the monitoring carried out during passive closure.

The Site will remain in aftercare for a period to be agreed with the EPA. This period will be both time based, and performance based. In other words it will be for a period of time as agreed with the EPA, provided all monitoring and measurement continues to provide assurance that the Site is environmentally stable. In the event it is necessary to carry out further works, the Site will re-enter the Active Mine Closure process and transition again into passive closure and aftercare once the works are completed successfully.

The process by which the mine transitions into aftercare is expected to be formally agreed with the EPA (and other relevant statutory stakeholders) in a Mine Closure Agreement document, which may define the mechanism to transition into aftercare and the relevant timelines. The document may also define what documents must be issued by each party at each point in the process (for example Saint-Gobain will be required to submit a 'Final Validation Report' to the Regulatory Authorities). If satisfied with the Final Validation Report the EPA must issue a document stating that the Authorities are satisfied that the closure plans have been properly implemented. This document from the Authorities may be referred to as a 'Mine Closure Completion Certificate' (MCCC). Issuance of the MCCC indicates the commencement of aftercare.

Active and Passive Monitoring

Typical active monitoring during aftercare may include:

- Measurement of groundwater level.
- Taking and testing of groundwater samples.
- Taking and testing of soil samples.
- Taking and testing of air samples.
- Biological monitoring.

Typical passive monitoring during aftercare may include:

- Surface water flow measurements.
- Surface level monitoring.

The decision to use active or passive methodologies will depend on the monitoring requirements and the technologies available during the aftercare period. The CRAMP is a live document and will be subject to revisions as there are developments in the industry, changes in legislation, and any other external factors. The CRAMP will continue to evolve and ensure that at all times the most appropriate and best available techniques are included for monitoring.

3.2.4 Surrender of EPA Licence

The end of the aftercare period will be marked and documented by the surrender of the licence to the EPA. The licence may only be surrendered if the aftercare period has been stable and without incident. Saint-Gobain also have an option of partially surrendering the licence during the passive validation period or aftercare period. A partial surrender means that the scope of the licence can change, and areas can be removed from the Site red-line boundary. In order to achieve a partial surrender of the licence Saint-Gobain will be required to request a change to the licence (typically Technical Amendment as opposed to a full Review will be sufficient). Saint-Gobain would be required to submit all relevant information to the EPA and the EPA will complete an exit audit to establish if they are satisfied that all risks have been removed or adequately remediated. If the EPA is satisfied it will revise the licence boundary.

3.3 Developing the CRAMP

Closure planning is an iterative process, with detail and accuracy of the plan increasing as the mine moves through its mine life. As per best practice the company will carry out a review of the mine closure plan on an annual basis. This will examine the closure goals, the activities to be completed, and the costs associated with each activity. The detail and accuracy of the plan will progress with each review. During the planning phase the closure plan will provide detail of the closure plan in general terms and cost estimates will as a result be within a range of what the final cost will be. As the mine life progresses and there is greater certainty on the detail of the closure plan and when it will be executed, the accuracy and detail of the plan will be increased. An example of this is provided in the 2020 ICMM good practice guide (Figure 2 below).

Asset stages	Time remaining to predicted closure		Overall cost estimate accuracy	Indicative engineering stage gates
	LoA = 85 years	LoA = 10 years		
Exploration, design and construction	> 85 years	> 10 years	-50 to +100 %	Class 5 estimate
Early operations	85 – 70 years	10 – 8 years	-30 to +100 %	Improved class 5 estimate
Established operations	70 – 5 years	8 – 2 years	-15 to +50 %	Class 4 / 3 estimate
Pre closure execution	< 5 years	< 2 years	-10 to +20 %	Class 2 estimate
Closure execution and post – closure monitoring	0 to 15+ years	0 to 10+ years	-3 to +15 %	Class 1 estimate

Figure 2: Example of 2020 ICMM Guidance

While the values in the figure above are not directly applicable to Saint-Gobain, the overall principle is. It is as a consequence of this development of certainty over time that it is advisable to have a higher contingency in the early iterations of the plan, which can be reduced as the plan develops. Saint-Gobain will adopt this approach, with a 25% contingency being used in the CRAMP for the proposed Knocknacran West Mine Project.

3.4 Restoration and Rehabilitation

The terminology used within the mining industry for mine closure planning is typically 'Rehabilitation' rather than 'Restoration'. The International Council on Mining and Metals (ICMM) refers to Rehabilitation as - *'the return of land to a stable productive and self-sustaining condition, after taking into account beneficial uses of*

the Site and surrounding land. Reinstatement of degrees of ecosystems and function where restoration is not the objective.' Therefore, where possible restoration may be taken as an objective, but otherwise lands must be rehabilitated to stable self-sustaining condition.

Section 1.2 of the EPA's Guidance on assessing and costing environmental liabilities (2014) states that *'the terminology associated with environmental liabilities is complex. Various terms are used in reference to closure and restoration/aftercare, including: closure, decommissioning, residuals management, rehabilitation, remediation, restoration and aftercare. Various terms are also used in reference to closure and restoration/aftercare plans, including most commonly: closure, restoration and aftercare management plan (CRAMP); decommissioning management plan (DMP); and residuals management plan (RMP). Furthermore, the term 'environmental liability risk assessment' (ELRA) is sometimes used in reference to incidents only, and in other cases to a combined assessment covering closure, restoration/aftercare and incidents'.*

The creation of the Knocknacran West Mine offers the opportunity to carry out a full restoration of the existing Knocknacran Mine using the Overburden and Interburden materials that are stripped from Knocknacran West. This restoration option is not feasible for the existing Knocknacran Mine without the development of Knocknacran West Mine.

4.0 PHYSICAL CLOSURE PLAN

The nature of the mining process means that the working area is subject to continuous change as mining operations move to extract material from different parts of the resource. As such an element of progressive rehabilitation will be completed as part of normal operations. The nature of the operation will also mean that some infrastructure may be moved during the life of the mine, within the footprint of the operation, to ensure an efficient process. Where any movement of infrastructure takes place, it will be done so to a standard that is in line with success criteria and will not require locations where infrastructure was moved from to be revisited and rehabilitated. The costing for CRAMP will be for the rehabilitation works to be completed as per the final layout of the Site.

In line with best practice for mine closure accounting and the EPA guidance on assessing and costing environmental liabilities (2014), the revenue for the sale of assets is not netted off the cost of closure. However, the disposal cost for certain items that are expected to generate a revenue from sale at the end of the mine, e.g. mobile plant such as trucks, are taken to have a neutral disposal cost. The physical aspects of the Closure Plan for Knocknacran West Mine, listed below, are detailed in this chapter.

- 4.1 - Plant and infrastructure.
- 4.2 - Materials inventory and waste.
- 4.3 - Contaminated Land Risk.
- 4.4 - Rewatering of the Pit (surface water and groundwater considerations).
- 4.5 - Safety:
    i) 4.5.1 - Geotechnical stability of the pit during and post closure.
    ii) 4.5.2 - Management of access to the pit post closure (animals and people).
- 4.6 - Biodiversity.

4.1 Plant and Infrastructure

The plant and infrastructure to be used in the Knocknacran West Mine are listed below and a strategy for managing each of these items is provided in this section. Offices and welfare buildings will be retained during the initial phases of closure to be used by workers. However, once active closure is approaching its completion all buildings at Knocknacran West will be removed. Buildings and welfare facilities at the main Saint-Gobain Site will be used by the remaining workforce during the passive period of closure.

The plant and infrastructure to be removed is listed below:

- Office unit and lunchroom;
- Welfare facilities comprising toilet and wash hand basin;
- Water and power supply lines;
- First aid station (including eye-wash);
- Semi-mobile crusher;
- A fleet of (50/75 t) excavators, (40 t) ADTs (Articulated Dump Trucks), bulldozers, graders, tractors, bowsers and rollers;
- 1MVA transformer and associated infrastructure within a fenced-off area. The transformer will provide power and lighting to the semi-mobile in-pit crusher and facilities;
- A temporary compound to accommodate supervisory offices, welfare facilities and plant parking (the location of which will vary throughout the life of the mine as each stripping campaign is undertaken);
- A haul-road routing across the existing Knocknacran Open-Cast Mine;
- Conveyor to the crushing plant and homogeniser at the existing Knocknacran Plant Site;
- Conveyor stockpile bins and stockpile re-claim conveyor; and
- Crushers, and associated infrastructure.

4.1.1 Office Unit and Lunchroom

Portacabin offices and welfare facilities will be demolished, and demolition waste will be disposed of by licensed waste contractors. Any foundations/support and services will all be removed, and materials disposed of by licensed waste contractors.

4.1.2 Welfare Facilities comprising Toilet and Wash Hand Basin

Welfare facilities will be demolished and removed when mining has ceased. Any foundations will be removed, and materials disposed of by licensed waste contractors. The proprietary treatment system will be removed by a licenced waste contractor and the area will be remediated.

4.1.3 Water and Power Supply lines

Saint-Gobain will maintain a drawing of all services, and this will be updated as and when it is required. All power and water supply to the Site will be isolated on cessation of activities. Services may be provided above or below ground. Where supply lines are buried to a depth of greater than 1 m and not deemed to pose a risk going forward, they may be left buried. Where it is proposed to leave a buried service in the ground a detailed risk assessment will be prepared and submitted to the EPA as part of the updated closure plan. Where it is deemed appropriate to remove buried services, these services will be excavated and removed for disposal by licensed waste contractors, and the excavations backfilled.

Any services that are above ground (for example overhead power lines) will also be subject to risk assessment and must be removed if deemed necessary.

4.1.4 First Aid Station (including eyewash)

All materials and equipment from the first aid station will be removed and donated, sold, or disposed of by licenced waste contractors. Any biological waste will be segregated and disposed of by licenced waste contractors. Any structures or foundations will be demolished, removed and disposed of by licenced waste contractors.

4.1.5 Semi-Mobile Crusher

The crusher will be removed and sold or disposed of by licenced waste contractors. Any structures or foundations will be demolished and removed and disposed of by licenced waste contractors and the area is to be made good.

4.1.6 A Fleet of (50/75 t) Excavators, (40 t) ADTs (Articulated Dump Trucks), Bulldozers, Graders, Tractors, Bowsers and Rollers

An assessment of all remaining mobile plant will be completed when the mine closes. Plant that is in good working order will be sold and obsolete plant will be disposed of by licenced waste contractors. The obsolete plant will have a significant scrap value and will be taken as cost neutral from a disposal cost.

4.1.7 1 MVA Transformer and Associated Infrastructure within a Fenced off Area

The transformer will be removed and sold or disposed of by licensed waste contractors. Any structures or foundations will be demolished and removed and disposed of by licenced waste contractors and the area will be made good.

4.1.8 Temporary Compound including hardstand to accommodate Supervisory Offices, Welfare Facilities and Plant Parking

Buildings associated with this compound will generally be of ‘portable cabin’ design and will be removed once mining operations have ceased.

Where possible the cabins will be sold but based on the life of the mine it is assumed that cabins will have limited resale potential and as such a disposal cost for these items will be provided for. Any buildings of traditional construction (block / timber) will be demolished, and C&D waste will be disposed of by licensed waste contractors. The hardstand area will be excavated and the area reprofiled. Where possible excavated material will be used for reprofiling work. However, this is subject to the excavated material being deemed to be clean and not impacted by any contamination (in particular oil from vehicles). In the event that material is contaminated, this will be removed from Site and disposed of by a licenced waste contractor.

The foundations and services will all be removed, and materials disposed of by licensed waste contractors.

4.1.9 A Haul Road routing across existing Knocknacran Open-Cast Mine

The road will be excavated and the area reprofiled. Where possible excavated material will be used for reprofiling work. However this is subject to the excavated material being deemed to be clean and not impacted by any contamination in particular oil from vehicles. In the event that material is contaminated, this will be removed from Site and disposed of by a licenced waste contractor.

4.1.10 Conveyor to the Plant Site

The conveyor will be removed and sold or disposed of by licensed waste contractors. Steel supports, rollers, belting, motor and electrical infrastructure to be removed and recycled / reused using a licenced waste

contractor. Foundations to be removed and disposed of by licenced waste contractors and area is to be made good.

4.1.11 Conveyor Stockpile Bins and Stockpile Re-Claim Conveyor

The stockpile bins will be removed and sold or disposed of by licensed waste contractors. Steel supports, rollers, belting, motor and electrical infrastructure to be removed and recycled / reused using a licenced waste contractor. Foundations to be removed and disposed of by licenced waste contractors and area is to be made good.

4.1.12 Crushers and Associated Infrastructure

The crushers and associated infrastructures will be removed and sold or disposed of by licensed waste contractors. Steel supports, motor and electrical infrastructure to be removed and recycled / reused using a licenced waste contractor. Foundations to be removed and disposed of by licenced waste contractors and area is to be made good.

4.2 Materials Inventory and Waste

Prior to the closure of the operation, Knocknacran West will have an inventory of materials required to support the process as well as waste that naturally arise during operations. Both of these aspects need to be managed as part of the mine closure process.

4.2.1 Materials / Spare Parts Inventory

The types of materials and spare parts that will be held to support the Knocknacran West Mine are typical of what might be held by a quarry or any business with a large fleet of earthmoving equipment. Materials will include engine oil, coolant, grease, fuel, filters, hoses, pumps, motors, paint, degreaser, nuts and bolts and other general equipment spares. The first option for unused materials and spares will be to sell back to the Original Equipment Manufacturer (OEM), or to another third party. Experience has shown that the value or income that can be achieved by the sale of parts, even OEM parts, is extremely modest with the sale price being a fraction of the purchase price or book value – often as low as <20% of the purchase price. The value that is achieved for materials and spares is not a concern for the CRAMP. What is of relevance is whether or not there will be a cost to dispose of the material. If material cannot be sold, even at a great discount, there will be a disposal cost, as this material will technically become a waste.

Experience is that while the value of spares will be greatly reduced, they will be sold. Therefore, the need, and cost, to dispose of unused materials and spares will be very low. A modest contingency will be included in the closure costs to cover this item. A contingency of 1% of the inventory book value at closure or €10,000 (whichever is highest) is to be allowed.

There are two relevant aspects or opportunities when it comes to materials and spares that will be considered by Saint-Gobain as mine closure approaches and they are; take-back agreements and reduced inventory.

Take-Back Agreements

As described in the introduction, mining is relatively unique in that the closure of the operation is inevitable and predictable and as such this allows the operation to plan for the event. One simple step to be taken by Knocknacran is during the final years of operations when orders are being placed is to include a take-back agreement in contracts, whereby the supplier will be required to take back unused stock. A small premium may be included but this will be a fraction of the discount that will be applied if the unused stock is sold back by the mine.

Reduced Inventory

Because the closure of the operation is predictable it is possible to plan equipment maintenance around this. In particular a judgement call can be made by the mine in relation to the level of maintenance that is applied to the fleet and in particular the quantity of spares that are held on Site. While routine spares used for scheduled maintenance inside the remaining life of the mine will still be required, the quantity of other spares may be reduced and the risk around equipment availability and uptime becomes the aspect that is managed rather than the cost of disposal of spares. This is a judgment call for the management of the mine as the closure date approaches.

4.2.2 Waste

The cost of the disposal of waste associated with physical closure, as described in Section 4, is included in the line item for each element that is demolished and does not need to be accounted for in a separate line item. However, the operation does need to be mindful of the inventory of waste that will have accumulated in the weeks and months running up to closure (depending on frequency of waste collection). The mine will have a budget to dispose of general waste generated by the operation within its general operating budget. However, it is prudent to include a dedicated line item for waste disposal for unforeseen wastes that may arise during the closure process, or the risk of overrun on waste disposal costs associated with the disposal or assumptions on resale of items that did not materialise.

4.3 Contaminated Land Risk

Saint-Gobain operate a third party verified Environmental Management system accredited to ISO14001 and intend to operate to a very high standard at Knocknacran West. However, it is recognised that there is a risk of contamination, which can arise, for example burst hydraulic hoses that may occur despite the company having a proactive preventative maintenance programme. Procedures are in place to manage and deal with such events as and when they occur.

A full Site characterisation will be carried out after all operations are completed as it will represent the final ground rehabilitation requirement. The Site characterisation is made up of two elements, the first is measurement (sampling and analysis), and the second is defining and agreeing post rehabilitation concentrations 'target values'. There are various standards with respect to soil contamination that can be used to determine the post rehabilitation concentration target values, these include those developed by the United Kingdom Environment Agency contaminated land guidance, referred to as CLEA. The UK CLEA guidelines have a published scientific basis, and their use is considered 'good practice' in the assessment of contaminated land.

Category 4 Screening Levels (C4SLs) from the CLEA guidance consist of cautious estimates of contaminant concentrations in soil that are still considered to present an acceptable level of risk. These guidance values give different ranges for different end uses of the land, obviously the risk and exposure pathways are dependent on the future uses of the land.

As an example, Figure 3 below presents the acceptable values for Benzo(a)pyrene, which is taken as a surrogate marker for Poly Aromatic Hydrocarbons (PAH's), which may be associated with land contamination associated with fuel, hydraulic oil, engine oil or any other hydrocarbons used at Knocknacran West.

Land-Use	pC4SL (mg/kg)		
	HCVs with suggested changes to exposure parameters	LLTCs with no change to exposure parameters	LLTCs with suggested changes to exposure parameters
Residential (with consumption of homegrown produce)	2.4	3.2	5.0
Residential (without consumption of homegrown produce)	2.5	3.4	5.3
Allotments	2.7	5.1	5.7
Commercial	36	77	77
POS_{resi}	4.9	NA	10
POS_{park}	10	NA	21

Figure 3: C4SLs for Benzo(a)pyrene, extracted from Appendix E of the DERFA research project SP1010

A full list of target values for all parameters of interest will be developed and agreed with the EPA for the Site post implementation of the closure plan. In order to achieve the agreed target values, it is possible that Saint-Gobain will be required to remove some 'contaminated land' and this will be removed using licensed waste contractors in agreement with, and with approval from, the EPA.

4.4 Rewatering of the Pit (Surface Water and Groundwater Considerations)

Mining, both underground and open-cast, has been carried out for many years in and around the location of the proposed Knocknacran West Mine. All of this previous and current mining activity has had to manage water and as such there is an extensive knowledge and understanding of the hydrogeological setting. A comprehensive review of water has been carried out as part of the EIAR submitted as part of the planning application for the proposed project. As described in the Water Chapter (8.0) of the Planning EIAR, all historical and current extraction activities at the Site have occurred beneath the water-table. Groundwater entering the existing Drumgoosat underground workings is pumped from a borehole to a series of settlement ponds which drain through an oil interceptor prior to being discharged to an existing licensed receiving water discharge point on the River Bursk. Groundwater and surface water entering the existing Knocknacran Open-Cast Mine is pumped from a sump located on the existing pit floor and routed through the same system. Groundwater from the adjacent operating underground Drummond Mine also passes through the settlement ponds prior to discharge.

The drawdown zone of contribution is described as being well-established and in existence, since the time of development of the Drumgoosat Mine (a period of nearly 60 years). It is concluded that the zone of contribution that would arise if the Knocknacran West Mine is permitted, would be no different to the current zone of contribution. This is because the well that dewaters the Drumgoosat underground workings already fully dewaters the area of the proposed Knocknacran West open-cast mine, so that the future area of mining influence will not increase. It is believed that if there is an opportunity to restore the peripheral areas of the existing Knocknacran open-cast mine as part of the progressive backfilling process during the life of the mine, this would marginally reduce the cumulative zone of contribution for all Saint-Gobain's mining activities.

For the purposes of the CRAMP the expected operational zone of contribution (pre closure) for Knocknacran West is taken to be the existing zone of contribution.

This section of the CRAMP assumes that ultimately there will be a full recovery of groundwater in the area.

4.4.1 Hydrogeological Setting

The geology and hydrogeological setting of the proposed mine is described in Chapters 7 and 8 respectively in the EIAR. The Site is described as being located in the Kingscourt Outlier, a half-graben structure formed of Carboniferous and Permo-Triassic rocks. The Kingscourt Fault forms the western boundary of the Kingscourt Outlier. The stratigraphy and geological structures have a dominant north-south strike.

The bedrock consists of the Kingscourt Gypsum Formation, which is described as consisting of mudstone with gypsum and anhydrite of Permian age. There is evidence of post-depositional weathering or solution (karst) on the upper surfaces of the gypsum beds as seen in the western part of the deposit currently exposed in the Knocknacran open-cast mine. However, no major cave systems have been encountered in either the current open-cast mine or adjacent underground workings. There is no evidence from the underground workings at Drummond or Drumgoosat to suggest the major north-south trending graben structures are important water-bearing features. Rather, the available data suggests they are barriers to groundwater flow across their strike plane.

Dolerite sills occur in the Permo-Triassic sequences at Kingscourt, with the principal intrusion in the Middle Mudstone between the two gypsum units/beds. A secondary intrusion is generally restricted to the Lower Mudstone but is known to occasionally cross-cut the Lower Gypsum in some areas. The sills are interpreted as having been hydrothermally altered as they were intruded, resulting in susceptibility to weathering and thereby acting as potential conduits for water where altered.

The Site is underlain by grey brown podzolic and associated gley soils, which have generally originated from limestone glacial till. The soils are predominantly underlain by tills derived from Lower Palaeozoic rocks. The depth of Overburden across the Site where it has not been stripped or re-worked is variable in thickness, reflecting the nature of the drumlin landscape.

Most of the groundwater movement within the strata of the Kingscourt Gypsum Formation is described as occurring under fracture flow conditions through structures (faults, or occasionally karst within the gypsum units) or within the dolerite sills which are locally altered and more potentially permeable than the surrounding gypsum and mudstone units. The observed geological discontinuities within the strata means there is limited lateral or vertical groundwater flow within the Kingscourt Gypsum Formation on a site scale. The layered nature of the strata impedes the downward flow of groundwater to the mine voids and creates strong vertical hydraulic gradients.

The geology information and available water level data suggest that the area of drawdown influence from the mining is anisotropic in a north-south direction. The relatively low groundwater inflow rates to Drumgoosat and Knocknacran produce highly localised areas of drawdown, primarily defined by north-south trending faults. Penetration of the June 2018 Drummond Mine Fault by mining extended the area of influence by a small amount to the south and west.

The proposed placement of low permeability backfill (mudstone) within the existing Knocknacran open-cast will have the positive benefit of reducing any hydraulic connection in the gypsum strata and effectively isolating the Drumgoosat / Knocknacran West mining areas from the Drummond Mine to the south.

Figure 4 below presents the groundwater level baseline conditions as interpreted from monitoring well drawdown data.

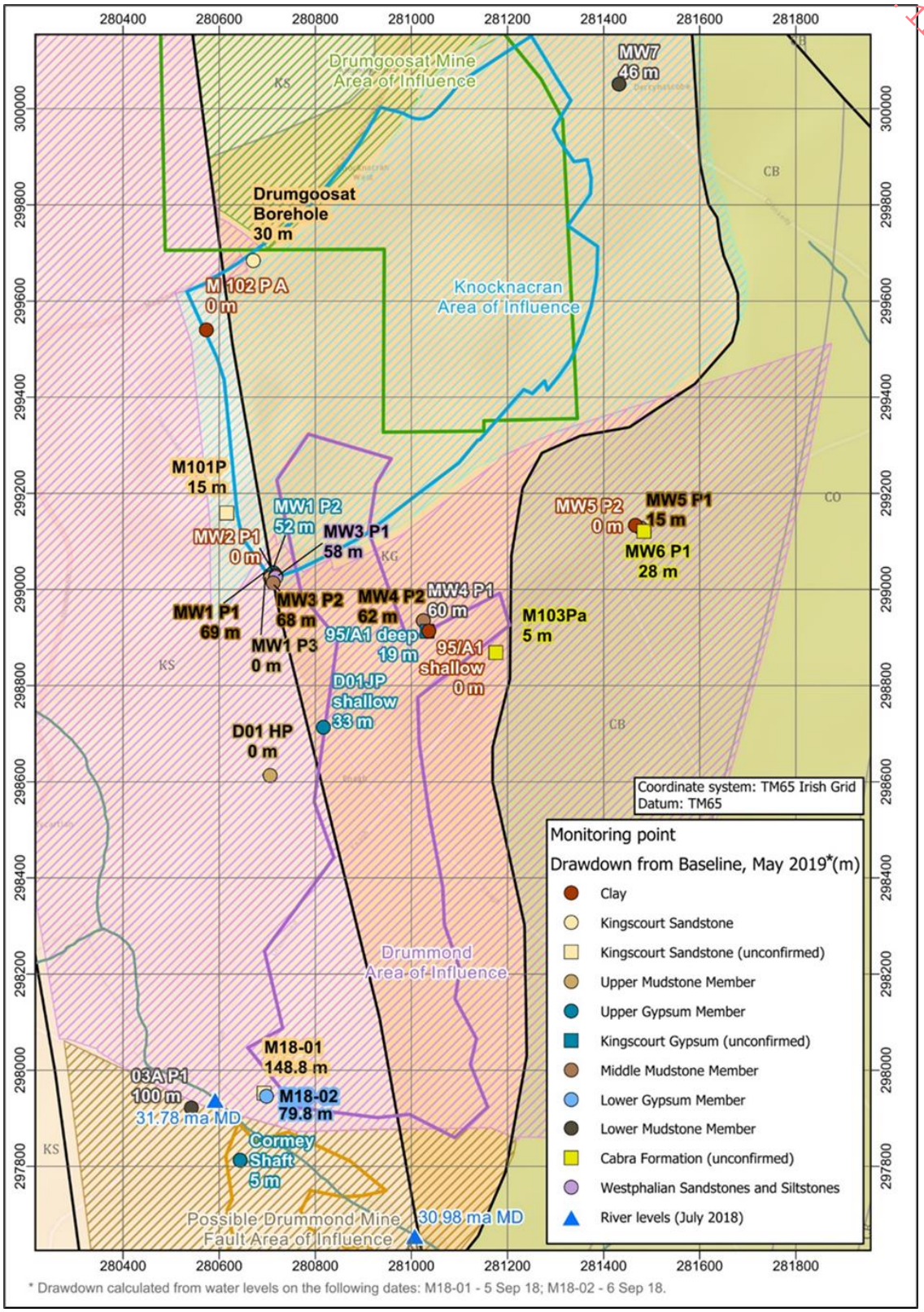

Figure 4: Groundwater Level Baseline Conditions as interpreted from Monitoring Well Drawdown Data

4.4.2 Surface Water - Hydrology

The three primary local surface water courses in the district are:

- Magheracloone Stream which runs north to south along the western boundary of the Site;
- River Bursk (also known as River Rahans) which runs north to south in an artificially straightened channel along the eastern boundary and which receives discharge from the Site; and
- River Lagan (also known as the River Glyde south of Aclint Bridge) which receives water from both the Magheracloone and Bursk and flows from west to east to the south of the Site.

The Corduff Stream also rises in the area above the Drumgoosat underground mine and flows north-east to Lough Fea, about 2 km northeast of the Site. Lough Fea is part of the River Bursk catchment. The Bursk flows south into Bursk Lough, then Rahans Lough (Raffan's Lough), and then into the River Lagan. Bursk Lough is also fed by Descart Lough. The overall drainage pattern in the area is principally northwest-southeast or north-south as defined by divides set by the local topography. Surface water quality is typically good (or unpolluted), being classed as Q4 to Q5 by the EPA.

4.4.3 Pre Mining Baseline Groundwater Levels

Because mining has been ongoing for so many decades around the Kingscourt area there is limited baseline data for pre mining groundwater levels.

Groundwater levels will typically be influenced by the topography and will vary seasonally with recharge taking place over the winter months resulting in seasonal highs in late spring and lows in early autumn. The existing topography in the vicinity of the Site is undulating in nature and varies in level from approximately 40 to 60 m OD. The lowest topographic point close to the study area is the River Bursk (between 25 and 32 m OD).

4.4.4 Rewatering of the Open Pit at Mine Closure

Upon completion of mining and placement of backfill at Knocknacran West Mine, the dewatering pumps in the mine and the Drumgoosat well will be permanently shut down and the water levels within the open-cast void will recover to form an open waterbody (lake).

The level of water in the lake is expected to rise to ca. 39 m OD. The groundwater flow system around Knocknacran West will be similar to pre-mining, with slow discharge occurring across the boundaries of the hydrogeological block. Monitoring of groundwater elevation in wells around the region will show the rate of recovery.

The 2021 Saint-Gobain Closure Plan (KD Environmental Ltd) estimates that it will take ca. 30 to 40 years for groundwater elevations to return to baseline. It will be possible to establish the return to pre-mining baseline conditions from an interpretation of the groundwater elevations on an annual basis. Seasonal variation will still be a factor during the recovery period, with a reduction in recovery to be expected during the late summer and autumn. The return to baseline conditions will be apparent once the groundwater elevations return to the usual pattern of seasonal variation, with no further year-on-year cumulative increase. Further information on the rewatering of the mine is provided in Chapter 8.0 of the EIAR.

To prepare for rewatering and to mitigate against risk, backfilling will take place at locations within the open-cast mine. This is to mitigate against the risk associated with potential for gypsum remaining in the mine to be dissolved over time by incoming groundwater flows. This dissolution, if it were to occur, has the potential to cause settlement and increase sulphate concentrations in the groundwater and possibly surface water. To mitigate against this risk during the operation, low permeability mudstone will be placed against the

southern and eastern walls of the open-cast mine, and also along the northern and western walls of the open-cast where gypsum is exposed.

This will mean that the gypsum that remains in place in the Upper and Lower Units surrounding the open-cast (including beneath the roads) will become hydraulically isolated from any active groundwater flow pathways, which will greatly reduce the potential for any on-going kinetic reactions and possible gypsum dissolution which, in turn, will help minimize the potential for any future settlement.

To mitigate against the risk of pollution from mining related materials and equipment, all material related to mining activities will be removed from the open pit. A Site assessment, including soil sampling, will be conducted to identify any risk associated with hydrocarbon or other material that may have spilled.

4.4.5 Potential for Rewatering of the Open Pit to Impact on Groundwater

The groundwater flow system around Knocknacran West will be similar to pre-mining, with slow discharge occurring across the boundaries of the hydrogeological block. Any potential minor groundwater flow to the south will be interrupted because of the low permeability backfill placed in the existing Knocknacran open-cast mine, which will have the positive benefit of reducing any hydraulic connection in the gypsum strata and effectively isolating the Knocknacran West mining areas from the Drummond Mine to the south.

4.4.6 Potential for Rewatering of the Open Pit to Impact on Surface Water

As part of the rehabilitation of the mine the baseline surface water flow will become established. Surface water that previously reported to the sump within the pit will form part of the pit lake or will be routed towards the surrounding natural drainage and ditch system.

The quality of the surface water that flows on and off the rehabilitated Knocknacran West Site will be the same as the surface water quality on surrounding lands and will not have a negative impact on receiving water bodies. Environmental monitoring, chemical and biological will be carried out during the passive closure period to demonstrate that there is no impact on surface water quality.

4.4.7 Potential for Rewatering of the Open Pit to Impact on Drinking Water Supplies

The national well database compiled by the GSI contains records of 43 private and public wells located within 3 km of the proposed Knocknacran West open-cast. Of these, 6 wells are used for public water supply, with the remainder used for agricultural or domestic purposes (where usage is known). Based on the available information, it is apparent that all existing local and community water supplies are hydraulically disconnected and isolated from the gypsum mining areas. No impacts have been observed to date, and it is not expected that the proposed extraction and restoration activities at Knocknacran and Knocknacran West mines will have any future impact on any water supply systems.

As described in Section 4.4.4 of this report to mitigate against risk of groundwater contamination, backfilling will take place at locations within the mine. This backfilling will mitigate the risk associated with potential for gypsum remaining in the mine to be dissolved over time by incoming groundwater flows.

4.5 Safety

Ensuring the safety of the open-cast mine post closure and that there is no risk to people or wildlife is a priority for Saint-Gobain. There are two key aspects with respect to open-cast mine safety that are discussed below.

4.5.1 Geotechnical Stability of the Open-Cast Mine during and Post Closure

The geotechnical setting of Knocknacran West is well understood, with the characteristics of the Site and the materials underlying the Site having been well established by previous work. During 2018 and 2019 Golder

conducted additional borehole sampling and laboratory testing to confirm the stratigraphy and material parameters associated with the proposed Knocknacran West Mine. A total of 8 representative cross-sections around the perimeter of the proposed Knocknacran West Mine were selected for stability analyses to meet the design criteria for a Factor of Safety (FoS) of 1.5 for the overall open-cast slope.

The cross-sections were created using a combination of logs from previous boreholes within the footprint of the proposed open-cast mine and logs from the Golder 2018-2019 ground investigation programmes. In all cases, the cross-sections were developed from existing ground surface to the top of the Lower Seam Gypsum unit.

The following slope stability cases were analysed:

- An inter bench slip surface for the different strata; and
- An overall slope slip surface.

The EIAR summarised that, based on a review of historical data and recent slope stability analyses (using limit equilibrium modelling software SLOPE-W version 10.0.2.1001) carried out by Golder, the FoS varies from between 1.5 to 2.3 for the overall open-cast slope, and from 1.2 to 2.5 for the inter bench which meets design criteria FoS values. The proposed Knocknacran West Mine will be developed on a phased basis, which will require detailed design of the long-term perimeter slopes and the short-term internal slopes. These detailed designs will be optimized to extract the Lower Gypsum Unit and maintain the required FoS and thus may have shallower or steeper overall slope gradients depending on the nature of overburden materials present in that phase footprint.

The Site's existing Emergency Response Plan for Knocknacran and Drummond mines will be adapted to include Knocknacran West. The plan will describe the design features that must be included for all works during the development of the Knocknacran West open-cast mine to ensure pit slope stability. The plan will continue into the closure phase to ensure that closure works enhance the stability of the open pit.

A series of measurements will be taken during the life of the mine, and both during and after implementation of the closure plan to assess pit slope stability. For example, measurements of ground elevation / movement at specified and agreed locations will be taken of a regular basis. A Trigger Action Response Plan (TARP) will be put in place during operations, and both during and after implementation of the closure plan. The TARP will assess all measurements and sets trigger levels for each of the measurements. It will also describe what actions must be taken if a trigger value is exceeded.

Responses to breaches of trigger values will be defined in the TARP put in place at the time of the closure of the mine. The specific TARPs will be established and developed in agreement with the EPA and other relevant authorities.

4.5.2 Management of Access to the Pit Post Closure

Despite the implementation of a robust closure plan certain hazards will remain at the open pit once the mine is rehabilitated. In particular there is a risk associated with deep open water that remains, in the event of unauthorised access. Saint-Gobain will reprofile the open pit walls to provide a stable landform and minimise any high walls. However, the landform, like many natural landforms may pose a slip and trip hazard to people in the event of unauthorised access.

The solution to be adopted by Saint-Gobain to manage this risk is the same solution that is adopted worldwide to manage the risk left by open pit lakes, and that is to secure the area to prevent access by unauthorised people. A fence will be put in place around the entire perimeter of the area and signage will

be erected warning people of the hazard. The fence will be checked on a scheduled basis and if necessary, repairs will be carried out. As part of the checks, observations will be made to establish if there is evidence of access being gained. In the event that it becomes apparent that access is being gained the company will explore, in conjunction with the relevant State Agency, what additional measures may be taken.

4.6 Biodiversity

The closure of the open pit at Knocknacran West offers opportunity to create an open area of water with associated wetland features providing an area of considerable wetland nature conservation interest. While there are other factors, two of the key requirements for nature and biodiversity to thrive are the presence of water and the lack of disturbance from people.

The rehabilitation of the open pit at Knocknacran will be a source of water and as described in the section above, actions will be taken to prevent access by unauthorised people, which will result in very little access, and disturbance, by people. Therefore, the rehabilitated satisfies these two key requirements for nature and biodiversity to thrive.

In general, 'nature will find a way' when left to its own devices, meaning that even in a 'do nothing' scenario an element of biodiversity will become established around the open pit. The term 're-wilding' is a term that is commonly used today and that leans on the principle of the do nothing approach and allow the natural process to take place. However, it is possible to further enhance the biodiversity interest of the Site by taking steps as part of the rehabilitation process and it is Saint-Gobain's intention to take this approach.

The steps to be taken will include reprofiling work, particularly along the edge of the pit lake. The introduction of inlets and margins will provide excellent habitat for wildlife. Some selective planting is also advisable as this too will provide additional habitat. Planting would consist of native species and would be under the guidance of an ecologist and as part of a Biodiversity Action Plan, that would look at type of plants to be introduced as well as location and density of planting.

The objective will be to create habitats to attract and maintain a diverse range of wildlife in the area. The focus of planting will be on native trees and grasses. An assessment of the surrounding landscape will be completed to establish which plants are thriving in the area. An important consideration will be the planting of hedgerows to create bird and small mammal habitats, and in particular to provide a corridor to allow fauna to move within the Site and connect to other rehabilitated lands owned by Saint-Gobain and other third-party lands.

As described in the section above, the open pit will have controls to prevent the access of unauthorised people to the Site and this will have the effect of also preventing the access of large animals to the rehabilitated site. However, a tremendous range of fauna will be able to access the rehabilitated open-cast site, including insects, birds and small animals.

While an ecologist will advise Saint-Gobain in the run up to closure and during the rehabilitation process, this will be a passive system and once the rehabilitation is completed and the opportunities for biodiversity have been created, nature will be allowed to take its course and there will be a re-wilding of the open pit and it's surrounds.

A number of examples of enhancement of biodiversity interest as part of the rehabilitation of a gypsum open pit mine are provided in the 2021 EuroGypsum publication 'Biodiversity Stewardship in Gypsum Quarrying: Our Best Practices'. Examples provided include; Cormeilles Val d'Oise and Coubron-Vaujours, Seine-Saint-Denis in France, and Turda, Cluj County in Romania, all of which are operated by Saint-Gobain companies.

5.0 SUCCESS CRITERIA

Ensuring that there are clear metrics that can be used to demonstrate that closure works are complete and to demonstrate that the works were completed successfully is very important. To this end, the Knocknacran West mine closure strategy will be underpinned by a set of success criteria, and these will be used as a framework for validation of rehabilitation performance.

The criteria will be agreed with the EPA. They will be specific, measurable, achievable, realistic and time related (SMART), and will be used as indicators to determine whether closure objectives have been met. The achievement of these success criteria will be verified through a monitoring process and will subsequently lead to sign off and approval from the EPA.

It is proposed that success criteria will be established for all of the following aspects:

- Elevation of the water within the open pit (in m OD, which demonstrates baseline levels have been achieved);
- Time for elevation of the water within the open pit to return to baseline levels;
- Concentration for chemical parameters in surface water (agree suite of parameters and limit values, with reference to European Communities Environmental Objectives (surface water) Regulations 2009 (S.I. No. 272 of 2009) as amended;
- Concentration for chemical parameters in groundwater (agree suite of parameters and limit values, with reference to European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010) as amended;
- Concentration for chemical parameters in soil (agree suite of parameters and limit values);
- Ground subsidence movement in mm per year that must not be exceeded at agreed monitoring locations; and
- List of all infrastructure and plant to be demolished / removed.

A copy of the success criteria will follow in future iterations of the CRAMP and will include the specific target values, where applicable, once agreed with the EPA. Additional success criteria may be included, should the need arise.

5.1 Monitoring Programme

The monitoring programme for the post closure and aftercare period is to be agreed with the Regulatory Authorities during the life of the mine and will be included in future iterations of the CRAMP.

The monitoring programme will:

- Focus on the parameters that can be used to demonstrate success of the closure implementation.
- Initially there will be no reduction in the frequency or scope of monitoring that will be prescribed in the EPA Licence. So that during the closure period and for the first year of aftercare, there will be no change. Or if there is a change, it may be an increase. Monitoring will only then decrease on the basis of predictable 'steady state' data being achieved.
- Monitoring that is justifiably no longer required will be removed from the programme, for example it is anticipated there will be vibration monitoring required to assess the vibrations from blasting in

the pit during operation of the mine. With no blasting to take place post closure, there will be no justification or requirement to continue with vibration monitoring.

- Monitoring will be for all aspects of importance and will include surface water, groundwater, air quality, subsidence, ecological metrics for land and water.
- Initially Saint-Gobain will retain environmental staff and will carry out much of the sampling and possibly the analyses. As closure progresses and in particular during the aftercare period, sampling and analyses may be outsourced to contractors.

Further iterations of the CRAMP will include a detailed monitoring programme for closure and aftercare periods, to be agreed with the EPA.

5.2 Reporting

It is expected reporting will be required to continue as per the schedule as set out in the EPA licence and this will include the results of all scheduled and routine environmental monitoring, for example surface water emissions. The Annual Environmental Report (AER) and Environmental Liabilities Risk Assessment (ELRA) will continue to be prepared and submitted.

Specific studies, reviews and reports may be required during the closure implementation process and in particular during the passive validation period. These reports will be prepared by persons with expertise in the aspects being reported.

The bulk of the reports will be required during the initial period after closure has been completed (the passive validation period) to demonstrate the implementation and success of the closure plan for Knocknacran West.

There are a number of separate aspects that will require expert reports, and each will be completed by different experts (for example water reports will be very different to subsidence reports). It is also anticipated that for certain aspects, experts' reports will be required to be updated to describe the changes with time and ultimately, it is anticipated, demonstrate that steady state has been achieved. The scope (and cost) of reports will vary. This will range for ca. €2,000 to ca. €15,000 per report. A general provision of €80,000 is being allowed for expert reports to be completed in the passive validation period.

6.0 EARLY CLOSURE SCENARIO

Early closure is a scenario that must be considered in the CRAMP as it is a material risk with respect to closure and a contingency plan must be in place. This section describes how an early closure would be managed.

6.1 Early Closure Contingency

While considered unlikely the consequence of an early closure must be considered. Early closure has very limited impact on the CRAMP. Most importantly the resources to implement must, and will, be available at all times and this will be explained in Section 11 of this CRAMP report.

In the event of an early closure all actions outlined in the CRAMP will be completed in the same way as if the mine ran for the full life. In particular Sections 4.1 to 4.4, which described the key activities to be completed during physical closure, will all be completed as described.

The final arrangement and shape of the remaining pit will be different to what was planned. Consideration will be given in particular to geotechnical stability. This will be considered by a suitably qualified geotechnical

engineer. This is not deemed to be a material risk, there is a budget for reprofiling work at the pit and there should be no additional costs that are not already catered for in the mine closure estimate.

The biodiversity opportunity may change if there is an early closure. This is because the landform left is likely to be different, for example less open water (i.e. a smaller lake) may remain. The rehabilitation of the Site will take this into account and ensure there is a contingency to enhance biodiversity even if there is an early closure.

Another aspect to consider is the rehabilitation of the Knocknacran open pit. The plan is that the Overburden and Interburden from Knocknacran West will be used to backfill the existing Knocknacran open pit. In the event that Knocknacran West was to close before the Knocknacran open pit is fully rehabilitated this may have an impact on the closure plan for the Knocknacran open pit. In the unlikely event there was insufficient material to fill the existing Knocknacran open pit, the existing Knocknacran pit would retain an element of an open water (lake) feature, which will offer potential for additional biodiversity interest.

7.0 CLOSURE TIMELINE

Active Closure

	1 Month PC	2 Month PC	3 Month PC	4 Month PC	5 Month PC	6 Month PC
Dewatering of pit	■					
Assessment for and removal of any soil contamination from site	■	■				
Reprofiling of pit		■	■	■		
Removal of residual waste associated with mining operations	■					
Removal of buried services	■					
Removal of conveyor stockpile bins and stockpile re-claim conveyor		■				
Removal of conveyor		■				
Removal of crusher			■			
Removal of hardstands			■	■		
Removal of haul road				■		
Removal of transformer					■	
Planting of trees and other flora					■	
Demolition and removal of buildings						■
Removal of mobile fleet						■
Removal of spare parts						■
Environmental monitoring	■	■	■	■	■	■

PC - Post Closure

Figure 5: Estimated Active Closure Timeline

Passive Closure

	7 Month PC	8 Month PC	9 Month PC	10 Month PC	11 Month PC	12 Month PC	13 Month PC	14 Month PC	15 Month PC	16 Month PC	17 Month PC	18 Month PC
Environmental monitoring	■	■	■	■	■	■	■	■	■	■	■	■
Experts reports	■	■	■	■	■	■	■	■	■	■	■	■

Figure 6: Estimated Passive Closure Timeline

Aftercare						
	Years 1 to 5 Aftercare	Years 6 to 10 Aftercare	Years 11 to 15 Aftercare	Years 16 to 20 Aftercare	Years 21 to 25 Aftercare	Years 26 to 30 Aftercare
Environmental monitoring						
Experts reports						

Figure 7: Estimated Aftercare Closure Timeline

8.0 MINE CLOSURE COST ESTIMATE

A summary of the CRAMP cost estimate, including the mine closure cost estimate, is presented in Figure 8 below. The detailed closure costings can be found in Appendix B.

CRAMP costs (in Euro incl. 25% contingency)		
Cost Element 1 Active Closure	Demolition / Removal of surface infrastructure and plant.	642,612
Cost Element 2 Passive Closure	Validation monitoring.	251,149
Subtotal (Closure Cost)		**893,761**
Cost Element 3 Aftercare	Monitoring / Assurance	1,853,750
Total CRAMP cost		**2,747,511**

Figure 8: Estimated Closure Costs

9.0 FINANCIAL ASSURANCE

Saint-Gobain intends to implement its mine closure plan in line with the detail provided in this document and a cost estimate has been determined on this basis. Planning for mine closure is an iterative process and requires ongoing review during the life of the mine to account for the progress of the mining production, developments in the industry with respect to mine closure and potential environmental impact, and changes to rates or assumptions with respect to costs. The closure cost estimate will be reviewed on an annual basis to ensure adequate financial assurance is in place. Aftercare costs have also been calculated and provided for and are covered in Section 12.

A summary of the overall Mine Closure Estimate is outlined in Section 8 and full details of the estimate are included in Appendix B. The financial provision will be provided in accordance with EPA guidelines.

9.1 Cost of Physical Closure

A summary of the overall Mine Closure Estimate is outlined in Section 8 and full details of the revised estimate are included in Appendix B.

9.2 Closure and Aftercare funding

Saint-Gobain actively engages with the EPA and has agreements in place for CRAMP funding in relation to its existing activities. These arrangements will be extended by the company in line with the EPA guidelines on financial assurance. As rehabilitation work is carried out and the CRAMP reviewed each year the revised future costs will be reassessed, and the fund adjusted as appropriate.

9.3 Review and Updating

Saint-Gobain will review the mine closure estimate each year as part of an annual review to ensure the plan remains valid and there are sufficient funds in place to implement the plan.

9.4 Risks

The annual review process will provide assurance against the cost risk. The review will consider the scope of mine closure and current projected timelines. It will also consider developments within the industry and learnings with respect to mine closure and management of closure risk, as well as market conditions and inflationary pressures with respect to costings.

The objective of the review each year will be, to firstly ensure that the appropriate extent of works is described to manage the closure risk, and secondly to ensure the cost estimate calculated to carry out these works is accurate.

The annual review process will be carried out by Saint-Gobain taking appropriate professional advice. The review will result in the update of the CRAMP and ELRA documents and associated cost and funding forecasts which will be submitted to the EPA annually[6].

In the event that it is established during the annual review that there are adjustments required to the funding arrangements then Saint-Gobain will agree alternative arrangements with the EPA.

10.0 INTERESTED AND AFFECTED PARTIES

This section of the Knocknacran West mine CRAMP describes the general approach to managing the potential social consequences of mine closure.

A Stakeholder Management Plan is currently in place at Saint-Gobain, and this will be maintained and updated throughout the course of the mine's life.

10.1 List of Key Stakeholders

A list of the key stakeholders and their concerns is provided in Table 1 below.

[6] ELRA will be reviewed every three years, unless otherwise agreed with the EPA.

Table 1: Key Stakeholders and their Concerns

Stakeholders	Key Concerns
Saint-Gobain – Corporate Office	Interested to ensure successful mine operation, sustainability, and successful mine closure implementation in line with best practice and the Groups policies.
Customers	Customers want assurance that they raw material is being sourced from a responsible operator who is managing all aspects of the business including closure. Customers will want adequate notice before the mine closes (as this will affect the supply of product).
Government and Regulatory Bodies including: The EPA The Department of Environment, Climate and Communications Monahan County Council Inland Fisheries Ireland The Health and Safety Authority	Regulatory Compliances, Safety, Health and Environmental performance
Employees	Preparing for closure and Health and Safety
The local community including: The immediate (<5km radius) The greater local community (<40km radius)	Mine closure Environmental performance Employment Community Welfare & Relations
Contractors and Suppliers	Policies, practices, and wind down of the operation

10.1.1 Customers

Corporate Social Responsibility (CSR) extends throughout the full supply chain. It is not enough for businesses to ensure they run a responsible operation at their premises, they must also ensure that they buy raw materials from responsible operations. As a supplier of raw material Saint-Gobain ensures that its customers are aware of how it is managing its business in a responsible manner, including how the operations will be closed responsibly.

Saint-Gobain recognises the need that customers have for certainty in their supply chain and will ensure that adequate notice is provided before the mine closes.

10.1.2 Regulatory Authorities

Over the years Saint-Gobain has established a robust communications system with the Regulatory Authorities responsible for permitting operations and Inland Fisheries Ireland. Saint-Gobain meets regularly with the

different Agencies and provides an update to all parties on the environmental performance of the company. This engagement will continue and include information on the Knocknacran West project.

10.1.3 Employees

A number of different mechanisms have been put in place by Saint-Gobain to keep its staff informed of changes in the business environment. Mine closure would be one such change. This information will be part of the overall communications programme operated by Saint-Gobain for all its Irish employees. This includes passive means such as emails, notice boards and newsletters, as well as active communication from line management to their teams.

Each year the company will review and revise its life of mine, in which it identifies the mineral resource and reserve, and projects the rate of mining required to adequately work the gypsum deposit. As such there will always be a good understanding of the life of mine.

10.1.4 Local Community

Saint-Gobain will maintain its active programme of engagement with the local community. The programme provides a means for the mine to communicate all relevant information and will also be used to share the plans for mine closure and indeed communicate the progress of mine closure implementation when that time comes.

Prior to closure and in the early stages of closure there will be an increase in interest from the local community and it is Saint-Gobain's intention to increase the frequency of engagement accordingly to share information and ensure the views of the community are taken on board at this critical time.

10.1.5 Irish Water

Irish Water is a key stakeholder for Saint-Gobain due to the impact that mining has on groundwater levels and the potential there is for impact on groundwater at mine closure. Irish Water will remain a key stakeholder throughout the life of the mine and during the closure process and will be kept informed at all times by Saint-Gobain in relation to the timing of closure.

10.1.6 Contractors & Suppliers

The operations at Knocknacran West will have a network of contractors and suppliers that support mining operations, ranging from the supply of goods and materials to the provision of technical and professional services. Mine closure has potential implications for the performance of these organisations through the loss of an important customer and client. Saint-Gobain will ensure that all suppliers and contractors are kept informed about plans for progressive mine closure.

11.0 RISKS

This section considers the key risks that are applicable to mine closure and aftercare.

11.1 Technical Knowledge

Management and key personnel at Saint-Gobain have wide-ranging knowledge and understanding of the operation and the environment around the proposed Knocknacran West mine and there is a high level of confidence that all aspects of closure have been adequately identified and will be adequately addressed during mine closure and aftercare.

Saint-Gobain employ a wide range of third party consultants to address different technical aspects that can arise during the life of mine. Consultants typically operate internationally and must be able demonstrate an

extensive track record of expertise. Examples of the companies that Saint-Gobain have consulted with in preparing the plans for the operations and closure of the Knocknacran West Development include; Golder Associates, Piteau Associates, SRK, Macroworks and others.

11.2 Cost Inflation

Inflation risk is covered in Section 9. This risk is managed by an annual review process, which ensures that there is adequate funding in place at all times.

11.3 Financial Assurance / Security of Funds

Financial Assurance is also covered in Section 9. A cost estimate has been produced for both closure and aftercare, and appropriate financial assurance will be put in place to meet these costs. Funding will be held in a form agreed with EPA according to the appropriate guidance.

11.4 Loss of Expertise / People / Resources before or during the Closure Process

Employees
A severance package will be put in place to incentivise employees to remain with the company until such time as they receive their redundancy notice. If an employee leaves without receiving their redundancy notice they will not receive any severance benefits. Employees will only be made redundant when their skills are not required.

Consultants
The key consultancies used by Saint-Gobain are typically large companies with many employees and crucially a number of employees who have worked on the Knocknacran West project. Therefore, in the event of an employee leaving the consultancy or retiring, there will be corporate knowledge within the company to continue providing the service.

Data / Information
Critical data and information will be retained by the company for a period agreed with the Authorities.

11.5 Early / Delayed Closure

The possible causes, likelihood, and contingency to manage the 'Early Closure' risk has been described in Section 6 of this report. This is not deemed a material risk, and financial assurance will be in place to meet the closure liability.

Delayed closure might be brought about by a delay in the extraction of gypsum reserves. Delayed closure is not considered a material risk. Delayed closure does not change the closure plan or the closure cost. The annual review process ensures that at all times the closure fund has sufficient funds available to implement the closure plan and this addresses the risk that a delayed closure could have with respect to inflating costs.

11.6 Change to Legislation

Ireland has adopted and enforced all relevant legislation and there is no pending environmental or mining related legislation, that Saint-Gobain is aware of, that could introduce new challenges to the mine closure process. Saint-Gobain will continue to assess developments in this area and also changes in best practices with respect to mine closure.

12.0 AFTERCARE AND POST CLOSURE VISION

The objective for closure planning for the Knocknacran Mine West operation is to carry out rehabilitation works that will leave a safe and environmentally secure Site. The vision is to enhance biodiversity opportunity for the area. Figure 9 below, taken from the Knocknacran West EIAR shows the vision for the rehabilitated Knocknacran West Site and the Knocknacran Site (to the south).

Figure 9: Rehabilitation of Knocknacran West and the Knocknacran Sites

The activities to be carried out on Site during aftercare are exclusively monitoring and reporting to provide assurance to Saint-Gobain and all stakeholders that the Site is safe and secure. A programme of work and associated cost estimate for aftercare is included in Appendix B and a summary is presented in Sections 3.2.3 and 5.1 of this document.

The detail of the aftercare programme will develop during the life of mine and indeed during the aftercare period itself. The programme will be reviewed on an annual basis and activities may be added or reduced.

13.0 REFERENCES

- https://www.epa.ie/publications/compliance--enforcement/licensees/reporting/financial-provisions/EPA_OEE-Guidance-and-Assessing-WEB.pdf.
- https://www.epa.ie/publications/compliance--enforcement/licensees/reporting/financial-provisions/guidance-on-assessing-and-costing-environmental-liabilities.php.
- https://www.icmm.com/website/publications/pdfs/environmental-stewardship/2019/guidance_integrated-mine-closure.pdf.
- Saint-Gobain Mining (Ireland) Ltd. Mine Site Decommissioning, Closure and Aftercare Management Plan (2021).
- Saint-Gobain Mining (Ireland) Ltd. Draft EIAR to support Planning Application c/o Golder Associates.
- EuroGypsum publication 'Biodiversity Stewardship in Gypsum Quarrying: Our Best Practices (2021).

Appendix A
IPCL Extract

Condition 10. Decommissioning & Residuals Management

10.1 Following termination, or planned cessation for a period greater than six months, of use or involvement of all or part of the installation in the licensed activity, the licensee shall, to the satisfaction of the Agency, decommission, render safe or remove for disposal/recovery any soil, subsoil, buildings, plant or equipment, or any waste, materials or substances or other matter contained therein or thereon, that may result in environmental pollution.

10.2 Decommissioning Management Plan (DMP)

10.2.1 The licensee shall maintain, to the satisfaction of the Agency, a fully detailed and costed plan for the closure, decommissioning and rehabilitation of the installation or part thereof.

10.2.2 The plan shall be reviewed annually and proposed amendments thereto notified to the Agency for agreement as part of the AER. No amendments may be implemented unless agreed by the Agency.

10.2.3 The licensee shall have regard to the Environmental Protection Agency Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision when implementing Condition 10.2.1 above.

10.2.4 The Decommissioning Management Plan shall include, as a minimum, the following:

(i) a scope statement for the plan;

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(ii) the criteria that define the successful decommissioning of the activity or part thereof, which ensures minimum impact on the environment;

(iii) a programme to achieve the stated criteria;

(iv) where relevant, a test programme to demonstrate the successful implementation of the decommissioning plan;

(v) a programme to address any remaining licence obligations; and

(vi) details of the costs for the plan and the financial provisions to underwrite those costs.

10.2.5 The licensee shall carry out closure, decommissioning and rehabilitation of the installation in accordance with the plan. No deviation from the plan shall be allowed unless agreed by the Agency.

10.2.6 The licensee shall carry out such tests, investigations or submit such certification, as may be requested by the Agency, to confirm that individual tasks of the plan are being progressed or have been completed.

10.2.7 A final validation report to include a certificate of completion for the Decommissioning Management Plan, for all or part of the installation as necessary, shall be submitted to the Agency within three months of execution of the plan. The licensee shall carry out such tests, investigations or submit certification, as requested by the Agency, to confirm that there is no continuing risk to the environment.

10.3 Closure, Restoration and Aftercare Management Plan (CRAMP)

10.3.1 The licensee shall maintain, to the satisfaction of the Agency, a fully detailed and costed plan for the closure, restoration and long-term aftercare of the landfill (CRAMP). The CRAMP shall, where appropriate, ensure closure of the landfill in accordance with the requirements of the Landfill Directive.

10.3.2 The plan shall be reviewed annually and proposed amendments thereto notified to the Agency for agreement as part of the AER. No amendments may be implemented unless agreed by the Agency.

10.3.3 The licensee shall have regard to the Environmental Protection Agency Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision when implementing Condition 10.3.1 above.

10.3.4 The CRAMP shall include, as a minimum, the following:

(i) a scope statement for the plan;

(ii) the criteria, including those specified in this licence, that define the successful closure and restoration of the landfill and which ensures minimum impact on the environment;

(iii) a programme to achieve the stated criteria;

(iv) where relevant, a test programme to demonstrate the successful implementation of the plan;

(v) details of the long-term supervision, monitoring, control, maintenance and reporting requirements for the restored landfill; and

(vi) details of the costings for the plan and the financial provisions to underwrite those costs.

10.3.5 Unless otherwise agreed by the Agency, the landfill shall be closed within two years of the date of the grant of this licence.

10.3.6 Subject to prior agreement by the Agency the licensee may use recovered materials for closure and aftercare at the landfill.

10.3.7 A final validation report to include a certificate of completion for the CRAMP shall be submitted to the Agency within three months of execution of the plan. The licensee shall carry out such tests, investigations or submit certification, as requested by the Agency, to confirm that there is no continuing risk to the environment.

Reason: ***To make provision for the proper closure of the activity ensuring protection of the environment.***

Condition 12. Financial Charges and Provisions

12.1 Agency Charges

12.1.1 The licensee shall pay to the Agency an annual contribution of €17,087, or such sum as the Agency from time to time determines, having regard to variations in the extent of reporting, auditing, inspection, sampling and analysis or other functions carried out by the Agency, towards the cost of monitoring the activity as the Agency considers necessary for the performance of its functions under the Environmental Protection Agency Act 1992 as amended. The first payment shall be a pro-rata amount for the period from the date of grant of this licence to the 31st day of December, and shall be paid to the Agency within one month from the date of grant of the licence. In subsequent years the licensee shall pay to the Agency such revised annual contribution as the Agency shall from time to time consider necessary to enable performance by the Agency of its relevant functions under the Environmental Protection Agency Act 1992 as amended and all such payments shall be made within one month of the date upon which demanded by the Agency.

12.1.2 In the event that the frequency or extent of monitoring or other functions carried out by the Agency needs to be increased, the licensee shall contribute such sums as determined by the Agency to defray its costs in regard to items not covered by the said annual contribution.

12.2 Environmental Liabilities

12.2.1 The licensee shall as part of the AER, provide an annual statement as to the measures taken or adopted at the installation in relation to the prevention of environmental damage, and the financial provisions in place in relation to the underwriting of costs for remedial actions following anticipated events (including closure) or accidents/incidents, as may be associated with the carrying on of the activity.

12.2.2 The licensee shall arrange for the completion, by an independent and appropriate qualified consultant, of a comprehensive and fully costed Environmental Liabilities Risk Assessment (ELRA) which addresses the liabilities from past and present activities. The assessment shall include those liabilities and costs identified in Condition 10 for execution of the DMP and CRAMP. A report on this assessment shall be submitted to the Agency for agreement. The ELRA shall be reviewed as necessary to reflect any significant change at the installation, and in any case every

three years following initial agreement. Review results are to be notified as part of the AER.

12.2.3 As part of the measures identified in Condition 12.2.1 the licensee shall, to the satisfaction of the Agency, make financial provision to cover any liabilities associated with the operation (including closure, restoration and aftercare). The amount of indemnity held shall be reviewed and revised as necessary, but at least annually. Proof of renewal or revision of such financial indemnity shall be included in the annual 'Statement of Measures' report identified in Condition 12.2.1.

12.2.4 The licensee shall revise the cost of closure, restoration and aftercare annually and any adjustments shall be reflected in the financial provision made under Condition 12.2.3.

12.2.5 The licensee shall have regard to the Environmental Protection Agency Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision when implementing Conditions 12.2.2 and 12.2.3 above.

Reason: ***To provide for adequate financing for monitoring and financial provisions for measures to protect the environment.***

Appendix B

Mine Closure Cost Estimate

Cost Element 1 - Active Closure

Demolition / Removal of surface infrastructure and plant.

Item Description	Item No.	Action Description	Comment / Notes	Unit	Quantity	Unit Price	Unit Price Source	Total
Buildings - Office units, lunchroom, welfare facilities comprising toilet and wash hand basin, first aid station (including safety shower and eye-wash).	1.1	Demolish structures	May be possible to sell portacabin units, but assumed all will need to be demolished and disposed. Demolition cost based on hire of two operators (at €500/day) and demolition equipment at €500 per day incl. fuel. Allow 10 working days to complete work.	Days	10	1500	Estimate / EPA 2014 Guidance on rates	15,000
	1.2	Remove waste material from site (transport cost)		Tonne	200	15	Estimate / EPA 2014 Guidance on rates	3,000
	1.3	Disposal of inert C&D waste off site		Tonne	100	4.5	Estimate / EPA 2014 Guidance on rates	450
	1.4	Disposal of waste material that will go to landfill		Tonne	100	110	Estimate / EPA 2014 Guidance on rates	11,000
	1.5	Disposal of waste material that may be hazardous off site		Tonne	1	1000	Estimate / EPA 2014 Guidance on rates	1,000
Disposal of spares and consumables	1.6	Sell or Dispose	Assumed to be zero cost (sell / return to supplier)				N/A	0
Disposal of non closure related residual waste from mining operation	1.7	Disposal as per existing provider agreements that will be in place	Quantity can only be estimated at this time. Waste will be effectively managed during the operation to prevent the build up of waste to be disposed of at closure. Estimated cost of €20,000.				Estimate	20,000
Water and power supply lines.	1.8	Isolate	Operator 2 days at €500 per day as per EPA cost guidance.	Days	2	500	EPA 2014 Guidance on rates	1,000
	1.9	Remove services that are <1m below ground	Two operators and an excavator for 5 days. Equipment available. Labour based on €500 per day and fuel estimate of €100 per day.	Days	5	1100	Estimate	5,500
1MVA transformer and associated infrastructure within a fenced-off area.	1.10	Sell or Dispose	A cost of €1,000 is included to provide for any disposal costs for transformer oil that may arise.	Total for task	1	1000	Estimate	1,000
Hardstand area to facilitate parking of employees and receipt of consumables.	1.11	Excavate and make good	Area to be excavated. Material to be used for reprofiling. Two operators, excavator, dumper for 5 days. Daily cost for operators €500. Fuel €75/day. Equipment available.	Days	5	1075	Estimate / EPA 2014 Guidance on rates	5,375
Haul-road routing across existing Knocknacran open-cast mine.	1.12	Excavate and make good	Area to be excavated. Material to be used for reprofiling. Two operators, excavator, dumper for 10 days. Daily cost for operators €500. Fuel €75/day. Equipment available.	Days	10	1075	Estimate / EPA 2014 Guidance on rates	10,750
Disposal of contaminated soil	1.13	Contingency for the disposal of overburden and surface from parking and roadways if contaminated with oil. Estimate of quantity and disposal cost.	Requirement is based on outcome of site assessment.	Tonne	50	150	2014 EPA guide	7,500
Conveyor to the manufacturing plant	1.14	Conveyor structure to be demolished. Conveyor belt to be removed and disposed of by a licensed waste contractor.	Steel supports, rollers, motor and electrical infrastructure to be removed and recycled / reused using a licensed waste contractor. Foundations to be removed and disposed of by licensed waste contractors and area is to be made good. Cost based on hire of two operators (at €500/day) and demolition equipment at €500 per day incl. fuel. Allow 5 working days to complete work.	Days	5	1500	Estimate	7,500
	1.15		Disposal of inert C&D waste off site.	Tonne	50	4.5	Estimate / EPA 2014 Guidance on rates	225
	1.16		Conveyor belt is widely reused within the circular economy, and could be taken as a zero disposal cost item. A provision of €1000 is allowed for recovery of any belt that is not reused (sold).	Total for task	1	1000	Estimate	1,000

Item Description	Item No.	Action Description	Comment / Notes	Unit	Quantity	Unit Price	Unit Price Source	Total
Conveyor stockpile bins and stockpile re-claim conveyor	1.17	Bins and conveyor structures to be demolished. Conveyor belt to be removed and disposed of by a licensed waste contractor. Steel supports, rollers, motor and electrical infrastructure to be removed and recycled / reused using a licensed waste contractor.	Foundations to be removed and disposed of by licensed waste contractors and area is to be made good. Cost based on hire of two operators (at €500/day) and demolition equipment at €500 per day incl. fuel. Allow 10 working days to complete work.	Days	10	1500	Estimate	15,000
	1.18		Disposal of inert C&D waste off site.	Tonne	50	4.5	Estimate / EPA 2014 Guidance on rates	225
	1.19		Conveyor belt is widely reused within the circular economy, and could be taken as a zero disposal cost item. A provision of €1000 is allowed for recovery of any belt that is not reused (sold).	Total for task	1	1000	Estimate	1,000
Semi-mobile crusher	1.20	Sell or Dispose	Cost is assumed to be zero. Equipment can be resold or scrap will have a residual value, no revenue assumed but disposal cost is taken to be zero				N/A	0
Fleet of excavators, Dump Trucks, bulldozers, graders, tractors, bowsers and rollers.	1.21	Sell or Dispose	Cost is assumed to be zero. Some equipment will be saleable (revenue from sales is not offset against closure cost) cost of disposal is taken to be zero as equipment to be scrapped will have residual value.				N/A	0
Dewatering of pit	1.22	Maintain dewatering of pit for a period of time as may be required to carry out rehabilitation works in the pit (removal of contaminated land / reprofiling)	Existing pumping infrastructure that will be installed for mining operation will be used. Assumed all works will be complete within 1 month. Two 20 KW pumps for 30 days is 28,800 kWhr.	kWh	28800	0.21	Estimate / EPA 2014 Guidance on rates	6,048
Reprofiling of pit and lands around pit	1.23	Reprofiling of pit and lands around pit as may be required for aesthetic or biodiversity reasons. Allow for 1 month. Existing equipment will be used. Costs associated with man power and fuel.	Four general operators EPA guidance is €500 per day (€2000 per day). These are expected to be existing employees (on salary) however the cost is taken to be as if operators to be hired in the event that the EPA take over closure works.	Days	90	2000	EPA 2014 Guidance on rates	180,000
	1.24		Assume 4 machines at 10 L/hr each. 320 L per day for 8 hours of operations per machine. At €0.8 per litre equals €256 per day.	Days	90	256	Estimate	23,040
Biodiversity interest	1.25	Planting of tress, sowing of grasses and other plants / wildflowers	Quantity and areas of replanting to be established and refined in further iterations of CRAMP. Estimate assume 2 people for 2 weeks at €500 per day. With plant and seed costs of 5000	Total for task	1	each	Estimate	15,000
Spare parts	1.26	Disposal of spare parts that cannot be sold	A cost of 1% of book value for spares or €10,000 to be held (which ever is greatest).	Total for task	1	each	Estimate	10,000
Co-ordination and Supervision of works	1.27	Retention of Saint-Gobain Personnel on existing wage structure	One supervisor for period of works.	Year	0.5	50000	Estimate	25,000
PSCS	1.28	Appoint third party to manage PSCS (Project Safety Construction Stage) for demolition works.		Total for task	1	each	Estimate	15,000
Land Contamination assessment	1.29	Soil sampling and testing.	Assessment of all land for contamination for parameters of interest (e.g. hydrocarbon). Report to be issued, which will identify and quantify any land contamination (area and depth).	Total for task	1	each	Estimate	15,000
Contaminated land	1.30	Removal of contaminated land.	Controls will be in place to prevent land contamination. However to provide assurance a quantity of land impacted is estimated at 300 m3. 50 m * 50 m to a depth of 0.25 m	m3	300	120	Estimate	36,000

Item Description	Item No.	Action Description	Comment / Notes	Unit	Quantity	Unit Price	Unit Price Source	Total
Environmental Monitoring	1.31	Continuation of prescribed environmental monitoring as per Licence requirements. Retention of Saint-Gobain staff to complete work. Samples to be sent to external lab. Cost will be dependent on licence conditions (licence yet to be drafted or issued). Will include at a minimum air, water, dust, noise, subsidence.	Environmental Technician (portion of their time, they will also work on other areas of Saint Gobain site - which is provided for in existing closure fund).				Estimate	12,500
	1.32		Laboratory Testing. Estimate average of 3 samples per week for 6 months. Cost €130 per sample. Provision for environmental sampling of receiving environment is included receiving environment in existing CRAMP funding for the Saint Gobain site.	Water samples	78	130	Estimate	10,140
	1.33		Noise - allow for one survey (if required)	Per monitoring event	1	835.88	2021 Saint Gobain existing site CRAMP rates	836
	1.34		Dust - monthly samples.	Per monitoring event	6	133.74	2021 Saint Gobain existing site CRAMP rates	802
	1.35		Subsidence - substantial provision is in place (€133 k over 30 years) for subsidence monitoring as part of the existing for Saint Gobain CRAMP. Includes monitoring of areas that are applicable to Knocknacran West. One additional monitoring event of €1,400 provided for in this CRAMP.	Total for task	1	1400	2021 Saint Gobain existing site CRAMP rates	1,400
Insurance	1.36	Employee & Third Party Insurance required to be held by the company.	Premium of €22194.21.77 in place for all other Saint Gobain operations. Add additional premium of 25% to cover Knocknacran West closure operations.	Total for task	0.25	22194.21	2021 Closure estimate	5,549
Environmental Insurance	1.37	Covers risk for any environmental incidents during rehabilitation	Saint Gobain is covered by a Group Insurance policy. An additional provision of €2,500 included, should additional coverage be required or in the event the operations are taken over by another entity.	Total for task	1	2500	Estimate	2,500
Licence Fee	1.38	Fee associated with EPA licence	Based on an annual EPA licence fee of €25,000 for six months	Total for task	0.5	25000	Estimate	12,500
Administration and other support	1.39	Support Staff	Full time positions will not be required for the closure works at Knocknacran West. It will be a shared resource with the remaining Saint Gobain site. Provision made for 50% of time for two positions (Manager €85 k PA, Fitter 60 k PA) for 6 months. Cost for Saint Gobain supervisor to oversee works provided in item 1.23 and Env staff covered in item 1.27	Year	0.25	145000	Estimate	36,250
Utilities (power / IT etc for closure period)	1.40	Cost to support staffs needs during period	IT support (1 supplier on call €5 k / IT equipment €1000). Telecommunications (€1 k). Power (€2 k). Waste disposal (€500).	For period	1	9500	Estimate	9,500
Total								514,090
Contingency (25%)								128,522
Grand Total								642,612

Cost Element 2 - Passive Closure

Passive Validation / Monitoring

Item Description	Item No.	Action Description	Comment / Notes	Unit	Quantity	Unit Price	Unit Price Source	Total
Environmental Monitoring	2.1	Continuation of prescribed environmental monitoring as per Licence requirements. Retention of Saint-Gobain staff to complete work. Samples to be sent to external lab. Cost will be dependent on licence conditions (licence yet to be drafted or issued). Will include at a minimum air, water, dust, noise, subsidence.	Environmental Technician (portion of their time).	Total for task	1	25000	Estimate	25,000
	2.2		Laboratory Testing. Estimate average of 3 samples per week for 12 months. Cost €130 per sample. Provision for environmental sampling of receiving environment is included in existing CRAMP funding.	Water samples	156	130	Estimate	20,280
	2.3		Noise - allow for one survey (if required)	Per monitoring event	1	835.88	2021 Saint Gobain CRAMP rates	836
	2.4		Dust - monthly samples.	Per monitoring event	12	133.74	2021 Saint Gobain CRAMP rates	1,605
	2.5		Subsidence - provision of €133 k over 30 years included in existing for Saint Gobain CRAMP provision. Includes monitoring of areas that are applicable to Knocknacran West. One additional monitoring event of €1,400 provided for in this CRAMP.	Total for task	1	1400	2021 Saint Gobain CRAMP rates	1,400
Insurance	2.6	Employee & Third Party Insurance required to be held by the company.	Premium of €22194.21.77 in place for all other Saint Gobain operations. Add additional premium of 25% to cover Knocknacran West closure operations.	Total for task	0.25	22194.21	2021 Closure estimate	5,549
Environmental Insurance	2.7	Covers risk for any environmental incidents during passive validation period.	Saint Gobain is covered by a Group Insurance policy. An additional provision of €5,000 included, should additional coverage be required or in the event the operations are taken over by another entity.	Total for task	1	5000	Estimate	5,000
Licence Fee	2.8	Fee associated with EPA licence	Based on current EPA licence fee of €25,000	Each	1	25000		25,000
Administration and other support	2.9	Support Staff	Full time positions will not be required for the passive validation period at Knocknacran West. It will be a shared resource with the remaining Saint Gobain site. Provision made for 50% of time for one technical positions (based on salary of €85 k PA). Cost for Env staff covered in item 2.1	Year	0.25	145000	Estimate	36,250
Expert reports	2.10	Consultants will be required to complete expert reports on specific aspects of closure for example contaminated land, rewatering and associated water risk, subsidence risk and ecology.	The scope (and cost) of reports will vary. This will range for c. €2,000 to c. €15,000. A general provision of €80,000 is being allowed for expert reports to be completed in the passive validation period.	Total	1	each	Estimate	80,000

Item Description	Item No.	Action Description	Comment / Notes	Unit	Quantity	Unit Price	Unit Price Source	Total
Total								200,919
Contingency (25%)								50,230
Grand Total								251,149

Cost Element 3 - Aftercare

Item Description	Item No.	Description	Year 1 Aftercare	Year 2 Aftercare	Year 3 Aftercare	Year 4 Aftercare	Year 5 Aftercare	Years 6 to 10 Aftercare	Years 11 to 15 Aftercare	Years 16 to 20 Aftercare	Years 21 to 25 Aftercare	Years 26 to 30 Aftercare	Total
Environmental Monitoring	3.1	Water / Groundwater / Air / Subsidence	50,000	40,000	30,000	20,000	15,000	25,000	25,000	25,000	25,000	25,000	280,000
Insurance	3.2	Employee & Third Party Insurance required to be held by the company.	2,000	2,000	2,000	2,000	2,000	10,000	10,000	10,000	10,000	10,000	60,000
Environmental Insurance	3.3	Covers risk for any environmental incidents during aftercare.	5,000	5,000	3,000	3,000	2,000	10,000	10,000	10,000	10,000	10,000	68,000
Licence Fee	3.4	Fee associated with EPA licence	25,000	25,000	20,000	15,000	10,000	25,000	25,000	25,000	25,000	25,000	220,000
Administration	3.5	Consultant or Saint-Gobain person to co-ordinate monitoring and reporting	30,000	30,000	20,000	20,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Expert reports	3.6	Provision for reports as may be required.	20,000	20,000	20,000	20,000	20,000	50,000	35,000	35,000	35,000	50,000	305,000
Total			132,000	122,000	95,000	80,000	124,000	195,000	180,000	180,000	180,000	195,000	1,483,000
Contingency (25%)			33,000	30,500	23,750	20,000	31,000	48,750	45,000	45,000	45,000	48,750	370,750
Grand Total			165,000	152,500	118,750	100,000	155,000	243,750	225,000	225,000	225,000	243,750	**1,853,750**

Appendix 3.4

Drainage Report - Community Sport Complex

HYDROCARE ENVIRONMENTAL LTD

Environmental Consultants
Cooperhill Rd., Beamore,
Drogheda, Co. Meath

Tel: 0419842378 Mob: 0877905155 / 0872208633 Email: info@hydrocareenvironmental.ie

Job Ref: 22-311

15/08/2022

Planning/Environmental Depts.,
Monaghan County Council,
The Glen,
Killygowan,
Monaghan H18 YT50.

Re: Further Information Request Planning Ref. No. 22/34.

Applicant: Saint-Gobain Mining Ireland Ltd

Site Address: Drummond TD, Derrynaglah and Knocknacran West, Magheracloone, Co. Monaghan

Planning Agent: Bernard Dinsmore, Chartered Architect, Warrenpoint, Co. Down.

Water Supply: Existing Group Water Scheme

To Whom it Concerns,

The Planning Agent has retained Hydrocare Environmental Ltd to issue a response to items R1 and R2 of the further information request for the planning ref. no. 22/34 for the next phase of the Community Sports Complex development at Drummond TD, Derrynaglah and Knocknacran West, Magheracloone, Co. Monaghan.

An initial surface water drainage report had been prepared during the first phase of this project, which has been granted planning permission under the ref. no. 20/365. The initial surface water drainage proposal was designed taking into account that the development will consist of multiple stages. It was sized so that the runoff surface water from all impermeable surface areas from all phases of the development can be managed by this system. It is proposed that the surface water discharge from the development be connected to the recently constructed surface water drainage system as designed in the Storm Water Drainage Proposal Report as granted permission under the planning ref. no. 20/365.

Please see the Storm Water Drainage Proposal Report which details the breakdown of the impermeable surfaces over different phases of works appended herewith. Included are the revised layout drawings detailing the connection points from the impermeable surfaces from the next phase of works to the recently constructed surface water drainage system.

Yours sincerely,

Daniel Nolan, BA BAI, Msc Environmental Engineering, FETAC Site Assessor, MIEI

Tel / Fax: (041) 9842378
Mobile : (087) 7905155/0872208633
Vat. No. 3349164IH

E-Mail: info@hydrocareenvironmental.ie
Website: www.hydrocareenvironmental.ie

Stormwater Drainage Proposal

Applicant

Saint-Gobain Mining Ireland Ltd.

Site Location

Drummond, Derrynaglah, Knocknacran West, Magheracloone, Co. Monaghan

Date of Report: 15th August 2022

Prepared By:

HYDROCARE ENVIRONMENTAL LTD

Document Control Sheet

Project No.: 22-311

Project Title: Next Phase of the Community Sports Complex in Drummond TD, Derrynaglah and Knocknacran West, Magheracloone, Co. Monaghan

Revision: A

Status: FINAL

Prepared By: Adrian Bacaoanu, *BSc. Applied Physics*

Reviewed By: Daniel Nolan, *BA BAI, Msc Environmental Engineering, FETAC Site Assessor, MIEI*

CONTENTS

1.1 INTRODUCTION

A stormwater proposal in accord with the Greater Dublin Strategic Drainage Study (GDSDS), Volume 2 and SUDS C697 guidance document has been prepared herewith. The proposed Community Sports Complex will be serviced by a new stormwater drainage system with an outfall to the piped stream at the northern site boundary. The drainage solution will incorporate a number of SUDS measures consisting of a swale, filter drains and attenuation tank.

Breakdown of Site Areas

- *Total Site Area – 85,061m^2*
- *Phase 1 Car Parking, Access Lane, and Footpath – 4,982m^2*
- *Phase 1 Proposed Changing Rooms and Shop – 251m^2*
- *Phase 1 Proposed Main Playing/Practice Pitch – 13,035m^2*
- *Phase 2 Car Parking and Access Lane – 3,512m^2*
- *Phase 2 Proposed Future Building – 2,279m^2*
- *Phase 2 Proposed Future Junior Pitch and Running Track – 15,987m^2*
- *Phase 2 Proposed Future Main Playing Pitch – 14,172m^2*
- *Phase 2 Proposed Future All Weather Pitches – 2,623m^2*

1.2 Stormwater Design

The 3 large football pitches will each be drained by a combination of surface drains, filter drains, and perimeter drains designed by Prunty Pitches. Each pitch will have a controlled outfall flow rate proportional to its surface area as a percentage of the total of the site area used to calculate the greenfield runoff rate. The outfall of each pitch will discharge to a collector drain from where the combined surface waters will outfall to the propose new 900mm DIA pipe via a manhole.

Each playing pitch has been assessed and determined that the combination of surface, filter and perimeter drains can provide sufficient storage for 100% of the peak 1 in 100-year runoff from the pitches. This is a good SUDS measure, as it assumes that the entire runoff from the pitches makes its way into the drain system and doesn't account for any infiltration

to the ground via the drains or through the surface. This also ensures a clean runoff water at the drain outfall with in-built filter treatment.

The treatment train approach is a preferred SUDS measure. The proposed driveway and part of the car parking areas will be drained by a swale running along one side. The remainder of the car parking area will be drained by a filter trench running along two sides of the car park to the north and west. The filter trench and swale will outfall to an attenuation tank.

This attenuation tank will be sized to ensure storage of the 1 in 100-year peak rainfall volume within the site of the runoff from the carparks, driveway, sports complex and all other impermeable surfaces.

The outfall from the attenuation tank will pass through a Class 1 By-Pass Petrol Interceptor, through a 225mm DIA pipe to a flow control device and out to the combination drain prior to discharging to the proposed new 900mm DIA pipe. The swale and filter drain will provide an additional level of filtration and pre-treatment of the surface water in addition to the petrol interceptor.

The breakdown of the flow controls applied to each pitch and the impermeable surface areas can be seen listed below.

- *Total Site Area – 59.06l/s*
- *Proposed Attenuation Tank – 28.06l/s*
- *Proposed Future Junior Pitch and Running Track – 14.5l/s*
- *Proposed Future Main Playing Pitch – 7.5l/s*
- *Proposed Main Playing/Practice Pitch – 7l/s*
- *Proposed Future All Weather Pitches – 2l/s*

1.3 Greenfield Runoff Rate

IH124 Greenfield Runoff Rate Calculation Sheet

27th July 2022

Project: Community Sports Complex at Knocknacran, Co. Monaghan

Site Location: Knocknacran, Co. Monaghan

Agent: Bernard Dinsmore, Chartered Architect, 24a Duke Street, Warrenpoint, Co. Down

The IH124 method was specifically introduced as an update to the original Flood Studies Report (1975) to address the runoff from small catchments (CI RIA C697 and IH124)

$$Q_{BAR}\ RURAL\ (m^3/s) = 0.00108\ AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

- Q_{BAR} RURAL Is the mean annual flood flow from a rural catchment (43% AEP or 2.3 year return period).
- AREA is the area of the catchment (km^2)
- SAAR is the standard average annual rainfall
- SOIL is the Soil Index, SOIL - 0.1 SOIL1 + 0.3 Soil2 + 0.37 Soil3 +0.47 Soil4 + 0.53 Soil5
- The soil type is selected based on the Flood Studies or the Wallingford Procedure WRAP maps.

Inputs

AREA:	8.506	Ha	Site AREA is 8.506Ha. As site is <50Ha, use 50Ha
SAAR:	955	mm	Grid Reference E:280535 N:299582
Soil:	0.470		FSR SPR value for SOIL type 4 is 0.47

Outputs

Q_{BAR} RURAL (l/s/Ha)-	6.94
Site Area (Ha)-	8.506
Q_{BAR} RURAL (l/s)-	59.06

	l/s
Q_1 =	50.20
Q_{30} =	124.03
Q_{100} =	153.56

Growth Curve Factors (GDSDS)	
Return Period (years)	Growth Curve Factor
1	0.85
Q_{BAR}	1
10	1.7
30	2.1
100	2.6
200	2.9

1.4 Stormwater Design to Include:

- Attenuation of runoff waters will be for the 100-year rainfall return period with 10% allowance for climate change.
- A total combined controlled outfall flow rate of 59.06l/s to be provided.

1.5 Design Calculations

The total impermeable surface areas include the 4,982m^2 phase-1 car parking, access lane, and footpath area, the 251m^2 phase-1 proposed changing rooms and shop, the 3,512m^2 phase-2 car parking and access Lane and the 2,279m^2 phase-2 proposed future building surface areas. The total impermeable surface areas from this development will be 11,024m^2 across both phase-1 and phase-2.

Return Period (Years):	**100**
Impermeable Area (m^2):	**11,024**
Controlled Outflow (l/s):	**28.06**
Climate Change Increase Allowance:	**10%**

Required Attenuation Volume for all Impermeable Surface Areas

Client: *Saint Gobain Mining Ireland*

Site Location: Knocknacran, Magheracloone, Co. Monaghan

Agent: *Bernard Dinsmore, Chartered Architect, 24a Duke Street, Warrenpoint, Co. Down*

Duration (time)	Duration (secs)	Rainfall Depth (mm)	Rainfall Depth Incl. Climate Change (mm)	Rainfall Intensity (mm/s)	Inflow Rate (m^3/s)	Inflow Rate (l/s)	Overflow Flow Rate (l/s)	Storage Rate (l/s)	Storage Volume (Litres)	Storage Volume (m^3)
5 mins	300	15.8	17.38	0.05793	0.63866	638.66	28.06	610.60	183179.1	183.1791
10 mins	600	22	24.2	0.04033	0.44463	444.63	28.06	416.57	249944.8	249.9448
15 mins	900	25.9	28.49	0.03166	0.34897	348.97	28.06	320.91	288819.8	288.8198
30 mins	1,800	30.8	33.88	0.01882	0.20750	207.50	28.06	179.44	322985.1	322.9851
1 hours	3,600	36.7	40.37	0.01121	0.12362	123.62	28.06	95.56	344022.9	344.0229
2 hours	7,200	43.6	47.96	0.00666	0.07343	73.43	28.06	45.37	326679	326.679
3 hours	10,800	48.3	53.13	0.00492	0.05423	54.23	28.06	26.17	282657.1	282.6571
4 hours	14,400	51.9	57.09	0.00396	0.04371	43.71	28.06	15.65	225296.2	225.2962
6 hours	21,600	57.5	63.25	0.00293	0.03228	32.28	28.06	4.22	91172	91.172
9 hours	32,400	63.6	69.96	0.00216	0.02380	23.80	28.06	-4.26	-137905	-137.905
12 hours	43,200	68.4	75.24	0.00174	0.01920	19.20	28.06	-8.86	-382746	-382.746
24 hours	86,400	81.4	89.54	0.00104	0.01142	11.42	28.06	-16.64	-1437295	-1437.3
48 hours	172,800	92.5	101.75	0.00059	0.00649	6.49	28.06	-21.57	-3727076	-3727.08
72 hours	259,200	102.3	112.53	0.00043	0.00479	4.79	28.06	-23.27	-6032621	-6032.62

Required Storage for 1 in 100 year Peak Rainfall Event:

Required Attenuation Storage for Phase-1 and Phase-2 Impermeable Surface Areas 344.03m^3						
Available Storage in Attenuation Tank						
Void Ratio of Proposed Attenuation Tank 95%						
Length	30	m				
Width	26	m				
Depth	0.5	m				
Total Storage Available In Attenuation Tank					370.5	m^3
Additional Storage Available in Swale						
Void Ratio of Proposed Swale 95%						
Lenth	130	m				
Width	3.5	m				
Depth	0.5	m				
Total Storage Available In Swale					130	m^3
Available Storage in Filter Drain						
Void Ratio of Proposed Filter Drain 30%						
Lenth	137.8	m				
Width	0.5	m				
Depth	0.7	m				
Total Storage Available In Filter Drain					14.47	m^3
Total Storage Available					514.97	m^3

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Return Period (Years):	**100**
Impermeable Area (m^2):	**15,987**
Controlled Outflow (l/s):	**14.5**
Climate Change Increase Allowance:	**10%**

Required Attenuation Volume for Phase-2 Junior Playing Pitch and Perimeter Running Track

Client: *Saint Gobain Mining Ireland*

Site Location: Knocknacran, Magheracloone, Co. Monaghan

Agent: *Bernard Dinsmore, Chartered Architect, 24a Duke Street, Warrenpoint, Co. Down*

Duration (time)	Duration (secs)	Rainfall Depth (mm)	Rainfall Depth Incl. Climate Change (mm)	Rainfall Intensity (mm/s)	Inflow Rate (m^3/s)	Inflow Rate (l/s)	Overflow Flow Rate (l/s)	Storage Rate (l/s)	Storage Volume (Litres)	Storage Volume (m^3)
5 mins	300	15.8	17.38	0.05793	0.92618	926.18	14.5	911.68	273504.1	273.5041
10 mins	600	22	24.2	0.04033	0.64481	644.81	14.5	630.31	378185.4	378.1854
15 mins	900	25.9	28.49	0.03166	0.50608	506.08	14.5	491.58	442419.6	442.4196
30 mins	1,800	30.8	33.88	0.01882	0.30091	300.91	14.5	286.41	515539.6	515.5396
1 hours	3,600	36.7	40.37	0.01121	0.17928	179.28	14.5	164.78	593195.2	593.1952
2 hours	7,200	43.6	47.96	0.00666	0.10649	106.49	14.5	91.99	662336.5	662.3365
3 hours	10,800	48.3	53.13	0.00492	0.07865	78.65	14.5	64.15	692789.3	692.7893
4 hours	14,400	51.9	57.09	0.00396	0.06338	63.38	14.5	48.88	703897.8	703.8978
6 hours	21,600	57.5	63.25	0.00293	0.04681	46.81	14.5	32.31	697977.8	697.9778
9 hours	32,400	63.6	69.96	0.00216	0.03452	34.52	14.5	20.02	648650.5	648.6505
12 hours	43,200	68.4	75.24	0.00174	0.02784	27.84	14.5	13.34	576461.9	576.4619
24 hours	86,400	81.4	89.54	0.00104	0.01657	16.57	14.5	2.07	178676	178.676
48 hours	172,800	92.5	101.75	0.00059	0.00941	9.41	14.5	-5.09	-878923	-878.923
72 hours	259,200	102.3	112.53	0.00043	0.00694	6.94	14.5	-7.56	-1959383	-1959.38

Required Storage for 1 in 100 year Peak Rainfall Event:

Required Attenuation Storage in Phase-2 Junior Playing Pitch and Running Track 703.9m^3		
Available Storage Under Playing Pitch		
60mm Depth of Sand across the Entire Pitch Surface		
Void Ratio for Sand = 0.6		
0.06m x 13,595m^2 x 0.6	489.456	m^3
Gravel Filled Surface Drains		
Void Ratio of Gravel = 0.3		
280m^3/ha x 1.3595ha x 0.3	114.21	m^3
Gravel Filled Collector Drains		
Void Ratio of Gravel = 0.3		
180m^3/ha x 1.3595ha x 0.3	73.42	m^3
Gravel Filled Perimeter Drains		
Void Ratio of Gravel = 0.3		
Perimeter Length = 462m		
Trench Depth = 0.9m		
Trench Width = 0.4m		
0.4m x 0.9m x 462m x 0.3	50.00	m^3
Total Storage Capacity in Junior Playing Pitch and Running Track Drainage System	727.08	m^3

HYDROCARE ENVIRONMENTAL LTD

Return Period (Years):	**100**
Impermeable Area (m^2):	**14,172**
Controlled Outflow (l/s):	**7.5**
Climate Change Increase Allowance:	**10%**

Required Attenuation Volume for Phase-2 Main Playing Pitch

Client: *Saint Gobain Mining Ireland*

Site Location: Knocknacran, Magheracloone, Co. Monaghan

Agent: *Bernard Dinsmore, Chartered Architect, 24a Duke Street, Warrenpoint, Co. Down*

Duration (time)	Duration (secs)	Rainfall Depth (mm)	Rainfall Depth Incl. Climate Change (mm)	Rainfall Intensity (mm/s)	Inflow Rate (m^3/s)	Inflow Rate (l/s)	Overflow Flow Rate (l/s)	Storage Rate (l/s)	Storage Volume (Litres)	Storage Volume (m^3)
5 mins	300	15.8	17.38	0.05793	0.82103	821.03	7.5	813.53	244059.4	244.0594
10 mins	600	22	24.2	0.04033	0.57160	571.60	7.5	564.10	338462.4	338.4624
15 mins	900	25.9	28.49	0.03166	0.44862	448.62	7.5	441.12	397010.3	397.0103
30 mins	1,800	30.8	33.88	0.01882	0.26675	266.75	7.5	259.25	466647.4	466.6474
1 hours	3,600	36.7	40.37	0.01121	0.15892	158.92	7.5	151.42	545123.6	545.1236
2 hours	7,200	43.6	47.96	0.00666	0.09440	94.40	7.5	86.90	625689.1	625.6891
3 hours	10,800	48.3	53.13	0.00492	0.06972	69.72	7.5	62.22	671958.4	671.9584
4 hours	14,400	51.9	57.09	0.00396	0.05619	56.19	7.5	48.69	701079.5	701.0795
6 hours	21,600	57.5	63.25	0.00293	0.04150	41.50	7.5	34.00	734379	734.379
9 hours	32,400	63.6	69.96	0.00216	0.03060	30.60	7.5	23.10	748473.1	748.4731
12 hours	43,200	68.4	75.24	0.00174	0.02468	24.68	7.5	17.18	742301.3	742.3013
24 hours	86,400	81.4	89.54	0.00104	0.01469	14.69	7.5	7.19	620960.9	620.9609
48 hours	172,800	92.5	101.75	0.00059	0.00834	8.34	7.5	0.84	146001	146.001
72 hours	259,200	102.3	112.53	0.00043	0.00615	6.15	7.5	-1.35	-349225	-349.225

Required Storage for 1 in 100 year Peak Rainfall Event:

Required Attenuation Storage in Phase-2 Main Playing Pitch		
748.5m^3		
Available Storage Under Playing Pitch		
60mm Depth of Sand across the Entire Pitch Surface		
Void Ratio for Sand = 0.6		
0.06m x 14,172m^2 x 0.6	510.192	m^3
Gravel Filled Surface Drains		
Void Ratio of Gravel = 0.3		
280m^3/ha x 1.417ha x 0.3	119.03	m^3
Gravel Filled Collector Drains		
Void Ratio of Gravel = 0.3		
180m^3/ha x 1.417ha x 0.3	76.52	m^3
Gravel Filled Perimeter Drains		
Void Ratio of Gravel = 0.3		
Perimeter Length = 487m		
Trench Depth = 0.9m		
Trench Width = 0.4m		
0.4m x 0.9m x 488m x 0.3	52.60	m^3
Total Storage Capacity in Main Playing Pitch Drainage System	758.33	m^3

HYDROCARE ENVIRONMENTAL LTD

Return Period (Years):	**100**
Impermeable Area (m^2):	**13,035**
Controlled Outflow (l/s):	**7**
Climate Change Increase Allowance:	**10%**

Required Attenuation Volume for Phase-1 Main Playing Pitch/Practice Pitch

Client: *Saint Gobain Mining Ireland*

Site Location: Knocknacran, Magheracloone, Co. Monaghan

Agent: *Bernard Dinsmore, Chartered Architect, 24a Duke Street, Warrenpoint, Co. Down*

Duration (time)	Duration (secs)	Rainfall Depth (mm)	Rainfall Depth Incl. Climate Change (mm)	Rainfall Intensity (mm/s)	Inflow Rate (m^3/s)	Inflow Rate (l/s)	Overflow Flow Rate (l/s)	Storage Rate (l/s)	Storage Volume (Litres)	Storage Volume (m^3)
5 mins	300	15.8	17.38	0.05793	0.75516	755.16	7	748.16	224448.3	224.4483
10 mins	600	22	24.2	0.04033	0.52575	525.75	7	518.75	311247	311.247
15 mins	900	25.9	28.49	0.03166	0.41263	412.63	7	405.63	365067.2	365.0672
30 mins	1,800	30.8	33.88	0.01882	0.24535	245.35	7	238.35	429025.8	429.0258
1 hours	3,600	36.7	40.37	0.01121	0.14617	146.17	7	139.17	501023	501.023
2 hours	7,200	43.6	47.96	0.00666	0.08683	86.83	7	79.83	574758.6	574.7586
3 hours	10,800	48.3	53.13	0.00492	0.06412	64.12	7	57.12	616949.6	616.9496
4 hours	14,400	51.9	57.09	0.00396	0.05168	51.68	7	44.68	643368.2	643.3682
6 hours	21,600	57.5	63.25	0.00293	0.03817	38.17	7	31.17	673263.8	673.2638
9 hours	32,400	63.6	69.96	0.00216	0.02815	28.15	7	21.15	685128.6	685.1286
12 hours	43,200	68.4	75.24	0.00174	0.02270	22.70	7	15.70	678353.4	678.3534
24 hours	86,400	81.4	89.54	0.00104	0.01351	13.51	7	6.51	562353.9	562.3539
48 hours	172,800	92.5	101.75	0.00059	0.00768	7.68	7	0.68	116711.3	116.7113
72 hours	259,200	102.3	112.53	0.00043	0.00566	5.66	7	-1.34	-347571	-347.571

Required Storage for 1 in 100 year Peak Rainfall Event:

Required Attenuation Storage in Phase-1 Main Playing Pitch/Practice Pitch 685.13m^3		
Available Storage Under Playing Pitch		
60mm Depth of Sand across the Entire Pitch Surface		
Void Ratio for Sand = 0.6		
0.06m x 13,035m^2 x 0.6	469.26	m^3
Gravel Filled Surface Drains		
Void Ratio of Gravel = 0.3		
280m^3/ha x 1.3035ha x 0.3	109.49	m^3
Gravel Filled Collector Drains		
Void Ratio of Gravel = 0.3		
180m^3/ha x 1.3035ha x 0.3	70.39	m^3
Gravel Filled Perimeter Drains		
Void Ratio of Gravel = 0.3		
Perimeter Length = 475m		
Trench Depth = 0.9m		
Trench Width = 0.4m		
0.4m x 0.9m x 475m x 0.3	51.30	m^3
Total Storage Capacity in Practice Pitch Drainage System	700.44	m^3

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Return Period (Years):	**100**
Impermeable Area (m^2):	**2,623**
Controlled Outflow (l/s):	**2**
Climate Change Increase Allowance:	**10%**

Required Attenuation Volume for Phase-2 All Weather Pitches

Client: *Saint Gobain Mining Ireland*

Site Location: Knocknacran, Magheracloone, Co. Monaghan

Agent: *Bernard Dinsmore, Chartered Architect, 24a Duke Street, Warrenpoint, Co. Down*

Duration (time)	Duration (secs)	Rainfall Depth (mm)	Rainfall Depth Incl. Climate Change (mm)	Rainfall Intensity (mm/s)	Inflow Rate (m^3/s)	Inflow Rate (l/s)	Overflow Flow Rate (l/s)	Storage Rate (l/s)	Storage Volume (Litres)	Storage Volume (m^3)
5 mins	300	15.8	17.38	0.05793	0.15196	151.96	2	149.96	44987.74	44.98774
10 mins	600	22	24.2	0.04033	0.10579	105.79	2	103.79	62276.6	62.2766
15 mins	900	25.9	28.49	0.03166	0.08303	83.03	2	81.03	72929.27	72.92927
30 mins	1,800	30.8	33.88	0.01882	0.04937	49.37	2	47.37	85267.24	85.26724
1 hours	3,600	36.7	40.37	0.01121	0.02941	29.41	2	27.41	98690.51	98.69051
2 hours	7,200	43.6	47.96	0.00666	0.01747	17.47	2	15.47	111399.1	111.3991
3 hours	10,800	48.3	53.13	0.00492	0.01290	12.90	2	10.90	117760	117.76
4 hours	14,400	51.9	57.09	0.00396	0.01040	10.40	2	8.40	120947.1	120.9471
6 hours	21,600	57.5	63.25	0.00293	0.00768	7.68	2	5.68	122704.8	122.7048
9 hours	32,400	63.6	69.96	0.00216	0.00566	5.66	2	3.66	118705.1	118.7051
12 hours	43,200	68.4	75.24	0.00174	0.00457	4.57	2	2.57	110954.5	110.9545
24 hours	86,400	81.4	89.54	0.00104	0.00272	2.72	2	0.72	62063.42	62.06342
48 hours	172,800	92.5	101.75	0.00059	0.00154	1.54	2	-0.46	-78709.7	-78.7097
72 hours	259,200	102.3	112.53	0.00043	0.00114	1.14	2	-0.86	-223234	-223.234

Required Storage for 1 in 100 year Peak Rainfall Event:		
Required Attenuation Storage in Phase-2 All Weather Pitches 122.7m³		
Available Storage Under Playing Pitch		
60mm Depth of Sand across the Entire Pitch Surface		
Void Ratio for Sand = 0.6		
0.06m x 2,623m² x 0.6	94.428	m³
Gravel Filled Surface Drains		
Void Ratio of Gravel = 0.3		
280m³/ha x 0.2623ha x 0.3	22.03	m³
Gravel Filled Collector Drains		
Void Ratio of Gravel = 0.3		
180m³/ha x 0.2623ha x 0.3	14.16	m³
Gravel Filled Perimeter Drains		
Void Ratio of Gravel = 0.3		
Perimeter Length = 220m		
Trench Depth = 0.9m		
Trench Width = 0.4m		
0.4m x 0.9m x 220m x 0.3	23.76	m³
Total Storage Capacity in All Weather Pitches Drainage System	154.39	m³

1.6 Attenuation Tank & Outfall Flow Control

The proposed attenuation tank will be a constructed concrete tank sized 30m(L) x 26m(W) x 0.5m(D) and has been sized to cater for the surface water runoff from both the Phase-1 and Phase-2 impermeable surfaces of the Community Sports Complex at Drummond TD, Derrynaglah and Knocknacran West, Magheracloone, Co. Monaghan. This attenuation tank and surface water drainage system is currently under construction having previously received planning permission with Phase-1 of the development under the planning ref. no. 20365. The attenuation tank will outfall via a 225mm diameter pipe to a class 1 by-pass petrol interceptor such as the Kingspan Klargester NSBE030 or similar. The petrol

interceptor will outfall via a 225mm DIA pipe to a flow restriction device where forward flows will be limited to a minimum of 28.06l/s using Controflow or similar approved device. From the flow control device, the stormwater will outfall via a 225mm DIA pipe to collection point which will outfall via 300mm DIA pipe to the proposed new 900mm DIA pipe along the Northern Site Boundary.

The total storage provided by the proposed attenuation tank is 370m^3 which is sufficient to provide onsite storage for the 1 in 100-year storm event with a 10% allowance for climate change which equates to 344.03m^3.

Please see site layout drawings, cross sections and long sections appended herewith.

Chamber Type C as per CC-SCD-00504 IL-38.30

2 No. 300mm DIA PIPE BETWEEN MH and BASE of DETENTION BASIN

300mm DIA PIPE @1:200 OUTFALL FROM COLLECTION POINT TO NEW 900mm DIA Concrete Pipe Culvert

225mm DIA PIPE OUTFALL FROM FILTER DRAIN TO MH

30m(L) x 28m(W) x 0.5m(D) Detention Basin

SW MH5 CL-40.35 IL-39.75

SW MH4 CL-40.45 IL-39.85

FLOW CONTROL DEVICE RESTRICTED TO 11.1l/s CL-40.65 IL-40.05

Phase 1 Civil Works Approved Under 20/365

CIVILS WORKS APPROVED UNDER 20/365

COLLECTION POINT CL-39.90 IL-38.62

225mm DIA PIPE @1:200 FROM FLOW CONTROL DEVICE TO COLLECTION POINT

FLOW CONTROL DEVICE RESTRICTED TO 26.85l/s CL-39.95 IL-38.75

OUTFALL FROM FUTURE JUNIOR PLAYING PITCH AND RUNNING TRACK TO FLOW CONTROL DEVICE

225mm DIA PERFORATED PIPE

FLOW CONTROL DEVICE RESTRICTED TO 2l/s CL-41.00 IL-39.50

OUTFALL FROM ALL WEATHER PITCHES TO FLOW CONTROL DEVICE

PROPOSED 130m (L) x 3.5m (W) x 0.5m (D) SWALE ALONG CAR PARK EDGE

APPROVED CAR PARKING

225mm DIA PIPE @1:200 FROM FLOW CONTROL DEVICE TO COLLECTION POINT

FILTER DRAIN 1m (W) x 67m (L) x 1m (D) – REFER TO HYDROCARE ENVIRONMENTAL LTD REPORT FOR DETAILS

Phase 2
ALL WEATHER
3G PITCHES

1044.85

ACCESS SUMP (CATCH PIT) TO PERMIT JETTING OUT OF THE PIPE

ACCESS SUMP (CATCH PIT) TO PERMIT JETTING OUT OF THE PIPE CL-41.69 IL-40.99

150mm DIA PIPE @1:200 OUTFALL FROM FILTER DRAIN TO SW MH3

225mm DIA PIPE @1:200 OUTFALL FROM SWALE TO SW MH3

SW MH3 CL-41.15 IL-40.34

Phase 2
JUNIOR PLAYING PITCH
(130x80m)
WITH PERIMETER
RUNNING TRACK

225mm DIA PIPE Connection Between Ditch Drain and Filter Drain

FILTER DRAIN 0.5m (W) x 137.8m (L) x 0.7m (D) – REFER TO HYDROCARE ENVIRONMENTAL LTD REPORT FOR DETAILS

50mm DIA PERFORATED PIPE

SW MH6 CL-41.50 IL-40.93

225mm DIA @1:200 Outfall From SW MH3 to Attenuation Tank

CLASS 1 BY-PASS PETROL INTERCEPTOR (Kingspan NSBE030 or Similar) CL-41.40 Outlet IL-40.29

225mm DIA PIPE 1:200 OUTFALL FROM ATTENUATION TANK TO FLOW CONTROL DEVICE

SW MH2 CL-41.20 IL-40.50

225mm DIA PIPE @1:200 FROM FLOW CONTROL DEVICE TO COLLECTION POINT

SW MH1 CL-41.90 IL-40.97

FLOW CONTROL DEVICE RESTRICTED TO 9.05l/s CL-41.90 IL-41.00

225mm DIA INFLOW TO SW MH3 FROM CAR PARK, SPORTS COMPLEX, GRANDSTAND AND ALL IMPERMEABLE SURFACES

30m (L) x 26m (W) x 0.5m (D) CONSTRUCTED CONCRETE ATTENUATION TANK CL-41.40 IL-40.40 CONSTRUCTED UNDER REF NO 20/365

SPORTS COMPLEX
Phase 2

Phase 2
GRANDSTAND

PLANT

ACCESS SUMP (CATCH PIT) TO PERMIT JETTING OUT OF THE PIPE CL-42.55 IL-41.85

OUTFALL FROM PRACTICE PITCH TO FLOW CONTROL DEVICE

Phase 1 Civil Works
Approved Under 20/365

225mm DIA PIPE @1:200 FROM FLOW CONTROL DEVICE TO COLLECTION POINT

FLOW CONTROL DEVICE RESTRICTED TO 9.9l/s CL-42.40 IL-41.40

OUTFALL FROM FUTURE PLAYING PITCH TO FLOW CONTROL DEVICE

GRASS PITCH APPROVED
UNDER 20/365.

Phase 2
MAIN PITCH
(142x90m)
+ run-off

7339

FL

WARM UP AREA

RECEIVED: 11/04/2023

FOR PLANNING PURPOSES ONLY
NOT CONSTRUCTION ISSUE
FULL DESIGN DETAIL TO BE
PROVIDED AT CONSTRUCTION
STAGE

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Proposed Site Layout

SAINT GOBAIN MINING IRELAND LTD
DRUMOND, DERRYNAGLAH, KNOCKNACRAN WEST, MAGHERACLOONE, CO. MONAGHAN

SCALE 1:1000 DATE: 15/08/2022

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FULL DESIGN DETAIL TO BE
PROVIDED AT CONSTRUCTION
STAGE

RECEIVED: 11/04/2022

Phase 1 Civil Works Approved Under 20/365

CIVILS WORKS APPROVED UNDER 20/365

Chamber Type C as per CC-SCD-00504 IL-38.30

2 No. 300mm DIA PIPE BETWEEN MH and BASE of DETENTION BASIN

300mm DIA PIPE @1:200 OUTFALL FROM COLLECTION POINT TO NEW 900mm DIA Concrete Pipe Culvert

225mm DIA PIPE OUTFALL FROM FILTER DRAIN TO MH

30m(L) x 28m(W) x 0.5m(D) Detention Basin

SW MH5 CL-40.35 IL-39.75

SW MH4 CL-40.45 IL-39.85

FLOW CONTROL DEVICE RESTRICTED TO 11.1l/s CL-40.65 IL-40.05

FLOW CONTROL DEVICE RESTRICTED TO 26.85l/s CL-39.95 IL-38.75

COLLECTION POINT CL-39.90 IL-38.62

225mm DIA PIPE @1:200 FROM FLOW CONTROL DEVICE TO COLLECTION POINT

OUTFALL FROM FUTURE JUNIOR PLAYING PITCH AND RUNNING TRACK TO FLOW CONTROL DEVICE

225mm DIA PIPE @1:200 FROM FLOW CONTROL DEVICE TO COLLECTION POINT

Phase 2 JUNIOR PLA (130x WITH PE RUNNIN

225mm DIA PERFORATED PIPE

FILTER DRAIN 1m (W) x 67m (L) x 1m (D) – REFER TO HYDROCARE ENVIRONMENTAL LTD REPORT FOR DETAILS

FLOW CONTROL DEVICE RESTRICTED TO 2l/s CL-41.00 IL-39.50

OUTFALL FROM ALL WEATHER PITCHES TO FLOW CONTROL DEVICE

PROPOSED 130m (L) x 3.5m (W) x 0.5m (D) SWALE ALONG CAR PARK EDGE

APPROVED CAR PARKING

Phase 2 ALL WEATHER 3G PITCHES

1044.85

ACCESS SUMP (CATCH PIT) TO PERMIT JETTING OUT OF THE PIPE

225mm DIA PIPE Connection Between Ditch Drain and Filter Drain

ACCESS SUMP (CATCH PIT) TO PERMIT JETTING OUT OF THE PIPE CL-41.69 IL-40.99

150mm DIA PIPE @1:200 OUTFALL FROM FILTER DRAIN TO SW MH3

225mm DIA PIPE @1:200 OUTFALL FROM SWALE TO SW MH3

SW MH3 CL-41.15 IL-40.34

CLASS 1 BY-PASS PETROL INTERCEPTOR (Kingspan NSBE030 or Similar) CL-41.40 Outlet IL-40.29

225mm DIA PIPE 1:200 OUTFALL FROM ATTENUATION TANK TO FLOW CONTROL DEVICE

SW MH2 CL-41.20 IL-40.50

FILTER DRAIN 0.5m (W) x 137.8m (L) x 0.7m (D) – REFER TO HYDROCARE ENVIRONMENTAL LTD REPORT FOR DETAILS

150mm DIA PERFORATED PIPE

SW MH6 CL-41.50 IL-40.93

225mm DIA @1:200 Outfall From SW MH3 to Attenuation Tank

ACCESS SUMP (CATCH PIT) TO PERMIT JETTING OUT OF THE PIPE CL-42.15 IL-41.45

225mm DIA INFLOW TO SW MH3 FROM CAR PARK, SPORTS COMPLEX, GRANDSTAND AND ALL IMPERMEABLE SURFACES

SPOR COMPLEX Phase 2

30m (L) x 26m (W) x 0.5m (D) CONSTRUCTED CONCRETE ATTENUATION TANK CL-41.40 IL-40.40 CONSTRUCTED UNDER REF NO 20/365

225mm DIA PIPE @1:200 FROM FLOW CONTROL DEVICE TO COLLECTION POINT

SW MH1 CL-41.90 IL-40.97

FLOW CONTROL DEVICE RESTRICTED TO 9.05l/s CL-41.90 IL-41.00

OUTFALL FROM PRACTICE PITCH TO FLOW CONTROL DEVICE

ACCESS SUMP (CATCH PIT) TO PERMIT JETTING OUT OF THE PIPE CL-42.55 IL-41.85

PLANT

Phase 2 GRANDSTAND

225mm DIA PIPE @1:200 FROM FLOW CONTROL DEVICE TO COLLECTION POINT

FLOW CONTROL DEVICE RESTRICTED TO 9.9l/s CL-42.40 IL-41.40

OUTFALL FROM FUTURE PLAYING PITCH TO FLOW CONTROL DEVICE

Phase 2

Phase 1 Civil Works Approved Under 20/365

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STORMWATER LAYOUT

SAINT GOBAIN MINING IRELAND LTD
DRUMOND, DERRYNAGLAH, KNOCKNACRAN WEST, MAGHERACLOONE, CO. MONAGHAN

SCALE 1:1000 DATE: 15/08/2022

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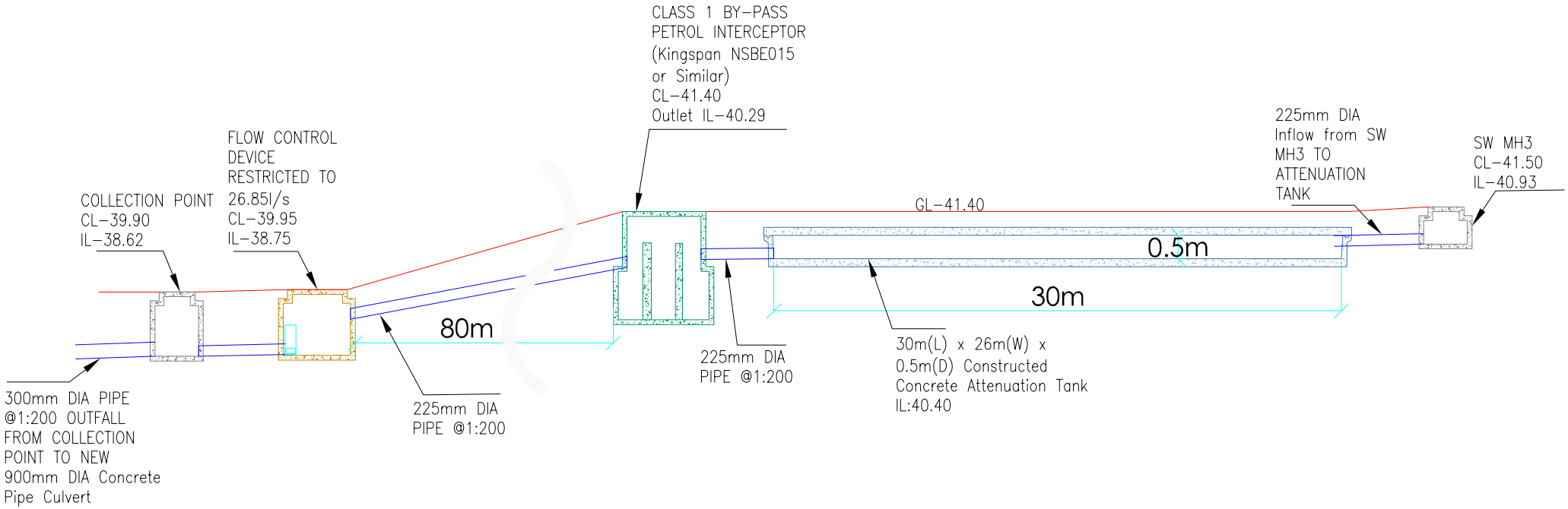
ATTENUATION TANK - LONG SECTION



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ATTENUATION TANK LONG SECTION

SAINT GOBAIN MINING IRELAND LTD
DRUMOND, DERRYNAGLAH, KNOCKNACRAN WEST, MAGHERACLOONE, CO. MONAGHAN

SCALE NTS DATE: 11/09/2020

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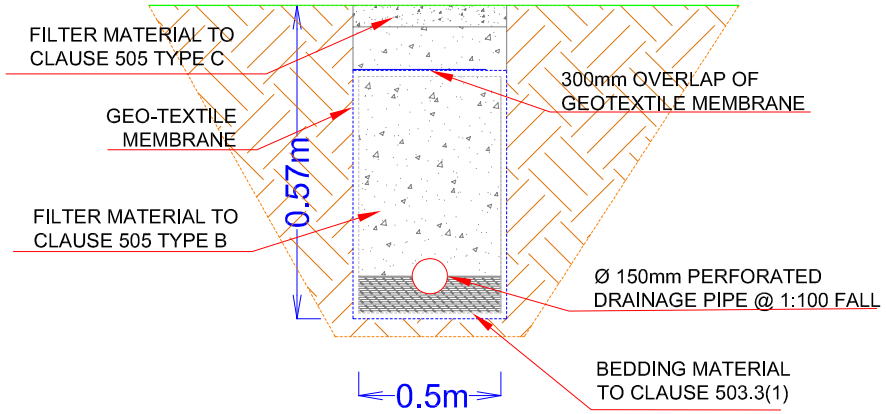
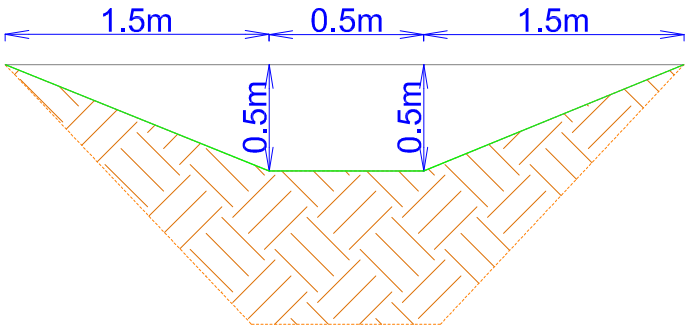
FILTER TRENCH CROSS SECTION



SWALE CROSS SECTION



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SWALE AND FILTER TRENCH CROSS SECTION

SAINT GOBAIN MINING IRELAND LTD
DRUMOND, DERRYNAGLAH, KNOCKNACRAN WEST, MAGHERACLOONE, CO. MONAGHAN

SCALE nts DATE: 11/09/2020

FOR PLANNING PURPOSES ONLY
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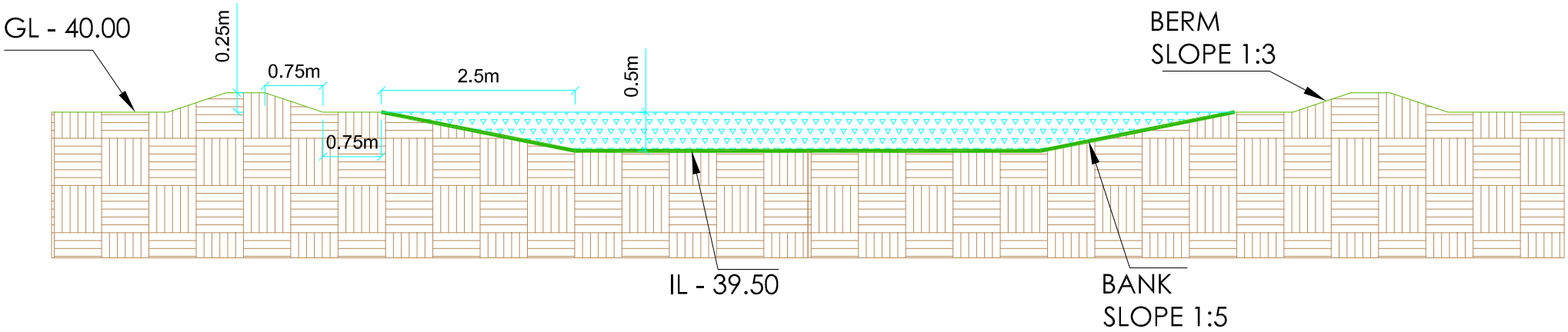

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DETENTION BASIN LONG SECTION

SAINT GOBAIN MINING IRELAND LTD
DRUMOND, DERRYNAGLAH, KNOCKNACRAN
WEST, MAGHERACLOONE, CO. MONAGHAN

SCALE NTS DATE: 15/08/2022

SEPARATORS

A RANGE OF FUEL/OIL SEPARATORS
FOR PEACE OF MIND

Kingspan

Klargester

60 YEARS OF
1955–2015 Expertise & Innovation

Separators

A RANGE OF FUEL/OIL SEPARATORS FOR PEACE OF MIND

Surface water drains normally discharge to a watercourse or indirectly into underground waters (groundwater) via a soakaway. Contamination of surface water by oil, chemicals or suspended solids can cause these discharges to have a serious impact on the receiving water.

The Environment Regulators, Environment Agency, England and Wales, SEPA, Scottish Environmental Protection Agency in Scotland and Department of Environment & Heritage in Northern Ireland, have published guidance on surface water disposal, which offers a range of means of dealing with pollution both at source and at the point of discharge from site (so called 'end of pipe' treatment). These techniques are known as 'Sustainable Drainage Systems' (SuDS).

Where run-off is draining from relatively low risk areas such as car-parks and non-operational areas, a source control approach, such as permeable surfaces or infiltration trenches, may offer a suitable means of treatment, removing the need for a separator.

Oil separators are installed on surface water drainage systems to protect receiving waters from pollution by oil, which may be present due to minor leaks from vehicles and plant, from accidental spillage.

Effluent from industrial processes and vehicle washing should normally be discharged to the foul sewer (subject to the approval of the sewerage undertaker) for further treatment at a municipal treatment works.

SEPARATOR STANDARDS AND TYPES

A British (and European) standard (EN 858-1 and 858-2) for the design and use of prefabricated oil separators has been adopted. New prefabricated separators should comply with the standard.

SEPARATOR CLASSES

The standard refers to two 'classes' of separator, based on performance under standard test conditions.

CLASS I

Designed to achieve a concentration of less than 5mg/l of oil under standard test conditions, should be used when the separator is required to remove very small oil droplets.

CLASS II

Designed to achieve a concentration of less than 100mg/l oil under standard test conditions and are suitable for dealing with discharges where a lower quality requirement applies (for example where the effluent passes to foul sewer).

Both classes can be produced as full retention separators. The oil concentration limits of 5 mg/l and 100 mg/l are only applicable under standard test conditions. It should not be expected that separators will comply with these limits when operating under field conditions.

FULL RETENTION SEPARATORS

Full retention separators treat the full flow that can be delivered by the drainage system, which is normally equivalent to the flow generated by a rainfall intensity of 65mm/hr.

On large sites, some short term flooding may be an acceptable means of limiting the flow rate and hence the size of full retention systems.

BYPASS SEPARATORS

Bypass separators fully treat all flows generated by rainfall rates of up to 6.5mm/hr. This covers over 99% of all rainfall events. Flows above this rate are allowed to bypass the separator. These separators are used when it is considered an acceptable risk not to provide full treatment for high flows, for example where the risk of a large spillage and heavy rainfall occurring at the same time is small.

FORECOURT SEPARATORS

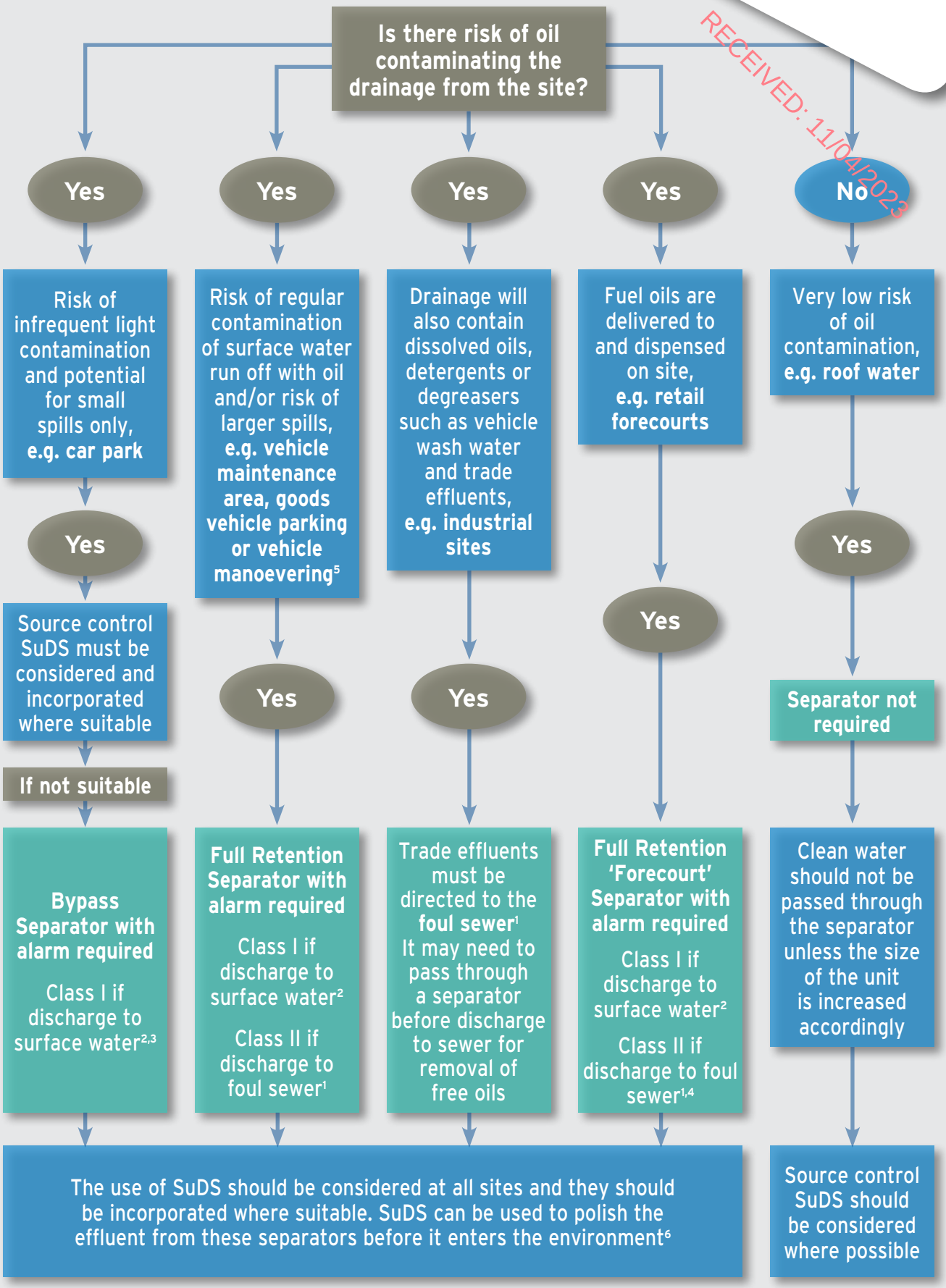
Forecourt separators are full retention separators specified to retain on site the maximum spillage likely to occur on a petrol filling station. They are required for both safety and environmental reasons and will treat spillages occurring during vehicle refuelling and road tanker delivery. The size of the separator is increased in order to retain the possible loss of the contents of one compartment of a road tanker, which may be up to 7,600 litres.

SELECTING THE RIGHT SEPARATOR

The chart on the following page gives guidance to aid selection of the appropriate type of fuel/oil separator for use in surface water drainage systems which discharge into rivers and soakaways.

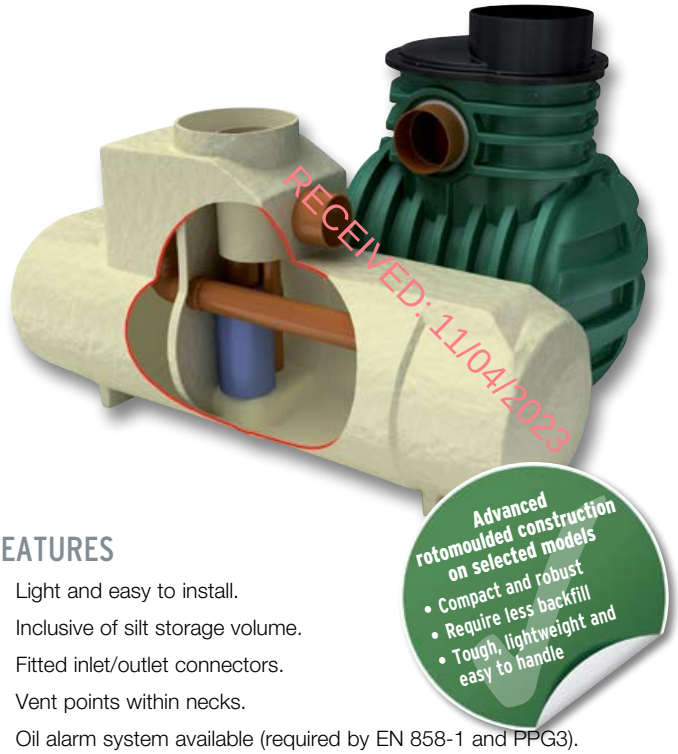
For further detailed information, please consult the Environment Agency Pollution Prevention Guideline 03 (PPG 3) 'Use and design of oil separators in surface water drainage systems' available from their website.

Kingspan Klargester has a specialist team who provide technical assistance in selecting the appropriate separator for your application.



1 You must seek prior permission from your local sewer provider before you decide which separator to install and before you make any discharge.
2 You must seek prior permission from the relevant environmental body before you decide which separator to install.
3 In this case, if it is considered that there is a low risk of pollution a source control SuDS scheme may be appropriate.
4 In certain circumstances, the sewer provider may require a Class 1 separator for discharges to sewer to prevent explosive atmospheres from being generated.
5 Drainage from higher risk areas such as vehicle maintenance yards and goods vehicle parking areas should be connected to foul sewer in preference to surface water.
6 In certain circumstances, a separator may be one of the devices used in the SuDS scheme. Ask us for advice.

Bypass NSB RANGE



APPLICATION

Bypass separators are used when it is considered an acceptable risk not to provide full treatment, for very high flows, and are used, for example, where the risk of a large spillage and heavy rainfall occurring at the same time is small, e.g.

- Surface car parks.
- Roadways.
- Lightly contaminated commercial areas.

PERFORMANCE

Klargester were one of the first UK manufacturers to have separators tested to EN 858-1. Klargester have now added the NSB bypass range to their portfolio of certified and tested models. The NSB number denotes the maximum flow at which the separator treats liquids. The British Standards Institute (BSI) tested the required range of Kingspan Klargester Bypass separators and certified their performance in relation to their flow and process performance assessing the effluent qualities to the requirements of EN 858-1. Klargester bypass separator designs follow the parameters determined during the testing of the required range of bypass separators.

Each bypass separator design includes the necessary volume requirements for:

- Oil separation capacity.
- Oil storage volume.
- Silt storage capacity.
- Coalescer.

The unit is designed to treat 10% of peak flow. The calculated drainage areas served by each separator are indicated according to the formula given by PPG3 NSB = 0.0018A(m2). Flows generated by higher rainfall rates will pass through part of the separator and bypass the main separation chamber.

Class I separators are designed to achieve a concentration of 5mg/litre of oil under standard test conditions.

FEATURES

- Light and easy to install.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.
- Vent points within necks.
- Oil alarm system available (required by EN 858-1 and PPG3).
- Extension access shafts for deep inverts.
- Maintenance from ground level.
- GRP or rotomoulded construction (subject to model).

To specify a nominal size bypass separator, the following information is needed:-

- The calculated flow rate for the drainage area served. Our designs are based on the assumption that any interconnecting pipework fitted elsewhere on site does not impede flow into or out of the separator and that the flow is not pumped.
- The drain invert inlet depth.
- Pipework type, size and orientation.

SIZES AND SPECIFICATIONS

UNIT NOMINAL SIZE	FLOW (l/s)	PEAK FLOW RATE (l/s)	DRAINAGE AREA (m²)	STORAGE CAPACITY (litres) SILT	OIL	UNIT LENGTH (mm)	UNIT DIA. (mm)	ACCESS SHAFT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT	STANDARD FALL ACROSS (mm)	MIN. INLET INVERT (mm)	STANDARD PIPEWORK DIA.
NSBP003	3	30	1670	300	45	1700	1350	600	1420	1320	100	500	160
NSBP004	4.5	45	2500	450	60	1700	1350	600	1420	1320	100	500	160
NSBP006	6	60	3335	600	90	1700	1350	600	1420	1320	100	500	160
NSBE010	10	100	5560	1000	150	2069	1220	750	1450	1350	100	700	315
NSBE015	15	150	8335	1500	225	2947	1220	750	1450	1350	100	700	315
NSBE020	20	200	11111	2000	300	3893	1220	750	1450	1350	100	700	375
NSBE025	25	250	13890	2500	375	3575	1420	750	1680	1580	100	700	375
NSBE030	30	300	16670	3000	450	4265	1420	750	1680	1580	100	700	450
NSBE040	40	400	22222	4000	600	3230	1920	600	2185	2035	150	1000	500
NSBE050	50	500	27778	5000	750	3960	1920	600	2185	2035	150	1000	600
NSBE075	75	750	41667	7500	1125	5841	1920	600	2235	2035	200	950	675
NSBE100	100	1000	55556	10000	1500	7661	1920	600	2235	2035	200	950	750
NSBE125	125	1250	69444	12500	1875	9548	1920	600	2235	2035	200	950	750

Rotomoulded chamber construction GRP chamber construction * Some units have more than one access shaft – diameter of largest shown.

Full Retention NSF RANGE

APPLICATION

Full retention separators are used in high risk spillage areas such as:

- Fuel distribution depots.
- Vehicle workshops.
- Scrap Yards

PERFORMANCE

Kingspan Klargester were the first UK manufacturer to have the required range (3-30 l/sec) certified to EN 858-1 in the UK. The NSF number denotes the flow at which the separator operates.

The British Standards Institute (BSI) have witnessed the performance tests of the required range of separators and have certified their performance, in relation to their flow and process performance to ensure that they met the effluent quality requirements of EN 858-1. Larger separator designs have been determined using the formulas extrapolated from the test range.

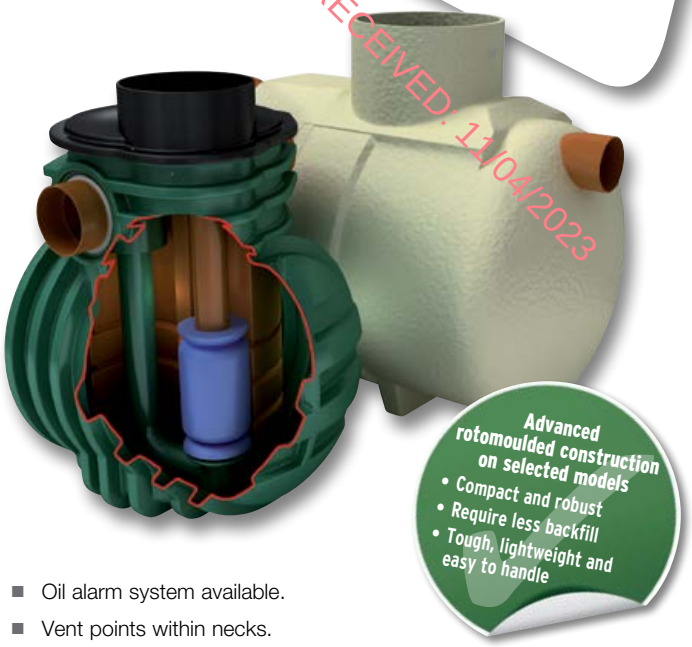
Each full retention separator design includes the necessary volume requirements for:

- Oil separation capacity.
- Silt storage capacity.
- Automatic closure device.
- Oil storage volume.
- Coalescer (Class I units only).

Klargester full retention separators treat the whole of the specified flow.

FEATURES

- Light and easy to install.
- Class I and Class II designs.
- 3-30 l/sec range independently tested and performance sampled, certified by the BSI.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.



- Oil alarm system available.
- Vent points within necks.
- Extension access shafts for deep inverts.
- Maintenance from ground level.
- GRP or rotomoulded construction (subject to model).

To specify a nominal size full retention separator, the following information is needed:-

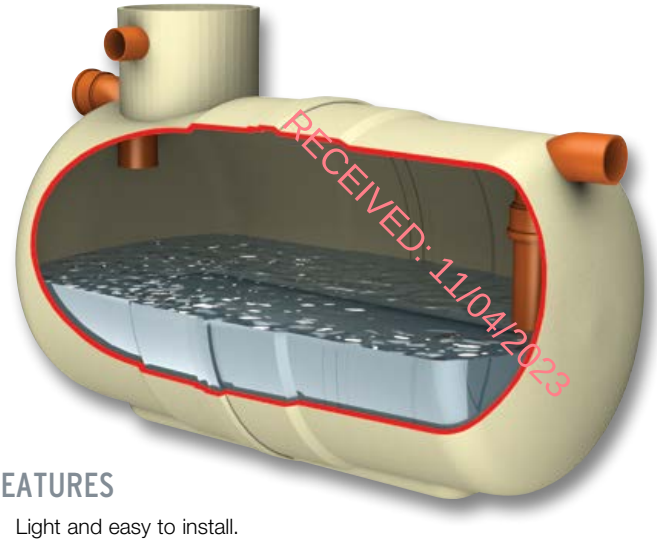
- The calculated flow rate for the drainage area served. Our designs are based on the assumption that any interconnecting pipework fitted elsewhere on site does not impede flow into or out of the separator and that the influent is not pumped.
- The required discharge standard. This will decide whether a Class I or Class II unit is required.
- The drain invert inlet depth.
- Pipework type, size and orientation.

SIZES AND SPECIFICATIONS

UNIT NOMINAL SIZE	FLOW (l/s)	DRAINAGE AREA (m^2) PPG-3 (0.018)	STORAGE CAPACITY (litres) SILT	OIL	UNIT LENGTH (mm)	UNIT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT	MIN. INLET INLET (mm)	STANDARD PIPEWORK DIA. (mm)
NSFP003	3	170	300	30	1700	1350	1420	1345	500	160
NSFP006	6	335	600	60	1700	1350	1420	1345	500	160
NSFA010	10	555	1000	100	2610	1225	1050	1000	500	200
NSFA015	15	835	1500	150	3910	1225	1050	1000	500	200
NSFA020	20	1115	2000	200	3200	2010	1810	1760	1000	315
NSFA030	30	1670	3000	300	3915	2010	1810	1760	1000	315
NSFA040	40	2225	4000	400	4640	2010	1810	1760	1000	315
NSFA050	50	2780	5000	500	5425	2010	1810	1760	1000	315
NSFA065	65	3610	6500	650	6850	2010	1810	1760	1000	315
NSFA080	80	4445	8000	800	5744	2820	2500	2450	1000	300
NSFA100	100	5560	10000	1000	6200	2820	2500	2450	1000	400
NSFA125	125	6945	12500	1250	7365	2820	2500	2450	1000	450
NSFA150	150	8335	15000	1500	8675	2820	2550	2450	1000	525
NSFA175	175	9725	17500	1750	9975	2820	2550	2450	1000	525
NSFA200	200	11110	20000	2000	11280	2820	2550	2450	1000	600

Rotomoulded chamber construction GRP chamber construction

Washdown & Silt



APPLICATION

This unit can be used in areas such as car wash and other cleaning facilities that discharge directly into a foul drain, which feeds to a municipal treatment facility.

If emulsifiers are present the discharge must not be allowed to enter an NS Class I or Class II unit.

- Car wash.
- Tool hire depots.
- Truck cleansing.
- Construction compounds cleansing points.

PERFORMANCE

Such wash down facilities must not be allowed to discharge directly into surface water but must be directed to a foul connection leading to a municipal treatment works as they utilise emulsifiers, soaps and detergents, which can dissolve and disperse the oils.

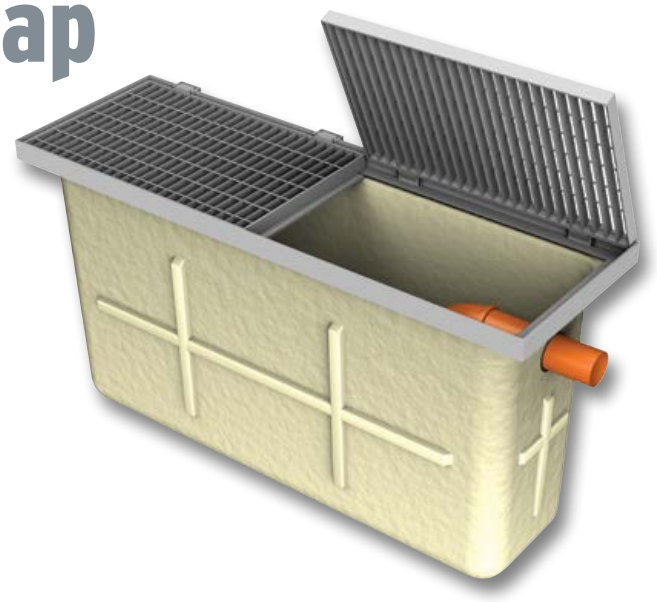
FEATURES

- Light and easy to install.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.
- Vent points within necks.
- Extension access shafts for deep inverts.
- Maintenance from ground level.

SIZES AND SPECIFICATIONS

REF.	TOTAL CAPACITY (litres)	MAX. REC. SILT	MAX. FLOW RATE (l/s)	LENGTH (mm)	DIAMETER (mm)	ACCESS SHAFT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT (mm)	STANDARD FALL ACROSS UNIT (mm)	MIN. INLET INVERT (mm)	STANDARD PIPEWORK DIA. (mm)	APPROX EMPTY (kg)
W1/010	1000	500	3	1123	1225	460	1150	1100	50	500	160	60
W1/020	2000	1000	5	2074	1225	460	1150	1100	50	500	160	120
W1/030	3000	1500	8	2952	1225	460	1150	1100	50	500	160	150
W1/040	4000	2000	11	3898	1225	460	1150	1100	50	500	160	180
W1/060	6000	3000	16	4530	1440	600	1360	1310	50	500	160	320
W1/080	8000	4000	22	3200	2020	600	2005	1955	50	500	160	585
W1/100	10000	5000	27	3915	2020	600	2005	1955	50	500	160	680
W1/120	12000	6000	33	4640	2020	600	2005	1955	50	500	160	770
W1/150	15000	7500	41	5435	2075	600	1940	1890	50	500	160	965
W1/190	19000	9500	52	6865	2075	600	1940	1890	50	500	160	1200

Car Wash Silt Trap



APPLICATION

Car Wash silt trap is designed for use before a separator in car wash applications to ensure effective silt removal.

FEATURES

- FACTA Class B covers.
- Light and easy to install.
- Maintenance from ground level.

Forecourt

APPLICATION

The forecourt separator is designed for installation in petrol filling station forecourts and similar applications. The function of the separator is to intercept hydrocarbon pollutants such as petroleum and oil and prevent their entry to the drainage system, thus protecting the environment against hydrocarbon contaminated surface water run-off and gross spillage.

PERFORMANCE

Operation ensures that the flow cannot exit the unit without first passing through the coalescer assembly.

In normal operation, the forecourt separator has sufficient capacity to provide storage for separated pollutants within the main chamber, but is also able to contain up to 7,600 litres of pollutant arising from the spillage of a fuel delivery tanker compartment on the petrol forecourt. The separator has been designed to ensure that oil cannot exit the separator in the event of a major spillage, subsequently the separator should be emptied immediately.

FEATURES

- Light and easy to install.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.
- Vent points within necks.
- Extension access shafts for deep inverts.
- Maintenance from ground level.
- Class I and Class II design.
- Oil storage volume.
- Coalescer (Class I unit only).
- Automatic closure device.
- Oil alarm system available.

INSTALLATION

The unit should be installed on a suitable concrete base slab and surrounded with concrete or pea gravel backfill. See sales drawing for installation.

If the separator is to be installed within a trafficked area, then a suitable cover slab must be designed to ensure that loads are not transmitted to the unit.

The separator should be installed and vented in accordance with Health and Safety Guidance Note HS(G)41 for filling stations, subject to Local Authority requirements.

SIZES AND SPECIFICATIONS

ENVIROCEPTOR CLASS	TOTAL CAP. (litres)	DRAINAGE AREA (m^2)	MAX. FLOW RATE (l/s)	LENGTH (mm)	DIAMETER (mm)	ACCESS SHAFT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT (mm)	STD. FALL ACROSS UNIT (mm)	MIN. INLET INVERT (mm)	STD. PIPEWORK (mm)	EMPTY WEIGHT (kg)
I	10000	555	10	3963	1920	600	2110	2060	50	400	160	500
II	10000	555	10	3963	1920	600	2110	2060	50	400	160	500
I	10000	1110	20	3963	1920	600	2110	2060	50	400	200	500
II	10000	1110	20	3963	1920	600	2110	2060	50	400	200	500

Alarm Systems

British European Standard EN 858-1 and Environment Agency Pollution Prevention Guideline PPG3 requires that all separators are to be fitted with an oil level alarm system and that it should be installed and calibrated by a suitably qualified technician so that it will respond to an alarm condition when the separator requires emptying.

- Easily fitted to existing tanks.
- Excellent operational range.
- Visual and audible alarm.
- Additional telemetry option.

PROFESSIONAL INSTALLERS

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Services include :

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- Assistance on gaining environmental consents and building approvals
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- Connection to discharge point and electrical networks
- Waste emptying and disposal

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Kingspan Klargester

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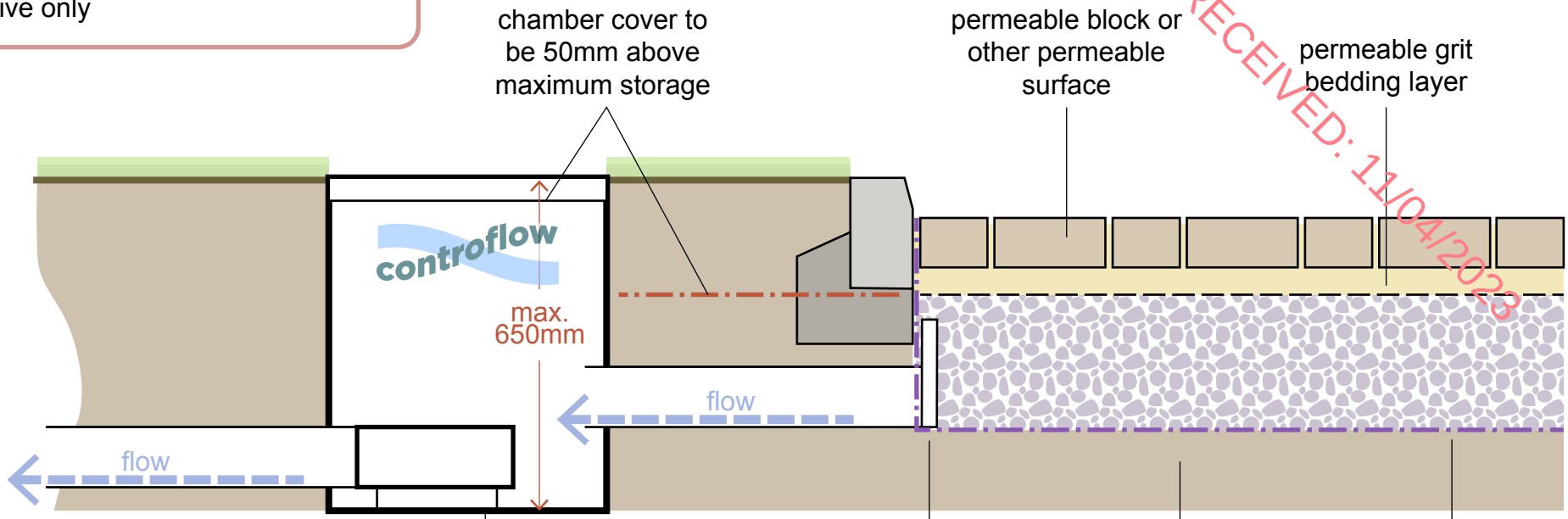
Issue No. 21: September 2015

NOTE : This is not a technical drawing - materials and dimensions shown are indicative only



The Controflow™ flow control chambers work on the principle of the protected orifice and slow flows passing through the SuDS management train.
There are two typical installation types :
1 - receiving from permeable pavement or other SuDS filter structure;
2 - receiving from on open SuDS stucture such as basin, pond or wetland.

info@controflow.com
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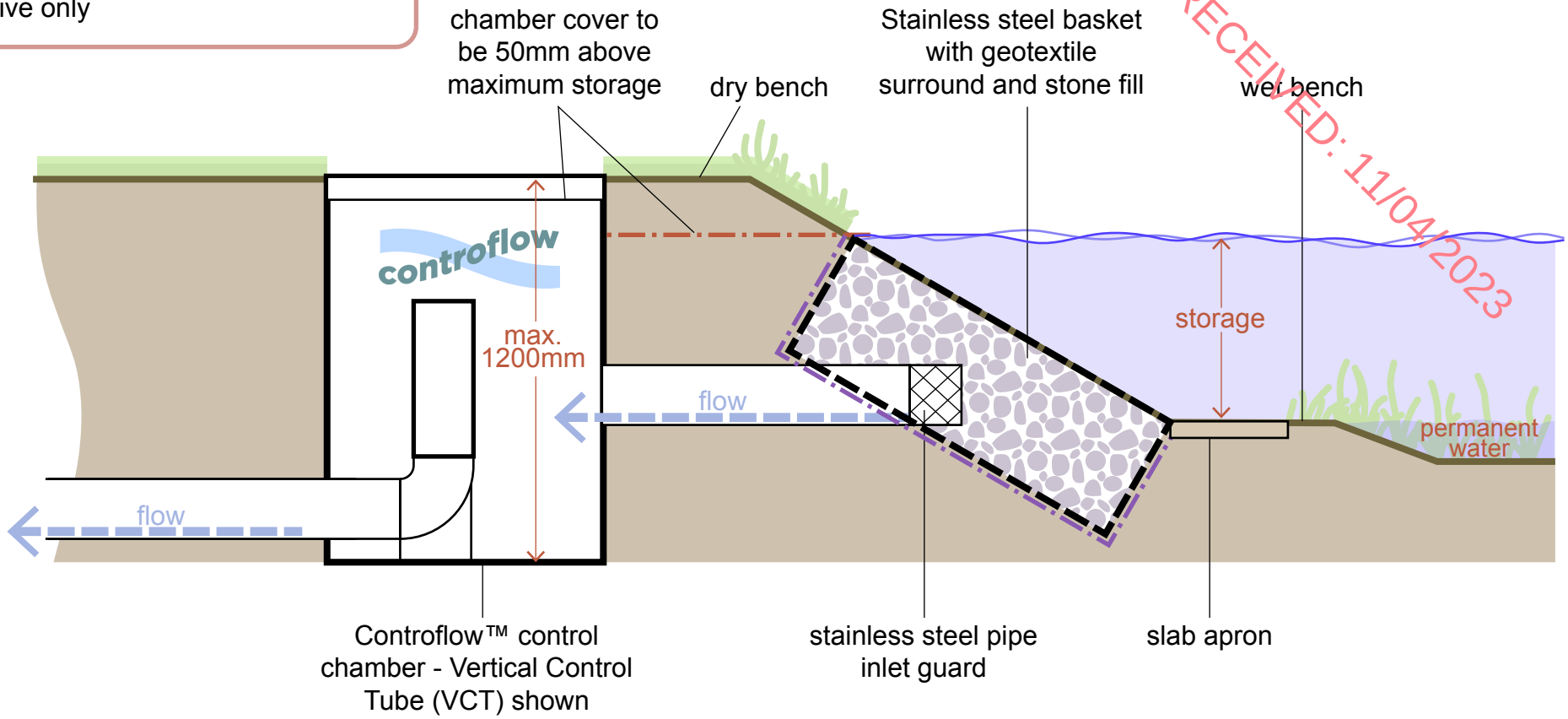
typical Installation type 1 : Permeable Pavement or other SuDS Filter Structure

NOTE : This is not a technical drawing - materials and dimensions shown are indicative only



The Controflow™ flow control chambers work on the principle of the protected orifice and slow flows passing through the SuDS management train.
There are two typical installation types :
1 - receiving from permeable pavement or other SuDS filter structure;
2 - receiving from on open SuDS stucture such as basin, pond or wetland.

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typical Installation type 2 : Open SuDS structure - basin, pond or wetland

Appendix 3.5

Design Report - Temporary Road Diversion and Cut-and-Cover Tunnel

REPORT

Design Report
Temporary Diversion Road and Cut-and-Cover Tunnel

Saint-Gobain Mining (Ireland) Limited

Submitted to:

Monaghan County Council (MCC)
on behalf of
Saint-Gobain Mining (Ireland) Limited
Gyproc Ireland
Kingscourt
Co. Cavan
A82 PF99

Submitted by:

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Town Centre House, Dublin Road, Naas,
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41000019.R03.A0

October 2022

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APPENDIX G
Response to Item 20.q.

1.0 INTRODUCTION

Golder-WSP Ireland Consulting Ltd (Golder-WSP) has been commissioned to prepare this Design Report for the proposed Temporary Diversion Road and the proposed Cut-and-Cover Tunnel below the R179, which are components in the Construction Stage – Enabling Works for the proposed Development, on behalf of Saint-Gobain Mining (Ireland) Limited (SGMI), for submittal to Monaghan County Council (MCC).

The Temporary Diversion Road will be the initially constructed and commissioned to divert traffic from the required segment of the R179 separating Knocknacran West from the existing Knocknacran Open-Cast Mine. The Cut-and-Cover Tunnel will then be constructed and commissioned to enable traffic to return to the former route along the R179, and to enable the movement of gypsum and overburden/interburden to the Knocknacran Site via covered conveyor and truck respectively. The Temporary Diversion Road will then be removed in conjunction with the construction phasing for the overall Knocknacran West development.

The estimated timeline for construction of the Temporary Diversion Road is ca. 3 to 6 months and the estimated timeline for construction of the Cut-and-Cover Tunnel is ca. 4 to 6 months (ca. 7 to 12 months in total).

2.0 SCOPE OF REPORT

This report has been prepared to provide a response to the following additional information items requested by MCC for Planning Ref. 22/34:

- **RFI. 20: Road and Traffic – Items a. to q. and Item t. (Items r. and s. are addressed independently)**
  The applicant is proposing to temporarily divert the R179 over a length of 500 m to allow for the construction of the tunnel structure. The applicant has not provided sufficient details for the proposed road alignment:

  The applicant is requested to submit the following in accordance with the relevant TII Publication specification for roadworks:

  a. **Proposed Vertical and Horizontal alignment drawings** to a suitable scale for the R179 diversion. The drawings must include the geometrical design information, including Chainage, Existing Levels, Proposed Levels, Level Difference, Horizontal Geometry and the Vertical Geometry.

     Response to Item 20.a.: See Drawings -00005 and -00006 provided in Appendix A and Section 5.2and 5.3 of this report.

     The design speed limit for the Temporary Diversion Road is 60 km/hr.

  b. **Series 200 – Site Clearance**. Plan layout of the proposed site clearance.

     Response to Item 20.b.: See Drawing -00002 provided in Appendix A and Section 5.0 of this report.

  c. **Series 300 – Fencing Drawing**

     (i) Layout plan drawing illustrating the location, type and setback distance of the proposed fencing type and all landowner access points required.

     (ii) Typical details drawing of the proposed fencing and gate type.

     Response to Item 20.c.(i) and (ii): See Drawings -00001, -00007, -00008 and -00010 provided in Appendix A and Section 5.10 of this report.

     There are no landowner access points or gates proposed in the fencing for the design extent of the Temporary Diversion Road.

d. Series 400 – Vehicle Restraint System

(i) Layout plan drawing illustrating the location, type and setback distance of the proposed vehicle restraint system or a design risk assessment and report that justifies a vehicle restraint system is not required.

Response to Item 20.d.(i): Refer to Drawing -00003 provided in Appendix A and Section 5.10 of this report.

The Risk Assessment Procedure for the VRS in accordance with TII Publication DN-REQ-03034 (Road Restraint Systems) is provided in Appendix B.

e. Series 500 – Road Drainage drawings to include:

(i) Layout plan drawing showing the proposed roadside drainage and the discharge locations.

(ii) Layout plan showing the location of the pre-earthworks drainage (crest and toe interceptor drains)

(iii) The plan drawing should indicate pipe sizes, gradients, pipe types, invert levels, manhole locations and the discharge locations with provision for headwalls.

(iv) Standard details of the proposed drainage.

Response to Item 20.e.(i) to (iv): Refer to Drawing -00004 provided in Appendix A and Section 5.8 of this report.

Drawing -00010 shows the reinstatement of the permanent road drainage for the R179 following the removal of the tie-ins for the Temporary Diversion Road.

Section 5.8 provides a summary of the culvert located to the west of the tie-in for the Temporary Diversion Road with the R179, which transfers the flows from the north side to the south side of the R179.

f. Proposed Culvert Details

(i) Long section of each culvert showing the invert level at the inlet and the outlet, gradient across the culvert, culvert types and the culvert diameter.

(ii) Culvert headwall details.

(iii) Details for the removal of all culverts installed to facilitate the temporary R179 diversion.

Response to Item 20.f.(i) to (iii): Refer to Drawing -00004 provided in Appendix A for the long section of the culvert at Chainage 100.

Drawing -00004 notes that drainage apparatus / construction details will be in accordance with TII RCD 500 Series.

Drawing -00010 shows the permanent road drainage for the R179 following the removal of the tie-ins for the Temporary Diversion Road.

g. Series 600 – Earthworks

(i) Cross-sectional drawings at 50m intervals and chainages of interest (transition from cut to fill) to illustrate the existing ground and proposed road levels.

(ii) Proposed embankment / cutting details, including side-slope information, proposed materials and pavement make-up.

Response to Item 20.g.(i) and (ii): Refer to Drawings -00006, -00007 and -00008 provided in Appendix A and Section 5.6 of this report.

h. Series 700 – Pavement Details

(i) Typical details illustrating the proposed material type and layer thickness.

Response to Item 20.h.(i): Refer to Drawings -00007 and -00008 provided in Appendix A and Section 5.7 of this report.

Drawing -00010 shows the permanent road reinstated pavement works for the R179 following the removal of the tie-ins for the Temporary Diversion Road.

i. Series 1200 – Line Marking and Signage

(i) Layout plan of the proposed road marking and signage to an appropriate scale.

Response to Item 20.i.(i): Refer to Drawings -00007, -00009 and -00010 provided in Appendix A and Section 5.10 of this report.

Drawing -00010 shows the permanent road reinstated line marking and removal of temporary diversion road signage for the R179 following the removal of the tie-ins for the Temporary Diversion Road.

j. Series 2600 – Landscaping

(i) Layout plan of the proposed landscaping.

Response to Item 20.j.(i): No significant landscaping works are proposed for the Temporary Diversion Road or the Cut-and-Cover Tunnel with the permanent R179 reinstated. Landscaping notes are provided on Drawing -0008 which state that embankment slopes and verges will be topsoiled (200mm depth) and sown with a seed mix of 70% wildflower and 30% grass.

Drawing -00010 shows the permanent road reinstated works for the R179 following the removal of the tie-ins for the Temporary Diversion Road.

k. Existing Services Drawing

(i) Layout plan showing the location of all existing services and the provisions included to protect same.

Response to Item 20.k.(i): Refer to Drawing -00001 provided in Appendix A and Section 5.4 of this report.

SGMI and the Main Contractor will liaise with the providers of all of the utilities present in the footprint of the proposed development in advance of any works to coordinate protection measures and/or diversions.

I. R179 Road Diversion Design Reports

To substantiate the proposed design of the R179 temporary design, the following Design Reports are required.

(i) A **Geotechnical Report** outlining the current ground conditions, the load bearing capacity and confirmation that the proposed road diversion has been designed taking account of a detailed Site Investigation Report

Response to Item 20.I.(i): A site investigation has been conducted for the Temporary Diversion Road and the Cut-and-Cover Tunnel during September 2022. A Geotechnical Interpretative Report has been prepared (Golder-WSP 2022) and is provided in Appendix RFI 29.b of the RFI Response Document. The design basis for the Temporary Diversion Road is discussed in Section 5.7.

(ii) **Drainage Design Report** substantiating that:

i. Road side drainage has been adequately designed.

ii. Proposed culvert crossings have been adequately designed.

iii. The discharge locations have assessed to ensure that the surrounding drainage/river network has adequate capacity.

Response to Item 20.I.(ii): The drainage design is discussed in Section 5.8 of this report and is shown on Drawing -0004. The drainage calculations are provided in Appendix E.

Section 5.8 provides a summary of the culvert located to the west of the tie-in for the Temporary Diversion Road with the R179, which transfers the flows from the north side to the south side of the R179.

(iii) **Road Design Report**

The report should detail the design criteria selected and confirm that the diversion road has been designed according to TII standards. If this is not the case, all departures should be listed and justification for acceptance of these departures stated.

Response to Item 20.I.(iii): Refer to Section 5.2 of this report.

(iv) **Vehicle Restraint System Design Report**

The detailed design of a road restraint system is to be in accordance with the TII specification for roadworks Series 400 "*Safety Barriers and Pedestrian Guardrails*".

Response to Item 20.I.(iv): Refer to Section 5.10 of this report.

The Risk Assessment Procedure for the VRS in accordance with TII Publication DN-REQ-03034 (Road Restraint Systems) is provided in Appendix B.

(v) **Structural Design Report** for the proposed tunnel under the R179. The report shall include:

i. A Structural Engineer's Report on the proposed underpass stating that the structure is in accordance with the TII specifications and European standards.

ii. A geotechnical report outlining the current ground conditions, the load bearing capacity and confirmation that the proposed structure has been designed taking account of a Site Investigation Report.

Response to Item 20.l.(v): Refer to Section 6.7 of this report. The structural design report for the Cut-and-Cover is provided in Appendix C.

A site investigation has been conducted for the Temporary Diversion Road and the Cut-and-Cover Tunnel during September 2022. A Geotechnical Interpretative Report has been prepared (Golder-WSP 2022) and is provided in Appendix RFI 29.b of the RFI Response Document. The design basis for the Cut-and-Cover Tunnel is discussed in Section 6.7.

m. Professional Consultancy Indemnity Insurance and Engineer Reports

Submit the following details:

(i) Provide a Professional Indemnity insurance policy covering the entirety of the works. The policy shall be in a form acceptable to Monaghan County Council and shall be jointly in the names of the project designer and Monaghan Country Council and shall be for a minimum indemnity period of 12 years.

Response to Item 20.m.(i): WSP can provide a professional indemnity insurance policy to meet the request. A letter statement is provided in Appendix F. The extent and terms of the specific policy agreement will require clarification and agreement with Monaghan County Council.

n. The applicant shall submit a **Method Statement** detailing how the works are to be implemented and shall include:

(i) Details of construction. Provide a detailed method statement / works sequence on how it is proposed to excavate the existing road in accordance with and referencing the relevant TII specification / documentation whilst maintaining all existing utility infrastructure.

(ii) Diversion route or alternative traffic management.

(iii) Traffic Management and Health and Safety Plan.

(iv) Programme of Works such as timescales and stages.

Response to Item 20.n.(i) to (iv): Refer to Section 7.0 of this report.

o. R179 Road Permanent Works

Submit a Stage 1 and Stage 2 (not a combined Stage 1 and Stage 2) Road Safety Audit Report on the proposed permanent R179, specifically addressing the location of the proposed underground tunnel and the associated vehicle restraint system and roadside fencing.

Response to Item 20.o.: Refer to Section 5.11 and 6.12 and Appendix D of this report.

p. Submit **plan layout drawings** showing the location of:

(i) Proposed vehicle restraint system.

Response to Item 20.p.(i): Refer to Drawing -00003 provided in Appendix A and Section 5.10 and 6.10 of this report.

The Risk Assessment Procedure for the VRS in accordance with TII Publication DN-REQ-03034 (Road Restraint Systems) is provided in Appendix B.

(ii) Proposed fencing location.

Response to Item 20.p.(ii): See Drawings -00001, -00007, -00008 and -00010 provided in Appendix A and Section 5.10 and 6.10 of this report. There are no landowner access points or gates proposed in the fencing for the design extent of the Temporary Diversion Road.

q. Permanent solution to existing mine workings that go under the existing public road network:

The applicant has not clearly demonstrated how they propose to address the issue of future road subsidence on the public road network where previous mine workings exist.

The applicant must submit comprehensive proposals, including design reports, drawings, and other appropriate design details that demonstrate how the applicant proposes incorporating a permanent solution to the mine workings that go under the public roads as part of their open cast works.

Response to Item 20.q.: Refer to Section 6.13 and Appendix G of this report.

t. Proposed R179 Tunnel – Long Term Stability

Section 3.7 notes that the proposed tunnel under the R179 will be sealed with clean demolition rubble. The applicant has not defined how the structure's structural integrity can be inspected beyond the operational life of the mine. The applicant has not detailed how clean demolition rubble would meet the TII Specification for the use of materials within 500mm of a concrete surface of a structure. The applicant must provide:

(i) A detailed structural report with drawings outlining how the applicant proposed ensuring the tunnel's structural integrity for its design life of 120 years. The report shall include the proposed maintenance and inspection regime during the operational phase of the mine and the phase between the end of mine operations and the design life of the tunnel. Furthermore, the applicant shall detail their proposal for the structure when it exceeds its design life of 120 years. All reports shall explicitly identify that the applicant is responsible for the structure for its design life of 120 years and that they are responsible for its removal and replacement thereafter.

Response to Item 20.t.: Refer to Section 6.13 of this report.

The design life of the Cut-and-Cover Tunnel is 120 years. It is proposed that the Cut-and-Cover Tunnel be inspected, maintained and managed by SGMI in accordance with the EIRSPAN Bridge Management Scheme for the life of mine (30 to 40 years), or as agreed with the relevant authority. Following the end of life of mine, it is proposed that the Tunnel be sealed at either end and backfilled with concrete (specification in accordance with Table 1 in Section 6.13), or as agreed with the relevant authority, to ensure the long-term stability of the structure, and that the responsibility for the structure be then transferred to the relevant authority (TII or MCC).

3.0 PROPOSED DEVELOPMENT

The mine workings at the former Drumgoosat Underground Mine (closed in 1989) exist under the proposed Knocknacran West Open-Cast Mine. SGMI proposes to extract the remaining pillars, overlying roof beams, underlying floor beams and previously un-mined areas from both the Upper and the Lower Gypsum Units using open pit mining methods. The proposed Knocknacran West Open-Cast Mine site is ca. 54.3 ha, of this ca. 47.5 ha comprises the extraction area. The depths range from ca. 70 m to 80 m from the current ground elevation to the base of the lower gypsum unit. It is proposed to continue to use the existing processing facility on the existing Knocknacran Mine site for the processing of the extracted gypsum from Knocknacran West Mine.

3.1 Development Activities

The elements of the proposed Development that are relevant to this design report are described below and shown in Figure 1 and Figure 2.

- Development will include the construction of a Cut-and-Cover Tunnel under the Carrickmacross to Kingscourt regional road (R179) for the transport of gypsum (by haulage truck and covered conveyor) to the existing processing plant area at Knocknacran, and for the transport of overburden and interburden (by haulage truck) to the existing Knocknacran Open-Cast Mine site for ongoing restoration purposes. The construction of the proposed Tunnel will necessitate a temporary realignment of the R179 (Temporary Diversion Road) during the Tunnel construction period to allow the R179 to remain in constant use.

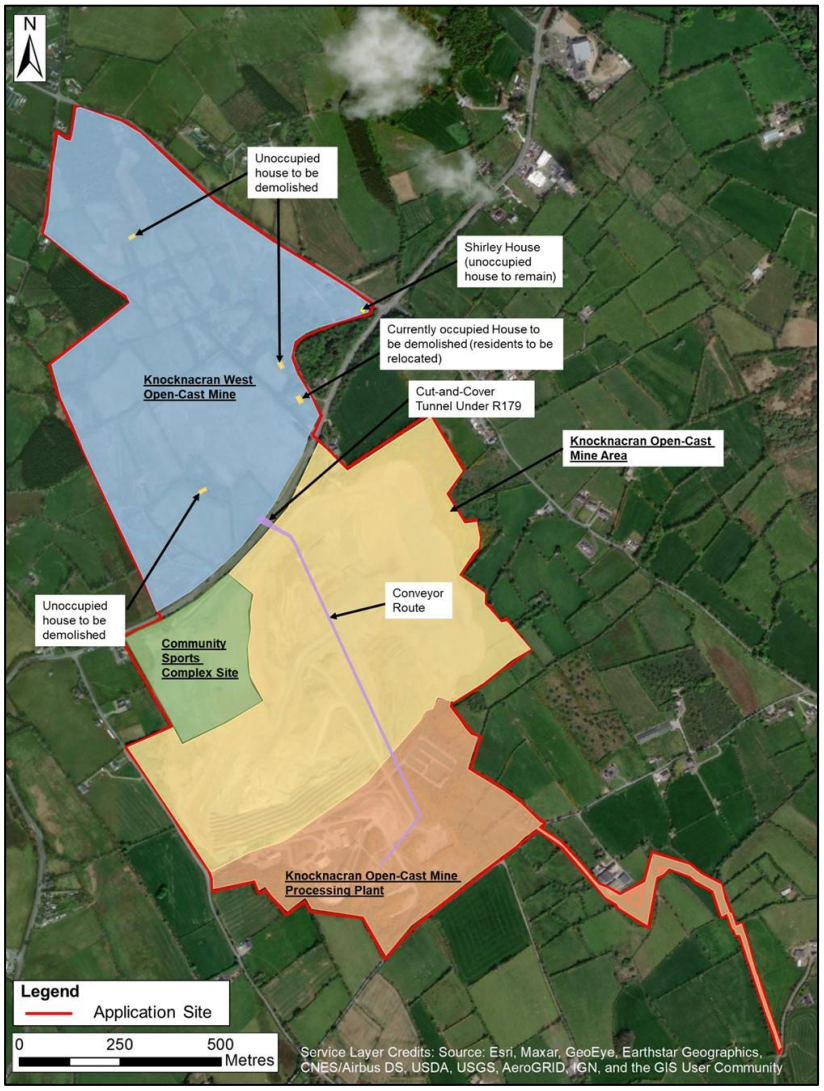


Figure 1: Proposed Development Site Layout showing Cut-and-Cover Tunnel

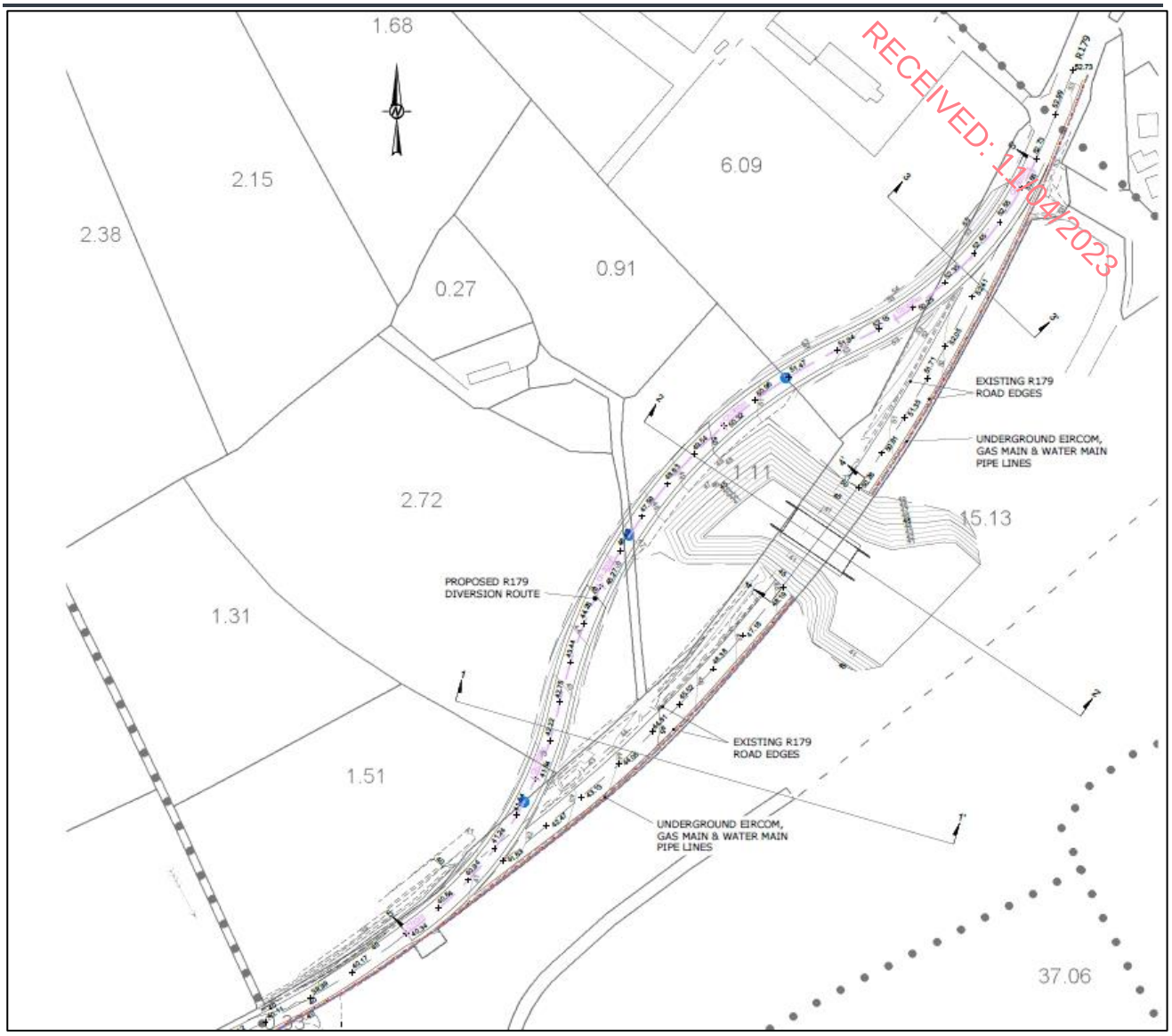


Figure 2: Routes for the proposed Temporary Diversion Road and Cut-and-Cover Tunnel

The overall Application Site area is ca. 140.4 ha[1], of which the proposed Knocknacran West Mine comprises ca. 54.3 ha, ca. 24.6 ha comprises the processing plant, ca. 8.6 ha will comprise the Community Sports Complex and ca. 51.5 ha will comprise the restoration area for the existing Knocknacran Mine.

Note: The coordinated system in use on Site is Irish National Grid (ING) and elevations are taken to Knocknacran Mine Datum (Malin Head + 1,002.6 m) (i.e. 50 mOD is equivalent to 1,052.6 mMD).

[1] The red line area encompasses a small area of the R179 (ca. 1.4 ha) which accounts for the slight discrepancy in total site area.

4.0 BACKGROUND

The proposed Knocknacran West Mine site encompasses the former Drumgoosat Mine underground workings to the north of the R179, see Figure 1 and Figure 3 below.

Prior to the initial subsidence event in September 2018 (refer to EIAR Chapter 7.0), activity on the site was mixed use. Above ground the land was previously used for pastoral farming, amenity uses (former Magheracloone Mitchell's GAA Club grounds and Community Centre) and a brownfield area to the north of the site which was the site of the former Drumgoosat Mine surface plant area which has become an area of semi-natural woodland. Below ground the majority of the site comprised (and continues to comprise) the former Drumgoosat Mine underground workings.

Former Drumgoosat Mine underground workings extend under the majority of the site, with some workings extending under the R179 and L4900 and under the footprints for the proposed Temporary Diversion Road and Tunnel (see Figure 3 below). The gypsum associated with the underground workings to the south of the R179 has been excavated during mining of the Knocknacran Open-Cast Mine.

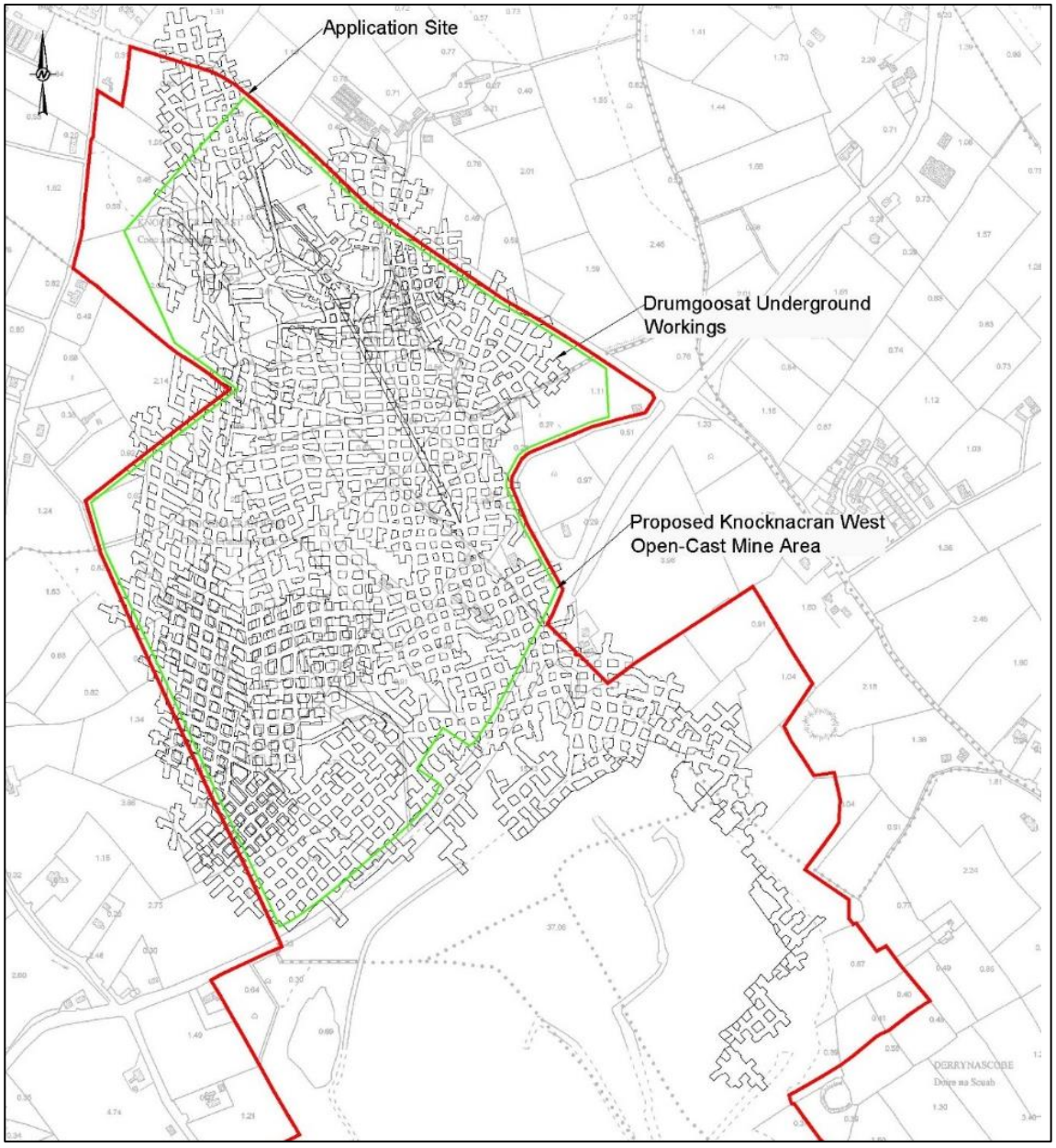


Figure 3: Plan showing extent of the former Drumgoosat Mine underground workings

Since the subsidence event in September 2018, work has been undertaken by SRK (with review by Wardell Armstrong for the Department of the Environment, Climate and Communications) to assess the causes and current, and future, stability of the existing underground workings beneath the site (refer to EIAR Chapter 7.0 and Appendices, and Item 22 of the RFI Response Document).

The only activities which have taken place on the Site since the subsidence event have related to remediation; through the removal of buildings, filling of subsidence features and regrading of the site, and monitoring and management of the site. The former GGA Club Grounds, Community Centre buildings and pitches were removed as part of site remediation works. Remediation of crown-holes and fissures associated with this subsidence event have also taken place. The site of the Grounds remains not in use, as does the wider site.

Figure 4 below shows the extent of the subsidence event (dashed magenta line) as identified by the tension cracks surveyed, and the location of the crown holes that were filled (dashed cyan lines). The footprints of the proposed Temporary Diversion Road and the Tunnel were not influenced by the subsidence event and the north end of the Temporary Diversion Road is located a minimum of 50m from edge of carriageway to the southern extent of the tension cracks from the subsidence event. Figure 3 shows that there are several large blocks in this area that have no mine workings.

Figure 4: Plan showing extent of the Subsidence Event and the footprint of Temporary Diversion Road

5.0 TEMPORARY DIVERSION ROAD

The design and alignment of the Temporary Diversion Road has been developed in accordance with the Transport Infrastructure Ireland (TTI) standards, namely:

- Analytic Pavement and Foundation Design, DN-PAV-03021, August 2022.
- Cross Sections and Headroom, DN-GEO-03036, May 2019.
- Design of Outfall and Culvert Details, DN-DMG-0371, June 2015.
- Drainage – Chamber Types, CC-SCD-00501, March 2015.
- Drainage – Typical Chamber Details, CC-SCD-00514, March 2015.
- Drainage – Filter Drains Trench and Bedding Details, CC-SCD-00520, March 2015.
- Drainage – Typical Swale Details, CC-SCD-00525, March 2015.
- Drainage – G.A. of a Headwall (Culvert Drains), CC-SCD-90520, January 2009.
- Drainage Systems for National Roads, DN-DNG-03022, June 2015.
- Earthworks – Interceptor Ditches, CC-SCD-00602, March 2000.
- Fencing – Cranked Concrete Post and Mesh, CC-SCD-00318, January 2007.
- Fencing – Timber Post and Tensioned Mesh Fence, CC-SCD-00320, August 2018.
- Rural Road Link Design, DN-GEO-03031, April 2017.
- Road Safety Audit, GE-STY-01024, December 2017.
- Specification for Road Works Series 200 – Site Clearance, CC-SPW-00200, December 2010.
- Specification for Road Works Series 300 – Fencing and Environmental Noise Barriers, CC-SPW-00300, August 2018.
- Specification for Road Restraint Systems (Vehicle and Pedestrian) Series 400, CC-SPW-00400, June 2020.
- Specification for Road Works Series 500 – Drainage and Service Ducts, CC-SPW-00500, March 2015.
- Specification for Road Works Series 600 – Earthworks, CC-SWP-00600, March 2013.
- Specification for Road Works Series 700 – Road Pavements – General, CC-SWP-00700, January 2016.
- Specification for Road Works Series 1200 – Traffic Signs and Road Markings, CC-SPW-1200, January 2019.
- Specification for Road Works Series 2600 – Miscellaneous, CC-SPW-2600, December 2010.
- Standard Construction Details – Series 600, CC-SCD-00601 to CC-SCD00610, April 2017.
- The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges, DN-REQ-03034, May 2019.

The design drawings for the Temporary Diversion Road are provided in Appendix A, the Road Safety Audit (Stage 1 and Stage 2) is provided in Appendix D and the design elements are discussed in the sections below.

5.1 Constraints

The Temporary Diversion Road geometry was chosen based on a 60 kph design speed. The horizontal and vertical geometry is based on Table 10.3 of DN-GEO-03031. Further constraints were:

- The new entrance to the GAA grounds to the west of the start of the alignment;
- The entrance to a private residence (under the ownership of the Applicant - SGMI) to the north-east of the end of the alignment; and
- The requirement to provide enough working space to safely install the Tunnel and the need to protect ground monitoring equipment (extensometers) installed adjacent to the existing R179.

5.2 Geometry

Horizontal Alignment

The alignment begins to the south-west of Knocknacran West, approx. 50 m east of the new entrance to the GAA grounds. The alignment starts with a left-hand curve of radius 180 m for a distance of approximately 140 m at which point it joins a right-hand curve of radius 255 m, for a distance of 24 m. The alignment continues with a left-hand curve radius 180m for a distance of 130 m is used to tie the Temporary Diversion Road into the existing R179 road. The total horizontal alignment is 506 m.

Vertical Alignment

The Vertical alignment was chosen to follow existing ground where possible and to comply with standards in Table 10.3 of DN-GEO-03031. The Vertical alignment begins with a gradient of 1.5% for 100 m, at which point a sag curve of K=26 is used to allow the alignment to rise in level for 120 m. A crest curve of K=30 is then utilised to bring the Temporary Diversion Road level in line with the existing R179. A straight gradient is then utilised to tie the temporary road into the existing R179.

The longitudinal alignment of the carriageway mimics the increasing gradient of the segment of the R179, from south-west to north-east. The Temporary Diversion Road carriageway rises from 40.33 mOD at the start to 48.25 mOD at the midpoint (7.92 m over 253 m, overall 3.13% gradient) and the continues to rise to 52.73 mOD at the end (4.48 m over 253 m, overall 1.77% gradient). A total of 12.4 m over 506 m (overall 2.45% gradient).

Relaxations and Departures

The use of 180 m horizontal curves at the start and end of the alignment is considered a relaxation of the standard as set out in Table 10.3 of DN-GEO-03031.

Access along Route

There are no access points along the alignment of the Temporary Diversion Road.

5.3 Carriageway Cross-Section

The carriageway cross-section is designed to match the cross section of the existing R179. This consists of a road carriageway of 7 m (3.5 m lanes), hard strips of 1 m and 2 m verges. The carriageway comprises a total width of 13 m and is a Type 2 Single carriageway (CC/SCD/0002).

A maximum superelevation of 5% has been applied to the carriageway, with a filter drain located at the centre of the 2 m verge (see Drawings KNCN-WSP-HAW-SW-GN-Z-CH-00004 & 00008 for details in Appendix A).

5.4 Services along Route

There are no overhead or underground utility service disruptions associated with the alignment of the Temporary Diversion Road. Refer to Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00001 for approximate locations of existing services/utilities.

Extensometers installed to monitor the R179 are present adjacent to and within the alignment. Refer to Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00001 for approximate locations. These instruments will be adjusted as required by the design and manhole covers installed as needed.

5.5 Site Clearance

The site clearance for the Temporary Diversion Road comprises stripping the site of topsoil and subsoil and removal of trees, hedgerows and scrub for the extent shown on Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00002.

The works shall be conducted in accordance with the relevant NRA Guidelines for the protection of trees, hedgerows, scrub and crossing of watercourses during the construction of national road schemes.

The material will be handled in accordance with the Resource Waste Management Plan (RWMP) for the proposed Development (see response to RFI.4d).

5.6 Earthworks

Excavation for cut / fill slopes shall be conducted in accordance with the Specification for Road Works Series 600 – Earthworks, CC-SWP-00600, March 2013 and the Standard Construction Details – Series 600, CC-SCD-00601 to CC-SCD00610, April 2017.

Method compaction will be utilized for the preparation of the sub-formation and the capping.

5.7 Structural Design

A site investigation has been conducted along the route of the proposed Temporary Diversion Road to establish the ground conditions and geotechnical parameters (Golder-WSP 2022).

The design of the pavement on a basis of a minimum subgrade C.B.R. of 4% is proposed. Inspection and testing is recommended to be undertaken on the subgrade to validate during the construction.

The pavement design is Pavement Type A – 200 mm fully flexible, in accordance with Chapter 4 of DN-PAV-03021, August 2022, and comprises:

- 40mm HRA 35/14 F SURF 40/60 DES SURFACE COURSE ;
- 60mm AC 20 DENSE BIN 40/60 DES BINDER COURSE;
- 100mm AC32 DENSE BASE 40/60 DES BASE COURSE ;
- 150mm CLAUSE 804 TYPE B SUBBASE; and
- Min. 300mm CAPPING comprising CLASS 6F1 or CLASS 6F2, in accordance with DN-PAV-03021.

5.8 Drainage

5.8.1 Existing Drainage

A Drainage Assessment and Maintenance Plan was prepared for Knocknacran West (Golder 2020A) following the remediation of the former Magheracloone GAA Grounds. Drawing -00011 provided in Appendix E shows the current topography and surface water drainage in the footprint of Knocknacran West and in the proposed alignment for the Temporary Diversion Road (Fields A, B, J and H in Figure 5 below).

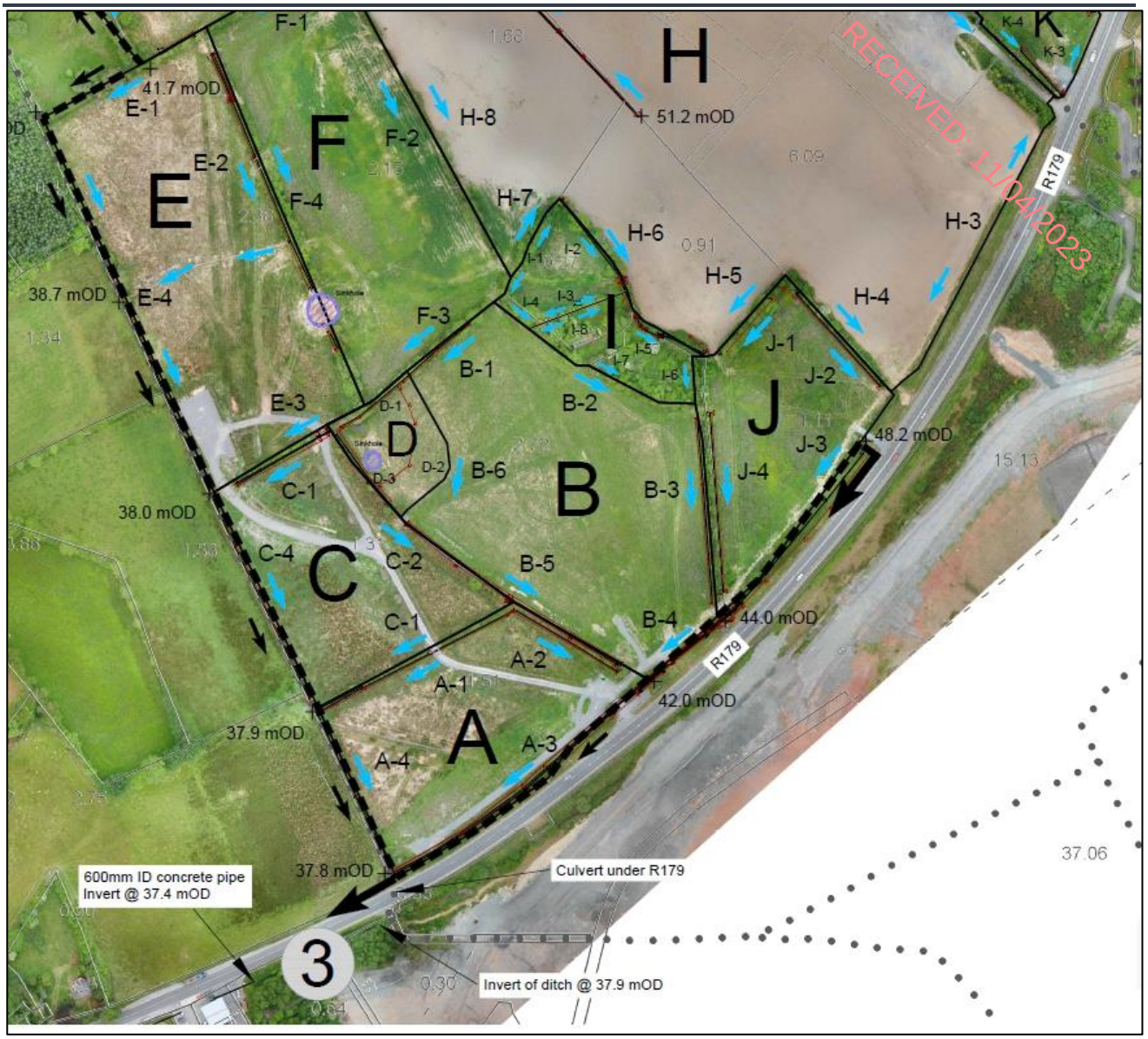


Figure 5: Plan showing existing surface water drainage routes for Knocknacran West (Golder 2020A)

The existing drainage flow paths are to the south-west and there is a limited catchment area on the north side of the Temporary Diversion Road as the topography rises and diverts the drainage to the west and north. On the south side of the Temporary Diversion Road, the topography falls to the south and south-west and drainage will enter the existing flow paths alongside the R179 (segment J-3 to B-4 to A-3 in Figure 5), which are open ditches with inverts at ca. 1 m below the ground level, and ca. 1 m to 1.5 m wide bases, and 3.0 m to 4.0 m wide crests.

The outfall for this catchment is at the junction of segment A-3 and A-4 (Figure 5) where the two open ditches meet and flows through a 750 diameter culvert from the north side to the south side of the R179. A 0.6 m wide x 1.2 m high stone arch culvert also exists at this location and runs parallel to the 750mm diameter culvert.

The open ditches leading to the north (A-4, C-4 and E-4 in Figure 5) are wider (ca. 4 m), deeper (ca. 1.5m) and have a shallower gradient. At the time of the drainage assessment and survey (Q3 2020), there appeared to be a blockage at both of culvert, and it was leading to flooding in field A and the drains heading to the north were full. Downstream of this culvert, the drainage system is shown in Figure 6 below.

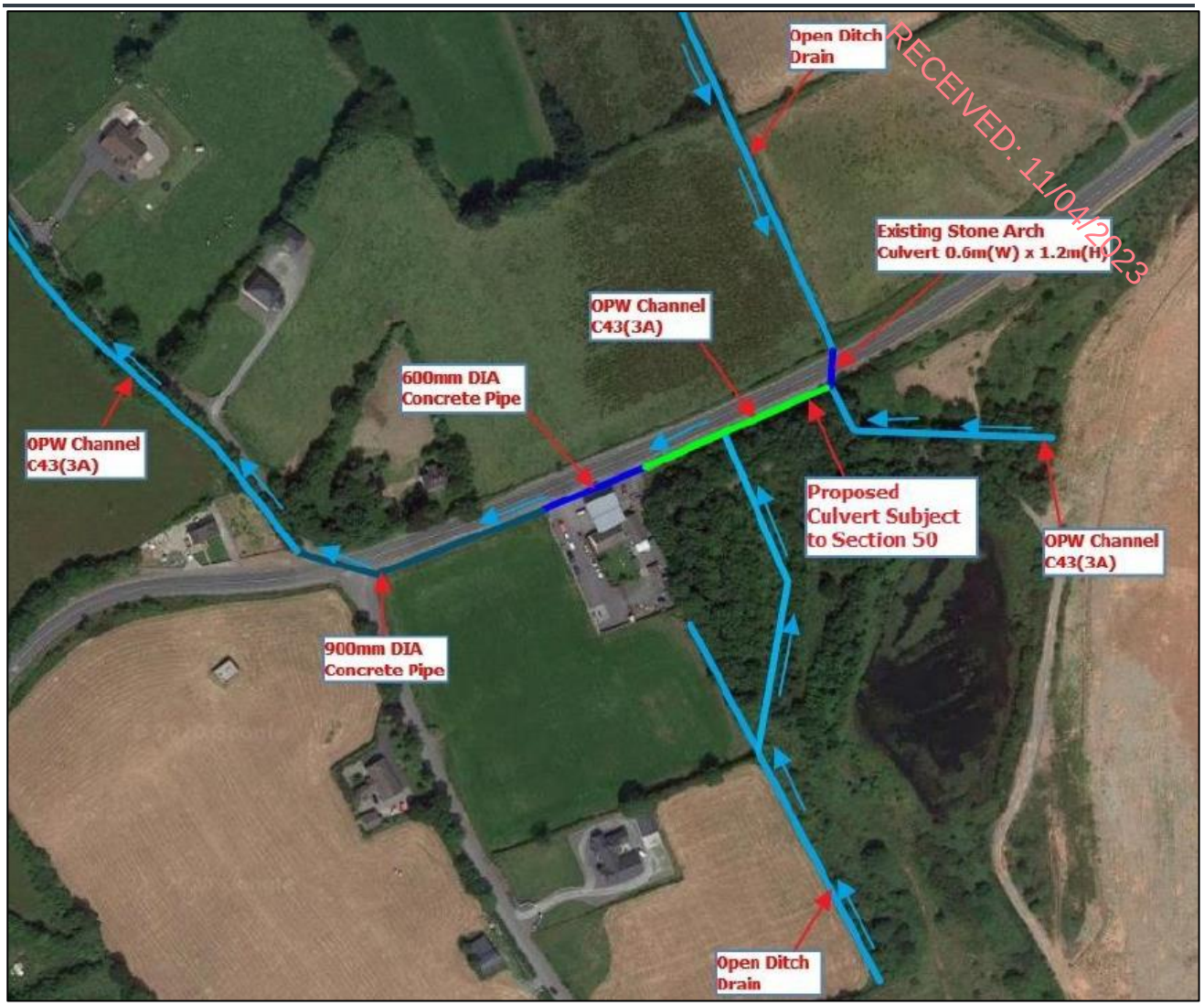


Figure 6: Plan showing existing surface water drainage routes downstream of Stone Arch Culvert

Subsequently, Phase 1 of the Magheracloone-Mitchells GAA Pitch Development was constructed on the south side of the R179 (MCC Planning Ref. 20/365). This development required the upgrade of the open ditch along its north boundary with the R179 (OPW Channel), where 900 mm and 1,200 mm diameter concrete pipes were installed (green line segment in Figure 6) to connect to the existing 600 mm diameter pipe (dark blue line segment in Figure 6). The works also required the connection of the 750mm diameter culvert to the new 900mm diameter pipe system and the stone arch culvert was subsequently blocked off.

Both sides of the 750mm culvert were exposed in Dec 2021, a survey of the inverts was undertaken, and a 'pig' was pulled through the culvert to clean it. Figure 7 below shows photos taken following the cleaning of the culvert on the north entry point and the south exit point, at either side of the R179. The entry point has an invert level of 37.844 mOD and the exit point has an invert level of 37.815. The total culvert length is 31.15m.

As built drawings for the 750mm culvert and the completed drainage works for the Phase 1 Magheracloone-Mitchells GAA Pitch Development are provided in Appendix E, along with the Section 50, OPW approval for the installation.

Figure 7: 750mm diameter culvert – North Entry on left and South Exit on right

Since the commissioning of the works, the 750mm diameter culvert has been working effectively and has alleviated the flooding in field A and reduced the water build-up locally in the ditches on the north-side of the R179.

5.8.2 Proposed Drainage

Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00004 shows the Drainage Plan for the Temporary Diversion Road and Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00008 (Appendix A) provides the representative construction details.

The design calculations are provided in Appendix E and the design basis is described below:

- Designed in WinDes MicroDrainage:
  - Uses the FSR Rainfall Profile using the M5-60 data taken from the Magheracloone DDF data.
- **Road drainage (N01):**
  - Designed to no surcharge in pipe at 1yr return period + 20% climate change.
  - Designed to no flooding of chamber tops at 30yr return period + 20% climate change.
- **Pre earthworks (PED01) drainage**:
  - Designed to no flooding of ditches at 100yr return period + 20% climate change.
- Outputs are PDFs from MicroDrainage for each design (**N01 & PED01**)*.
- Drawing -00004 notes that drainage apparatus / construction details will be in accordance with TII RCD 500 Series.

The drainage system for the Temporary Diversion Road comprises

- An interceptor ditch on the north side of the Temporary Diversion Road to divert the green-field run-off from adjacent land falling towards the proposed alignment. The interceptor drains grades from east to west and outfalls into the existing open ditch at ca. Chainage 30 m, which is in segment A-3 of Figure 5, and subsequently drains west to the stone arch culvert.

- Filters drain on both sides of the carriageway, with both filter drains grades from east to west. Manholes are placed at intervals of 100 m, and/or at intercepts with drainage connections / crossing points / starting points.
- The south filter drain crosses over via a culvert (300 mm dia.) to the north filter drain at Chainage 80 m; and
- The north filter drain continues further west, joining with the filter drain for the R179 prior to outfall at a headwall to the existing open ditch at Chainage 0 m, which is in segment A-3 of Figure 5, and subsequently drains west to the stone arch culvert.

There is no overall increase in the catchment area for the Temporary Diversion Road contributing to runoff for the existing stone arch culvert. There is a net increase in the storage capacity of the overall drainage networks via the capacities of the pipes, even when accounting for the loss of volume storage available in the sections of existing field drains being removed by the Temporary Diversion Road. The area use will change, from field to surfaced road, so water runoff over the same area will be conveyed to the culvert quicker, however this is mitigated with the additional storage within the pipes, chambers, and filter material.

The pre earthworks drainage will be very similar to the existing scenario, so blockage risk will remain the same for field drainage. However, the stone arch culvert has recently been cleaned and connected to a piped drainage system and has shown to be alleviating the prior flooding and back-ups in the drainage system locally, thus providing an increased capacity for the system.

The road drainage will be provided by filter drains, such that surface water runoff filters through void spaces in the filter material and thus any material at risk of contributing to blockage risk would remain at the verge surface level. Overall there will be a net reduction in risk of silt contributing to the existing culvert and causing a blockage.

The section of road between the existing stone arch culvert and the outfall of the Temporary Diversion Road (roughly 85 m) will remain as existing and will have the same blockage risk as it does have currently.

There will be a net decrease during the tunnelling works as existing sections of the R179 are removed and drained separately with the development works.

Sensitivity checks have been conducted for the Temporary Diversion Road and the reinstated R179 for the 100yr + 20% and the 100yr + 40% storm events and are provided in Appendix E. As there is no net increase in the contributing area being drained, this will provide an indication of the flood risk for the area once the Temporary Diversion Road is removed.

5.9 Landscaping

No significant landscaping works are proposed for the Temporary Diversion Road.

Landscaping notes are provided on Drawing -0008 which state that embankment slopes and verges will be topsoiled (200 mm depth) and sown with a seed mix of 70% wildflower and 30% grass.

5.10 Fencing, Lighting, Signage and Road Markings

Fencing

Temporary passively safe fencing (Timber Post and Tensioned Mesh Fence) installed alongside carriageway with 3 m maintenance strip provided for each side. Fencing also to be installed to protect the slope down to the excavation area for the Tunnel. Refer to Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00001.

Permanent site boundary security fencing (Cranked Concrete Post and Mesh) will be installed for the Knocknacran West Pit, as per the Knocknacran Pit. Refer to Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00010.

Lighting

No lighting is proposed for the alignment.

Vehicle Restraint System

N2 VRS safety barriers, in accordance with DN-REQ-03034 (formerly NRA TD 19) and IS EN 1317, installed for an overall distance of 125 m on the south side of the Temporary Diversion Road to protect vehicles from the slope down to excavation area for the Tunnel (this excavation and slope are discussed in Section 6.0 below). The safety barrier will be located within the verge at the top of the embankment. The setback is reduced to 0.6 m to accommodate W4 working width within 2 m verge.

See Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00001 and Appendix B (VRS Risk Assessment).

Signage and Road Markings

Solid white line to be used in the centre and yellow dashed markings at edges of carriageway. Studs used accordingly, as per TSM Tab.7.6. Warning signs and double-sided single chevrons provided for curved alignment. See Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00009.

5.11 Road Safety Audit

A Stage 1 Road Safety Audit (RSA) and a Stage 2 RSA have been prepared for the Temporary Diversion Road, in accordance with TII GE-STY-01024, December 2017, and is provided in Appendix D.

Three issues were identified in the Stage 1 RSA and two issues were identified in the Stage 2 RSA relating to the Temporary Diversion Road.

The responses of the design team to the Stage 1 and Stage 2 Safety Audit Forms – Feedback on Audit Reports are also provided in Appendix D.

5.12 Closure and Removal

Subsequent to the completion of the Cut-and-Cover Tunnel and the commissioning of the reinstated R179, the Temporary Diversion Road shall be closed, and the footprint and watercourses remediated to their prior condition.

The infrastructure, bituminous materials, geosynthetics, pipes etc. shall be removed and disposed of / recycled in accordance with the RWMP for the proposed Development (see response to RFI.4d). The inert material shall be removed and stockpiled for re-use in the works, in accordance with the RWMP.

The watercourses and drainage systems shall be restored to their former routes and the connections to the existing R179 drainage system removed. The pavement tie-in locations for the Temporary Diversion Road shall be reinstated, refer to Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00010.

6.0 CUT-AND-COVER TUNNEL

The structure is located at the desired point for providing connecting access under the R179 between the existing Knocknacran Open-Cast Mine and the proposed Knocknacran West Open-Cast Mine. The overall objective is the reinstatement of the R179 alignment corresponding to the current alignment and geometry along with the provision of requisite safety measures associated with a cut-and-cover tunnel.

The design and alignment of the Cut-and Cover Tunnel has been developed in regard to the project requirements for transportation of materials by a combination of haulage truck and covered conveyor, the constraints of the R179 and the existing Knocknacran Open-Pit, and in accordance with the Transport Infrastructure Ireland (TTI) design standards, namely:

- Analytic Pavement and Foundation Design, DN-PAV-03021, August 2022.
- Cross Sections and Headroom, DN-GEO-03036, May 2019.
- Design for Durability, DN-STR-03012, October 2016
- Drainage – Chamber Types, CC-SCD-00501, March 2015.
- Drainage – Typical Chamber Details, CC-SCD-00514, March 2015.
- Drainage – Filter Drains Trench and Bedding Details, CC-SCD-00520, March 2015.
- Drainage Systems for National Roads, DN-DNG-03022, June 2015.
- EIRSPAN Bridge Management System Principal Inspection Manual, AM-STR-06054, September 2022
- EIRSPAN Bridge Management System Principal Maintenance Manual, AM-STR-06055, September 2022
- Fencing – Cranked Concrete Post and Mesh, CC-SCD-00318, January 2007.
- Inspection and Repair of Concrete Road Structures, AM-STR-06005, June 2014
- Management of Buried Concrete Box Structures, AM-STR-06020, June 2014
- Rural Road Link Design, DN-GEO-03031, April 2017.
- Road Safety Audit, GE-STY-01024, December 2017.
- Special Structures – Access Underpass, CC-SCD-02501, June 2014
- Special Structures – Access Underpass, CC-SCD-02502, June 2014
- Specification for Road Works Series 200 – Site Clearance, CC-SPW-00200, December 2010.
- Specification for Road Works Series 300 – Fencing and Environmental Noise Barriers, CC-SPW-00300, August 2018.
- Specification for Road Restraint Systems (Vehicle and Pedestrian) Series 400, CC-SPW-00400, June 2020.
- Specification for Road Works Series 500 – Drainage and Service Ducts, CC-SPW-00500, March 2015.
- Specification for Road Works Series 600 – Earthworks, CC-SWP-00600, March 2013.
- Specification for Road Works Series 700 – Road Pavements – General, CC-SWP-00700, January 2016.
- Specification for Road Works Series 1200 – Traffic Signs and Road Markings, CC-SPW-1200, January 2019.
- Specification for Road Works Series 2500 – Special Structures, CC-SPW-2500, July 2021.

- Specification for Road Works Series 2600 – Miscellaneous, CC-SPW-2600, December 2010.
- Standard Construction Details – Series 600, CC-SCD-00601 to CC-SCD00610, April 2017.
- Structural Review and Assessment of Road Structures, AM-STR-06042, June 2014
- The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges, DN-REQ-03034, May 2019.
- The Assessment of Road Bridges and Structures, AM-STR-06002, June 2014
- The Assessment of Bridge Substructures and Foundations, Retaining Walls and Buried Structures, AM-STR-06015, June 2014
- The Design of Buried Concrete Box and Portal Frame Structures, AM-STR-06029, June 2014

The design drawings for the Cut-and-Cover Tunnel are provided in Appendix A (KNCN-WSP-HAW-SW-GN-Z-CH-00001 and -00008) and the structural design for the precast concrete tunnel segments is provided in Appendix C.

The design of the reinstated R179 is provided on Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00010 in Appendix A.

6.1 Constraints

The existing R179 has a design speed of 80 kph for the segment separating Knocknacran West from the existing Knocknacran Open-Cast and has a centre-line elevation of 49.1 mOD at the location of the proposed Cut-and-Cover Tunnel and is on an approx. 2.0% gradient from south-west to north-east. Figure 8 below shows a cross-section of the R179 at the location of the proposed Cut-and-Cover Tunnel, viewed from south-west to north-east.

Figure 8: R179 Cross-Section (North to South) at location of proposed Cut-and-Cover Tunnel

The existing Knocknacran Open-Cast is located to the south of the location of the proposed Cut-and-Cover Tunnel. This area of the Open-Cast has been restored and the 1(V):3(H) battered landscaped slopes are offset approx. 50 m from the south verge of the R179 at a crest elevation of approx. 47.0 mOD. A working platform is proposed to be constructed at the south side of the Cut-and-Cover Tunnel at an elevation of 40.38 mOD.

The Temporary Diversion Road will be constructed to the north of the location of the proposed Cut-and-Cover Tunnel. The south verge of the Temporary Diversion Road is at an elevation of 49.71 m and is offset approx. 63 m from the north verge of the R179, as the intersection of centrelines of the Temporary Diversion Road the Cut-and-Cover Tunnel. The Temporary Diversion Road will be operational for the construction and commissioning period of the Cut-and-Cover Tunnel.

The proposed Knocknacran West Open-Cast will be excavated following the commissioning of the Cut-and-Cover Tunnel and the Temporary Diversion Road will be redundant. A working platform is proposed to be constructed at the north side of the Cut-and-Cover Tunnel at an elevation of 40.5 mOD. A slope is required to be excavated from a defined offset from the verge of the Temporary Diversion Road to the working platform.

6.2 Geometry

Excavation for Tunnel Construction

The installation of the precast concrete tunnel segments for the Cut-and-Cover Tunnel will require a significant excavation along the alignment of the R179 (south-west to north-east), measuring approx. 65 m at the road elevation and approx. 24 m at the tunnel base elevation. Similarly, a significant excavation is required perpendicular to the alignment of the R179 (south-east to north-west), extending from the crest of the 1(V):3(H) battered landscaped slopes of the Knocknacran Open-Cast to the Temporary Diversion Road, a distance of approx. 105 m.

The base elevation of the excavation is proposed to be approx. 40.25 mOD. A slope shall be excavated at a minimum grade of 1(V):2.5(H) from the working platform at the north side of the tunnel to a minimum off-set of 4.3 m from the south verge of the Temporary Diversion Road. Drawings KNCN-WSP-HAW-SW-GN-Z-CH-00001 and -00008 show the plan and sections of the proposed excavation.

Cut-and-Cover Tunnel

The proposed structure will comprise of 2 no. buried precast reinforced concrete UAN box tunnels, installed perpendicular to the R179 and parallel to each other. The tunnel segments have internal dimensions measuring 5 m high x 7 m wide (Type L precast units) and 5 m high x 5 m wide (Type S precast units), with the narrower Type S units installed for the eastern tunnel. 18 No. of each precast units are proposed, each measuring 1.99 m, providing a total tunnel length of 35.915 m.

The tunnel shall be constructed to an internal base elevation of 40.5 mOD on the north side and 40.38 mOD on the south side, allowing a gradient of 0.33% to the south. The top of the UAN segments is proposed to have a minimum of 3 m depth of fill to the crest of the restored R179 carriageway. Reinforced concrete headbeams, measuring approx. 0.8 m high x 0.35 m wide, shall be constructed over the tunnel entrances and wing walls extending out approx. 7 m long x 3 m high shall be constructed parallel to the tunnel entrances.

R179: Horizontal and Vertical Alignments

The horizontal alignment is on a straight over the extent of the structure and the extent of the section of the R179 removed for the construction and will correspond to the current alignment and geometry. The total horizontal alignment is expected to be approx. 65 m.

The vertical alignment of the R179 is on a crest curve as it passes over the structure. The vertical alignment of the section of the R179 removed for the construction will correspond to the current alignment and geometry

Relaxations and Departures

There are no relaxations or departures.

Access along Route

There are no access points along the alignment.

6.3 Carriageway Cross-Section

The carriageway cross-section is designed to match the cross section of the existing R179. This consists of a road carriageway of 7 m (3.5 m lanes), with hard strips of 1 m and 2 m verges. The carriageway comprises a total width of 13 m and is a Type 2 Single carriageway (CC/SCD/0002).

The carriageway has a 3% transverse slope, draining from the south side of the carriageway to the north side of the carriageway, where a filter drain is located in the maintenance strip.

6.4 Services along Route

There are a number of existing services located along the south side of the R179 that may be impacted by the construction works for the Cut-and-Cover Tunnel, see Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00001, and comprise:

- Magheracloone Group Water Scheme.
- Gas Networks Ireland (GNI) 315mm PE 4 Bar pipeline.
- Overhead Eir line.

Preliminary discussions have been conducted with the service providers and the preference is for temporary diversions of the services during the construction works, with reinstatement along the south side of the road during the backfilling works.

Extensometers installed to monitor the R179 are present adjacent to and within the alignment (see Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00001). These instruments will be adjusted as required by the design and manhole covers installed as needed.

6.5 Site Clearance

The site clearance for the Cut-and-Cover Tunnel comprises two elements:

- **R179 pavement structure** - stripping of bituminous layers, sub-base and capping layers for the extent shown on Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00002.
- **Tunnel entry and exit** for the extent shown on Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00002 - tripping the site of topsoil and subsoil and removal of trees, hedgerows and scrub for the extent shown on Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00002.

The works shall be conducted in accordance with the relevant NRA Guidelines for protection of trees, hedgerows and scrub and crossing of watercourses during the construction of national road schemes.

The material will be handled in accordance with the Resource Waste Management Plan (RWMP) for the proposed Development (see response to RFI.4d)

6.6 Earthworks

Excavation for cut / fill slopes shall be conducted in accordance with the Specification for Road Works Series 600 – Earthworks, CC-SWP-00600, March 2013 and the Standard Construction Details – Series 600, CC-SCD-00601 to CC-SCD00610, April 2017.

Method compaction will be utilized for the preparation of the sub-formation and the capping.

6.7 Structural Design

Cut-and-Cover Tunnel

A site investigation has been conducted along the route of the proposed Temporary Diversion Road and the Cut-and-Cover to establish the ground conditions and geotechnical parameters (Golder-WSP 2022) (Appendix 29b of the RFI document). The formation for the Tunnel will be in the overburden mudstone layer. The design of the Tunnel on a basis of a maximum bearing pressure of 200 kPa (including back fill over the Tunnel and live loads) for the serviceability limit state is proposed. Inspection and testing is recommended to be undertaken on the subgrade to validate during construction.

The structural design for the precast reinforced concrete UAN box tunnel segments is provided in Appendix C and is carried out in accordance with:

- Eurocode 1 ‘Actions on Structures – Part 2: Traffic Loads on Bridges’;
- Eurocode 2 ‘Design of Concrete Structures’;
- PD6694 ‘Recommendations for the design for structures subject to traffic loading’;
- TII - Special Structures – Access Underpass, CC-SCD-02501, June 2014;
- TII - Special Structures – Access Underpass, CC-SCD-02502, June 2014; and
- TII - Specification for Road Works Series 2500 – Special Structures, CC-SPW-2500, July 2021.

The structural elements are designed for Working Life: Category 5 – 120 years design life.

The precast reinforced concrete UAN box tunnel segments will be placed on a minimum 50 mm bedding layer of Class 6L material over a 75 mm blinding concrete layer, over compacted Class 6N2 fill of variable thickness, over graded and compacted suitable subgrade.

The backfill for the R179 restoration and the tunnel segments shall be Class 6N or Class 6P, placed and compacted in appropriate depth layers in accordance with CC-SPW-00600, March 2013.

Details, joints and waterproofing shall be constructed in accordance with the Standard Construction Details – 2500, April 2017 and are described below:

- Joints between precast units will comply with DN-STR-03012 (formerly BD 57) will consist of:
  - external surfaces shall be provided with a continuous 200 mmm wide strip of membrane bonded with high quality adhesive with compressible back up rod;
  - between units, a continuous hydrophilic seal with appropriate dimension shall be provided; and
  - internal surfaces shall be provided with a continuous two-part polysulphide sealant of appropriate dimensions
- A flexible joint will be used between the box structure and the wing walls to allow the walls to act independently.
- Two coats of epoxy resin waterproof paint will be applied to all buried concrete surfaces in accordance with DN-STR-03012 (formerly BD 57). Epoxy resin waterproof paint will not be applied to areas that are to be treated with spray applied waterproofing. The waterproofing to the roof slab will be protected by a nominally reinforced concrete screed of minimum thickness 75 mm. Hydrophobic pore liner to be applied to all exposed concrete surfaces.
- Joints and waterproofing systems designed for Working Life: Category 2 - 50 years design working life.

Materials and Finishes

- Road Surfacing: unit weight (γ) = 23 kN/m^3
- Class 6N / 6P backfill unit weight (γ) = 20 kN/m^3, φ = 35° to 50°
- Class 6N2 upfill: unit weight (γ) = 20 kN/m^3, φ = > 40°
- Reinforcing Steel: Grade B500B
- Stainless Steel Reinforcement: Type 1.4301 to IS EN 10088
- Concrete: unit weight (γ) = 24 kN/m^3 (unreinforced) + 1 kN/m^3 (reinforced) + 1 kN/m^3 (wet)

Details: Concrete Grade, Exposure and Cover for Durability			
Concrete Element	**Min. Concrete Grade (IS EN 206-1 & DN-STR-03012)**	**Exposure Classes**	**Cover ($c_{min,dur}$) as per DN-STR-03012**
PRECAST UAN – exposed face (horizontal)	C40/50	XC3, XC4	30mm
PRECAST UAN – exposed face (vertical)	C40/50	XC3, XC4	30mm
PRECAST UAN – buried face (horizontal - roof)	C40/50	XC2, XD2, XA1	50mm
PRECAST UAN – buried face (horizontal - base)	C40/50	XC2, XA1	30mm
PRECAST UAN – buried face (vertical - walls)	C40/50	XC2, XA1	30mm
Headbeams (exposed face)	C40/50	XC4, XD1, XF2	40mm
Headbeams (buried face)	C40/50	XC2, XD2, XA1	50mm
Wingwall (exposed face)	C40/50	XC4, XD1, XF2	40mm
Wingwall (buried face)	C40/50	XC2, XD2, XA1	50mm

Details: Concrete Finishes	
Concrete Element	**Concrete Finish**
Buried Unformed Surfaces	U1
Exposed Unformed Surfaces (excluding areas to be waterproofed)	U3
Buried Formed Surfaces	F1
Precast Elements	F4
Area of Deck to be Waterproofed	U4

R179

The design of the pavement on a basis of a minimum subgrade C.B.R. of 4% is proposed. Inspection and testing is recommended to be undertaken on the subgrade to validate during the construction.

The pavement design is Pavement Type A – 200 mm fully flexible, in accordance with Chapter 4 of DN-PAV-03021, August 2022, and comprises:

- 40mm HRA 35/14 F SURF 40/60 DES SURFACE COURSE ;
- 60mm AC 20 DENSE BIN 40/60 DES BINDER COURSE;
- 100mm AC32 DENSE BASE 40/60 DES BASE COURSE ;
- 150mm CLAUSE 804 TYPE B SUBBASE; and
- Min. 300mm CAPPING comprising CLASS 6F1 or CLASS 6F2, in accordance with DN-PAV-03021.

6.8 Drainage

6.8.1 Existing Drainage

Filter drains are present on the north and south verges of the R179.

As described in Section 5.0, the local drainage flow paths for the footprint of the works are to the south-west.

6.8.2 Proposed Drainage

The filter drains will be removed on the north and south sides of the R179 for the extent of the excavation required for the Cut-and-Cover works. Drainage from the R179 will be managed by the surface water management system for the Cut-and-Cover works for the construction duration.

The proposed development has no impact on the drainage for the current or reinstated alignment for the R179. No change to the current drainage system is proposed and the filter drains will be reinstated with the R179 pavement.

A permeable drainage layer will be provided for the full height, behind the precast reinforced concrete UAN box tunnel segments and behind the reinforced concrete wingwalls in accordance with DN-STR-03012 (formerly BD 57) and in accordance with Specification for Works in TII Publications. The permeable drainage layers shall have a 150 mm perforated uPVC pipe filter drain set in porous, no fines, concrete along the base.

The deck of the precast reinforced concrete UAN box tunnel segments shall have a minimum 75 mm depth of blinding concrete protection to the waterproofing which shall be constructed at a minimum 2.5% camber gradient to the unit edges to allow drained to the permeable drainage layer constructed at the sides.

The base of the precast reinforced concrete UAN box tunnel segments shall have a minimum 100 mm depth of C25/30 concrete with brush finish, reinforced with A142 mesh, constructed above the spray deck waterproofing.

Drainage from the tunnel will be directed to the rock fill working platform on the south side of the R179 and will subsequently discharge into the Knocknacran Open-Pit water management system.

6.9 Landscaping

No significant landscaping works are proposed for the Cut-and-Cover Tunnel.

Landscaping notes are provided on Drawing -0008 which state that embankment slopes and verges will be topsoiled (200 mm depth) and sown with a seed mix of 70% wildflower and 30% grass.

6.10 Fencing, Lighting, Signage and Road Markings

Fencing

Permanent site boundary security fencing (Cranked Concrete Post and Mesh) will be installed for the Knocknacran West Pit, as per the Knocknacran Pit (segment to be reinstated). Refer to Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00010.

Vehicle Restraint System

N2 VRS safety barriers, in accordance with DN-REQ-03034 (formerly NRA TD 19) and IS EN 1317, installed for an overall distance 20 m on either side of the R179, centred on the tunnel structure, to protect vehicles from the embankments at either side of the tunnel structure. The safety barrier will be located within the verges at the top of the embankments.

The safety barrier will be located within the verge at the top of the embankment. The setback is reduced to 0.6 m to accommodate W4 working width within 2 m verge.

See Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00001 and Appendix B (VRS Risk Assessment).

Lighting

No lighting is proposed for the alignment.

Signage and Road Markings

Solid white line to be used in the centre and yellow dashed markings at edges of carriageway. Studs used accordingly, as per TSM Tab.7.6. Warning signs and double-sided single chevrons provided for curved alignment. See Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00009.

6.11 Inspection and Maintenance

The proposed structure is of reinforced concrete box construction and therefore has no movement joints or deck bearings. Following construction it is proposed that the Cut-and-Cover Tunnel be inspected, maintained and managed by SGMI in accordance with the EIRSPAN Bridge Management Scheme for the life of mine (30 to 40 years), or as agreed with the relevant authority.

The structure is designated as Category 2 and the works will be checked as per the guidelines of Section 3.4 of DN-STR-03001.

6.12 Road Safety Audits

A Stage 1 Road Safety Audit (RSA) and a Stage 2 RSA have been prepared for the Temporary Diversion Road, in accordance with TII GE-STY-01024, December 2017, and is provided in Appendix D.

No issues were identified in the Stage 1 RSA or the Stage 2 RSA relating to the permanent works i.e. reinstatement of the R179 over the Cut-and-Cover Tunnel.

The responses of the design team to the Stage 1 and Stage 2 Safety Audit Forms – Feedback on Audit Reports are also provided in Appendix D.

6.13 Closure

The design life of the Cut-and-Cover Tunnel is 120 years. It is proposed that the Cut-and-Cover Tunnel be inspected, maintained and managed by SGMI in accordance with the EIRSPAN Bridge Management Scheme for the life of mine (30 to 40 years), or as agreed with the relevant authority. Following the end of life of mine it is proposed that the Tunnel be sealed at either end, and backfilled with concrete, in accordance with the specification listed in Table 1, or as agreed with the relevant authority, to ensure the long-term stability of the structure, and that the responsibility for the structure be then transferred to the relevant authority (TII or MCC).

Table 1: Concrete Specification for backfilling of Cut-and-Cover Tunnel

Parameter	Requirement
Cement Type	CEM1 to be determined by concrete supplier
Maximum Water/Cement Ratio	0.45
Maximum Cement Content	410 kg/m^3
Exposure Class	XD1
Design Chemical Class	DC-1
Concrete Strength Class	C40/50 (Cylinder Strength - MPa /Cube Strength - MPa)
Aggregate	max 20 mm
Admixtures	To be determined by cement supplier/contractor
Slump Class	To be determined by cement supplier/contractor

The entry / exit points for the Tunnel on the north and south sides of the R179 will be reinstated to their original ground elevations, in accordance with the closure plans for the Knocknacran and the Knocknacran West Open-Cast Mines.

The VRS infrastructure can then be removed and disposed of / recycled in accordance with the RWMP for the proposed Development (see response to RFI.4d).

The mine workings beneath the R179 are proposed to be backfilled by SGMI following the removal of the Lower Seam Gypsum in the base of the Knocknacran West Open-Cast Mine. The proposed methodology is described in Appendix G.

7.0 WORKS SEQUENCING AND METHODOLOGY

7.1 Construction Timeline

To facilitate the construction of the Cut-and-Cover Tunnel under the R179, a temporary realignment of the R179 (Temporary Diversion Road) during the Tunnel construction period to allow the R179 to remain in constant use.

The construction of the Temporary Diversion Road is expected to take 4 to 6 months.

The construction of the Cut-and-Cover Tunnel and the reinstatement of the R179 is expected to take 3 to 6 months.

The total construction project duration for these two elements is estimated to be 7 to 12 months.

Subsequently, the development of the Knocknacran West Open-Cast Mine and the ancillary works for the Knocknacran Open-Cast and Plant will commence.

7.2 Temporary Diversion Road Methodology

SGMI will coordinate the preparation of the following documents in advance of the construction works:

- Final Design Report for approval by MCC.
- Tender Package (Specification, Drawings and Bill of Quantities) for distribution to select Contractors.
- Design Stage Safety and Health Plan.
- Draft Construction Environmental Management Plan (CEMP).

The Main Contractor selected following the SGMI tender process will then prepare the following documents for review by SGMI and the Design and Project Management Teams:

- Construction Methodology and Programme of Works.
- Risk Assessment / Method Statement (RAMS) for the Works.
- Construction Stage Safety and Health Plan.
- Traffic Management Plan.

The traffic for the construction of the Temporary Diversion Road has been assessed in PMCE 2022 (refer to RFI Response - Appendix RFI 1) and it is envisaged that the Main Contractor will establish a site compound at the location of the former Magheracloone GAA Club buildings.

This location was previously utilized as a Contractor Compound during the remediation of the Magheracloone GAA Grounds following the disturbance event (Golder 2020B) and is accessed via the former entrance to the Magheracloone GAA Grounds on the north side of the R179.

Figure 9 below shows the proposed location for the Contractor Compound.

The methodology for site stripping, earthworks and construction of the Temporary Diversion Road are detailed in Section 5.0.

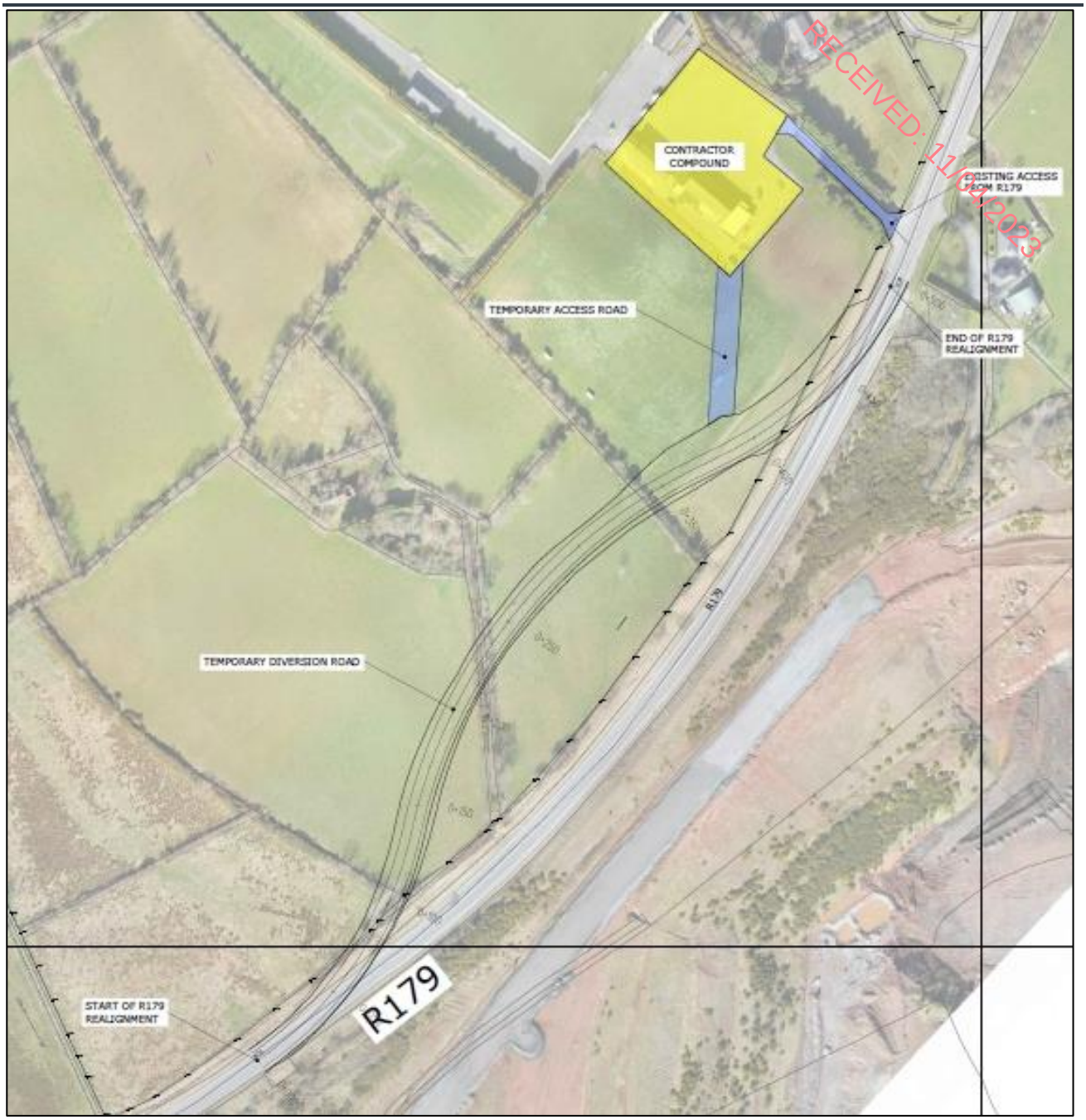


Figure 9: Construction Compound and Site Access for Temporary Diversion Road

7.3 Cut-and-Cover Tunnel Methodology

SGMI will coordinate the preparation of the following documents in advance of the construction works:

- Final Design Report for approval by MCC.
- Tender Package (Specification, Drawings and Bill of Quantities) for distribution to select Contractors.
- Design Stage Safety and Health Plan.
- Draft Construction Environnemental Management Plan (CEMP).

The Main Contractor selected following the SGMI tender process will then prepare the following documents for review by SGMI and the Design and Project Management Teams:

- Construction Methodology and Programme of Works.
- Risk Assessment / Method Statement (RAMS) for the Works.
- Construction Stage Safety and Health Plan.
- Traffic Management Plan.

The traffic for the construction of the Cut-and-Cover Tunnel has been assessed in PMCE 2022 (refer to RFI response Appendix RFI 1) and it is envisaged that the Main Contractor will establish site compounds on the R179 for ca. 100 m either side of the excavation (north compound and site compound), which will be accessed from either end of the Temporary Diversion Road. Traffic management barriers / gates will be installed at the entry points from the R179.

Figure 10 below shows the proposed locations for the Contractor Compounds. The methodology for site stripping, earthworks and construction of the Cut-and-Cover Tunnel are detailed in Section 6.0.

Figure 10: Construction Compound and Site Access for Cut-and-Cover Tunnel

There are a number of existing services located along the south side of the R179 that may be impacted by the construction works for the Cut-and-Cover Tunnel. These included:

- Magheracloone Group Water Scheme (south side of R179).
- Gas Networks Ireland (GNI) 315mm PE 4 Bar pipeline (south side of R179).
- Overhead Eir line (south side of R179).
- Extensometers to monitor road movement (north side of R179).

Preliminary discussions have been conducted with the service providers and the preference is for temporary diversions of the services during the construction works, with reinstatement along the south side of the road during the backfilling works.

Further discussions will be arranged to finalize the diversion arrangements following the planning decision and the agreed methodology and timelines will be included in the tender package for the Contractors.

The Main Contractor will manage and coordinate the diversion and reinstatement of these services as part of the contract works.

8.0 REFERENCES

Golder 2020A, Saint-Gobain Construction Products (Ireland) Limited, Drainage Assessment and Maintenance Plan, Knocknacran East and Knocknacran West Townlands, Golder Associates Ireland Ltd, 19120130.R07.A0, December 2020

Golder 2020B, Saint-Gobain Construction Products (Ireland) Limited Remediation of Disturbance Zone, Magheracloone GAA Grounds, CQA Validation Report, Golder Associates Ireland Ltd, 19120130.R07.A0, July 2020

Golder-WSP 2022, Saint-Gobain Mining (Ireland) Limited, Geotechnical Interpretative Report, Temporary Diversion Road and Tunnel, Golder-WSP Ireland Consulting Ltd, 41000019.R02.A0, October 2022

PMCE 2022, Knocknacran West Open-Cast Mine and Community Centre Complex, Traffic and Transport Assessment, P21-110-RP-001, Rev 8.0, September 2002

TII Publications, Transport Infrastructure Ireland Publications (Standards) System, Website (www.tiipublications.ie)

Signature Page

Golder-WSP Ireland Consulting Ltd

Billy Murphy
Principal, Geotechnical Engineer

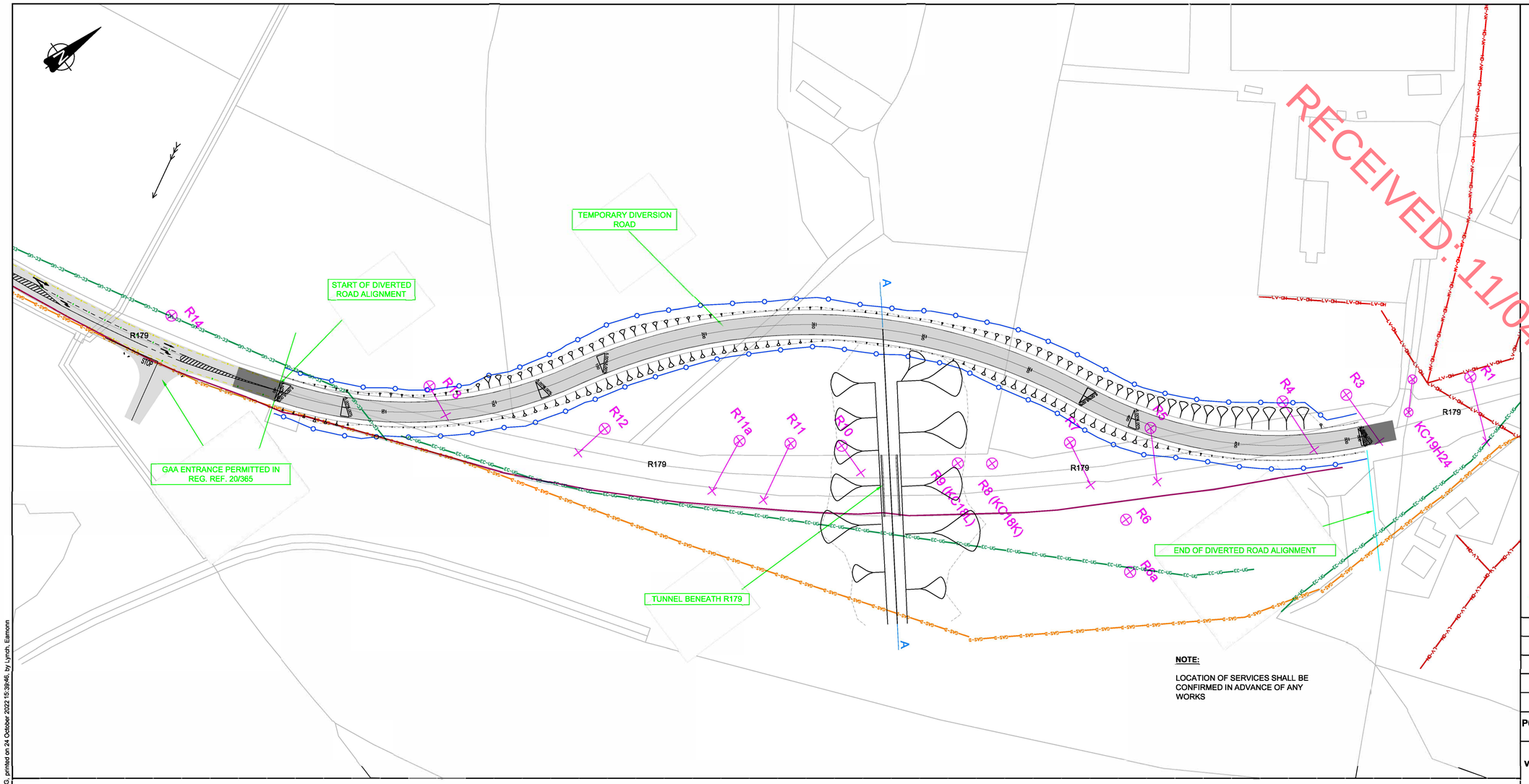
Brian Keenan
Associate Director, Geotechnical Engineer

BM/BK/ld

Registered in Ireland
Registration No.302231
At Trinity House, Charleston Road, Ranelagh, Dublin 6 D06C8X4, Ireland
VAT No. 6322231R

APPENDIX A

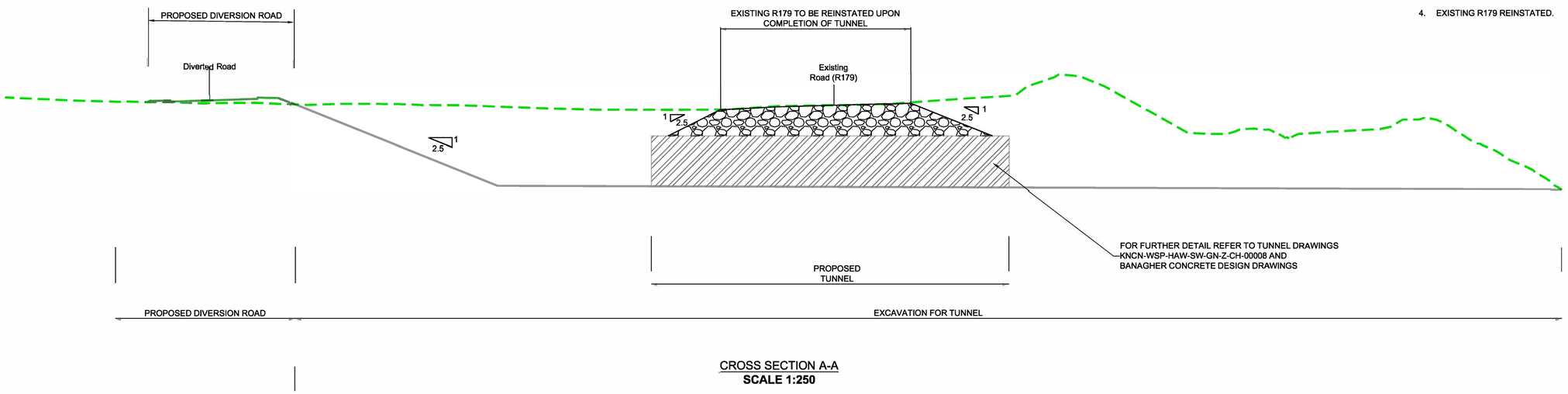
Drawings



RECEIVED: 11/04/2023

NOTE:

LOCATION OF SERVICES SHALL BE CONFIRMED IN ADVANCE OF ANY WORKS



CROSS SECTION A-A
SCALE 1:250

CONSTRUCTION PHASING:

1. DIVERSION ROAD CONSTRUCTED.
2. EXCAVATION FOR TUNNEL.
3. TUNNEL INSTALLED.
4. EXISTING R179 REINSTATED.

NOTES

1. All levels are in metres above ordnance datum.
2. All dimensions are in millimetres unless stated otherwise.
3. The design and alignment of the Temporary Diversion Road has been developed in accordance with the Transport Infrastructure Ireland (TTI) standards.
4. Drawing to be read in conjunction with drawings KNCN-WSP-HAW-SW-GN-Z-CH-00001-00010
5. All thickness dimensions are compacted thickness.

PLAN LEGEND:

- R179 TEMPORARY DIVERSION
- TEMPORARY FENCING
- PAVEMENT TYPE A - 200mm FULLY FLEXIBLE
- PAVEMENT TIE INTO EXISTING ROAD
- GAS
- EIR UNDERGROUND
- MGWS
- ESB OVERHEAD 400V 230V ING
- ESB OVERHEAD 10kV 20kV ING
- R8 (KC18K) EXTENSOMETERS

SECTION LEGEND:

- PROPOSED DIVERTED ROAD
- EXCAVATION WORKS
- PROPOSED TUNNEL
- EXISTING R179 ROAD TO BE REINSTATED
- EARTHWORK SLOPES
- EXISTING GROUND

Ver	Amendment	By	Checked	Approved	Date
P01	PRELIMINARY DESIGN	RJM	EL	BK	24/10/22

DRAWING STATUS: INFORMATION

wsp
Shorefield House, 30 Kinnegar Drive, Holywood, County Down, BT18 9JQ, UK
T+ 44 (0) 28 95953020
wsp.com

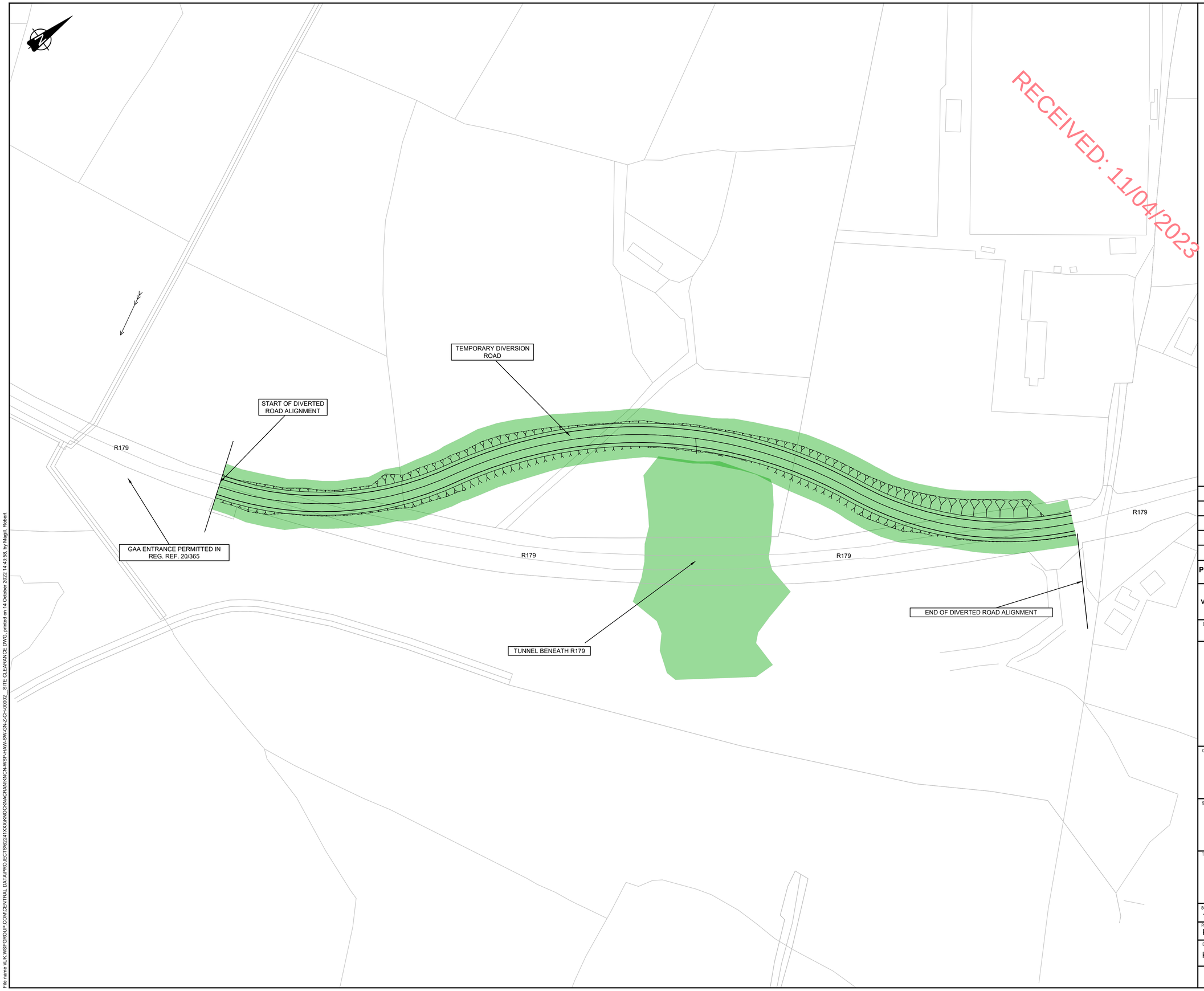
CLIENT: SAINT-GOBAIN MINING (IRELAND) LTD.

SITE/PROJECT: KNOCKNACRAN WEST

TITLE: DIVERSION ROAD AND TUNNEL GENERAL ARRANGEMENT RFI. 20

SCALE @ A1:	SCALE @ A3:	CHECKED:	APPROVED:
1:1,000	1:2,000	EL	BK
PROJECT NO: KNCN	DESIGNED: WSP	DRAWN: RJM	DATE: 24/10/2022

DRAWING No: KNCN-WSP-HAW-SW-GN-Z-CH-00001 REV: 1.0



NOTES

1. All levels are in metres above ordnance datum.
2. All dimensions are in millimetres unless stated otherwise.
3. The design and alignment of the Temporary Diversion Road has been developed in accordance with the Transport Infrastructure Ireland (TTI) standards.
4. Drawing to be read in conjunction with drawings KNCN-WSP-HAW-SW-GN-Z-CH-00001-00009
5. All thickness dimensions are compacted thickness.

PLAN LEGEND:

SITE CLEARANCE

Ver	Amendment	By	Checked	Approved	Date
P01	PRELIMINARY DESIGN	RJM	EL	BK	29/09/22

DRAWING STATUS: INFORMATION

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CLIENT: SAINT-GOBAIN MINING (IRELAND) LTD.

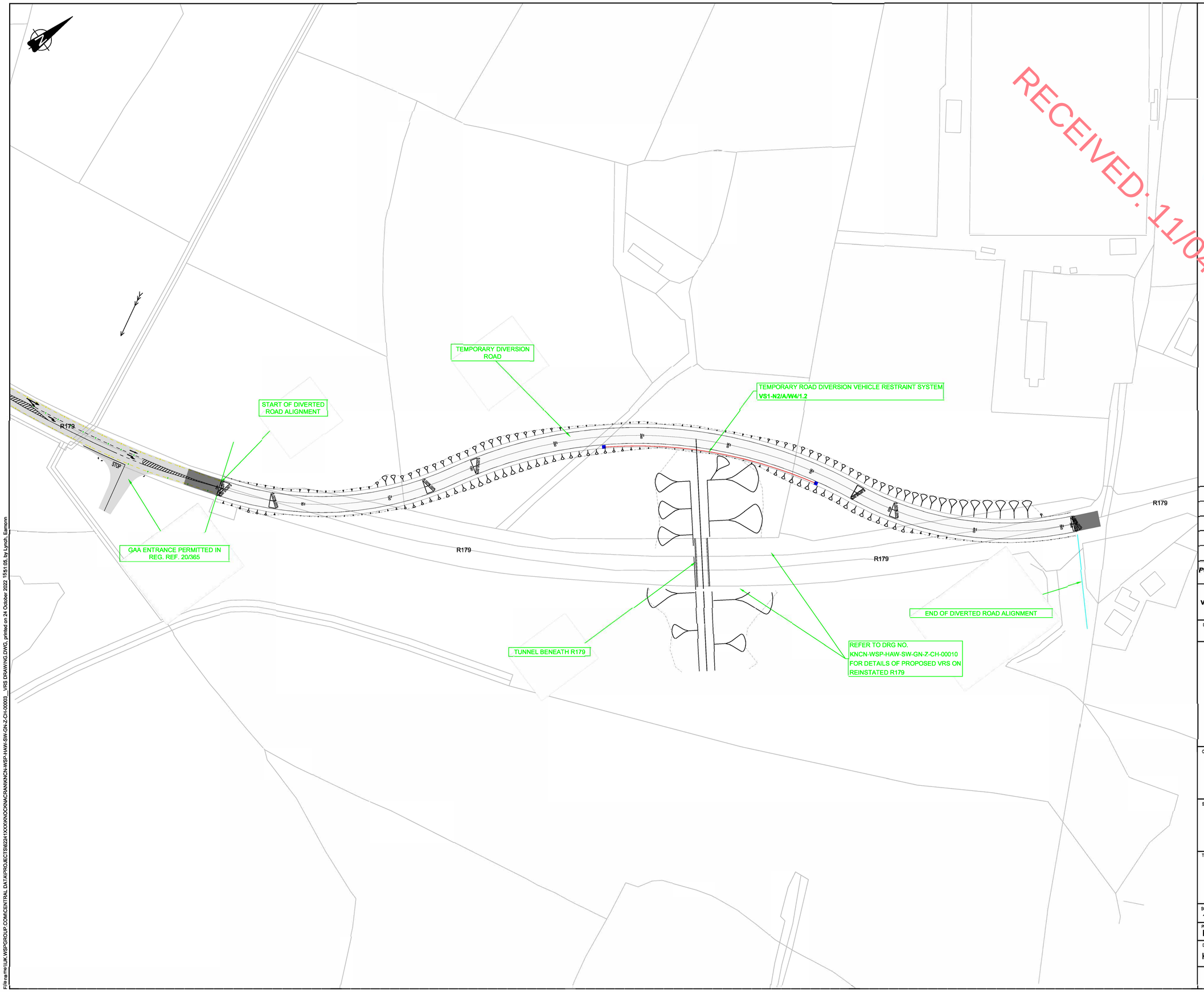
SITE/PROJECT: KNOCKNACRAN WEST

TITLE: DIVERSION ROAD AND TUNNEL SITE CLEARANCE RFI. 20

SCALE @ A1:	SCALE @ A3:	CHECKED:	APPROVED:
1:1,000	1:2,000	EL	BK

PROJECT NO:	DESIGNED:	DRAWN:	DATE:
KNCN	WSP	RJM	29/09/22

DRAWING No: KNCN-WSP-HAW-SW-GN-Z-CH-00002 REV: 1.0



NOTES

1. All levels are in metres above ordnance datum.
2. All dimensions are in millimetres unless stated otherwise.
3. The design and alignment of the Temporary Diversion Road has been developed in accordance with the Transport Infrastructure Ireland (TII) standards.
4. Drawing to be read in conjunction with drawings KNCN-WSP-HAW-SW-GN-Z-CH-00001-00010

PLAN LEGEND:

- R179 TEMPORARY DIVERSION
- N2 VEHICLE RESTRAINT SYSTEM
- T80 TERMINAL
- VS1-N2/A/W4/1.2 — REF-CONTAINMENT / IMPACT SEVERITY / WORKING WIDTH / SETBACK

Ver	Amendment	By	Checked	Approved	Date
P01	PRELIMINARY DESIGN	RJM	EL	BK	24/10/22

DRAWING STATUS: INFORMATION

wsp
Shorefield House, 30 Kinnegar Drive, Holywood, County Down, BT18 9JQ, UK
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wsp.com

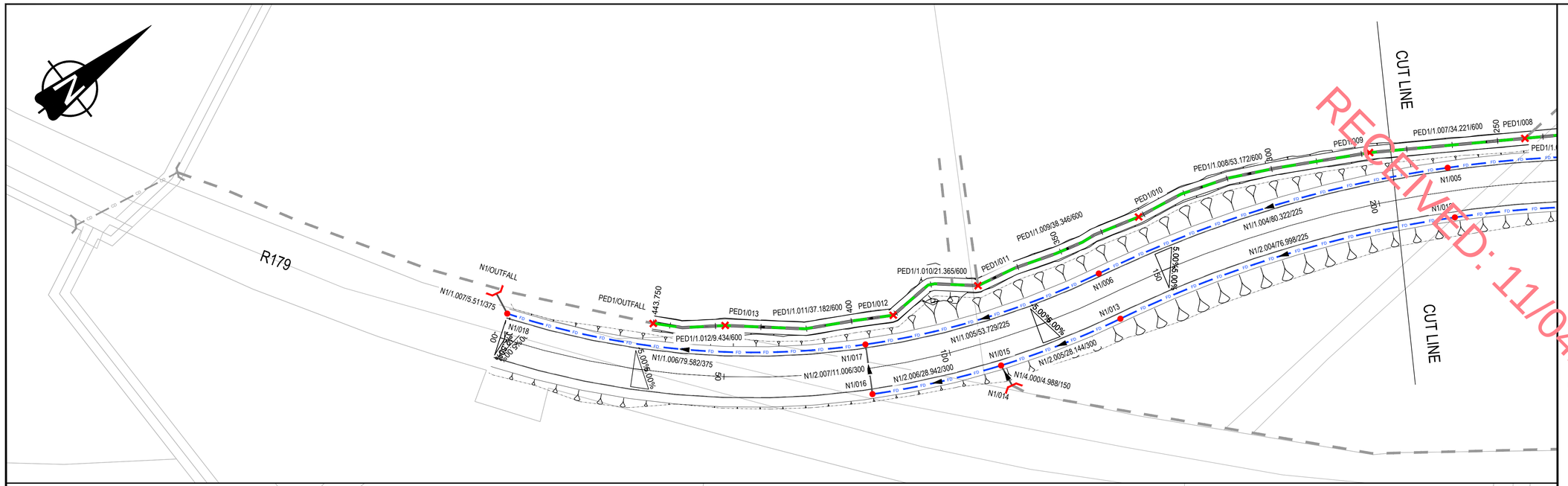
CLIENT: SAINT-GOBAIN MINING (IRELAND) LTD.

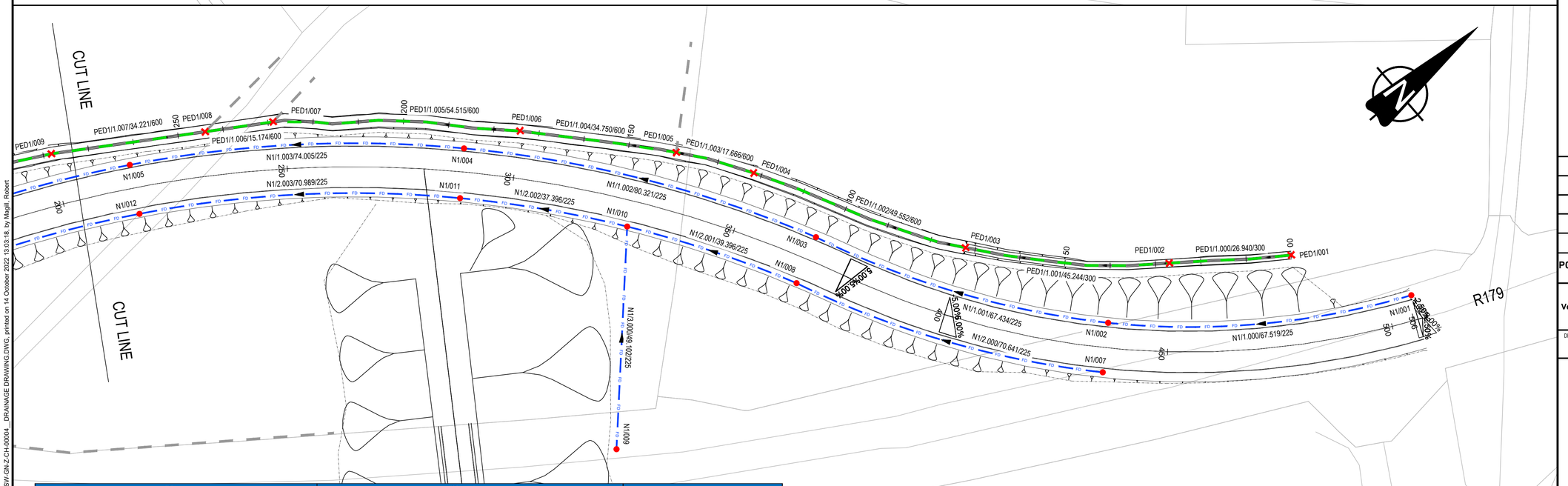
SITE/PROJECT: KNOCKNACRAN WEST

TITLE: DIVERSION ROAD AND TUNNEL VRS LAYOUT RFI. 20

SCALE @ A1:	SCALE @ A3:	CHECKED:		APPROVED:
1:1,000	1:2,000	EL		BK
PROJECT NO: KNCN		DESIGNED: WSP	DRAWN: RJM	DATE: 24/10/2022

DRAWING No: KNCN-WSP-HAW-SW-GN-Z-CH-00003 REV: 1.0





Pipes								Chambers								Comments
Pipe Ref.	Pipe Dia/ Base Width (mm)	Pipe Length (m)	Pipe Type	Trench & Bedding Type	U.S. I.L. (m)	Gradient (1:X)	D.S. I.L. (m)	U.S. Chamber Ref.	U.S. Easting (m)	U.S. Northing (m)	U.S. Chamber C.L. (m)	U.S. Chamber Depth (m)	U.S. Chamber Dia. (mm)	U.S. Chamber Type	D.S. Chamber Ref.	
N1/1.000	225	67.519	FD	H	51.225	199	50.885	N1/001	280954	300077	52.650	1.425	1050	F	N1/002	
N1/1.001	300	67.434	FD	H	50.810	218	50.500	N1/002	280915	300023	52.310	1.500	1050	F	N1/003	
N1/1.002	300	80.321	FD	H	50.500	45	48.720	N1/003	280859	299986	52.300	1.800	1050	F	N1/004	
N1/1.003	300	74.005	FD	H	48.720	20	45.030	N1/004	280793	299940	50.220	1.500	1050	F	N1/005	
N1/1.004	300	80.322	FD	H	45.030	22	41.320	N1/005	280748	299882	46.530	1.500	1050	F	N1/006	
N1/1.005	300	53.729	FD	H	41.320	39	39.950	N1/006	280719	299807	42.820	1.500	1050	F	N1/017	
N1/2.000	150	70.641	FD	H	51.410	77	50.490	N1/007	280922	300015	52.760	1.350	1050	F	N1/008	
N1/2.001	150	39.396	FD	H	50.490	38	49.440	N1/008	280863	299976	51.840	1.350	1050	F	N1/010	
N1/3.000	225	49.102	FD	H	49.575	234	49.365	N1/009	280865	299923	50.400	0.825	1050	F	N1/010	
N1/2.002	225	37.396	FD	H	49.365	37	48.345	N1/010	280830	299956	51.030	1.665	1050	F	N1/011	
N1/2.003	225	70.989	FD	H	48.345	19	44.645	N1/011	280801	299932	49.770	1.425	1050	F	N1/012	
N1/2.004	225	76.998	FD	H	44.645	23	41.315	N1/012	280757	299877	46.070	1.425	1050	F	N1/013	
N1/2.005	300	28.144	FD	H	41.240	69	40.830	N1/013	280730	299805	42.740	1.500	1050	F	N1/015	
N1/4.000	150	4.988	CD	Z	42.550	3	40.980	N1/014	280727	299777	43.300	0.750	-	HW	N1/015	Inlet from existing field drain. For HW detail refer to RCD/500/53.
N1/2.006	300	28.942	FD	H	40.830	66	40.390	N1/015	280722	299778	42.330	1.500	1050	F	N1/016	
N1/2.007	300	11.006	FD	H	40.390	25	39.950	N1/016	280710	299752	41.890	1.500	1050	F	N1/017	
N1/1.006	375	79.582	FD	H	39.875	145	39.325	N1/017	280700	299757	41.450	1.575	1050	F	N1/018	
N1/1.007	375	5.511	CD	Z	39.325	220	39.300	N1/018	280646	299699	40.650	1.325	1050	F	N1/Outfall	
Outfall to existing drain					39.300	-	-	N1/Outfall	280641	299701	40.180	0.880	-	HW	-	Tie in to existing ditch. For HW detail refer to RCD/500/53.

Pipes								Chambers								Comments
Pipe Ref.	Pipe Dia/ Base Width (mm)	Pipe Length (m)	Pipe Type	OC Side Slope (1:X)	U.S. I.L. (m)	Gradient (1:X)	D.S. I.L. (m)	U.S. Chamber Ref.	U.S. Easting (m)	U.S. Northing (m)	U.S. Chamber C.L. (m)	U.S. Chamber Depth (m)	U.S. Chamber Type	D.S. Chamber Ref.		
PED1/1.000	500	26.940	OC	2	55.700	84	55.380	PED1/001	280930	300063	56.000	0.300	OCP	PED1/002		
PED1/1.001	500	45.244	OC	2	55.380	31	53.900	PED1/002	280914	300042	55.680	0.300	OCP	PED1/003		
PED1/1.002	500	49.552	OC	2	53.600	64	52.830	PED1/003	280882	300010	54.200	0.600	OCP	PED1/004		
PED1/1.003	500	17.666	OC	2	52.830	41	52.400	PED1/004	280839	299985	53.430	0.600	OCP	PED1/005		
PED1/1.004	500	34.750	OC	2	52.400	17	50.410	PED1/005	280824	299975	53.000	0.600	OCP	PED1/006	Connection from existing field drain.	
PED1/1.005	500	54.515	OC	2	50.410	27	48.380	PED1/006	280798	299952	51.010	0.600	OCP	PED1/007		
PED1/1.006	500	15.174	OC	2	48.380	11	47.040	PED1/007	280761	299912	48.980	0.600	OCP	PED1/008	Connection from existing field drain.	
PED1/1.007	500	34.221	OC	2	47.040	29	45.860	PED1/008	280753	299899	47.640	0.600	OCP	PED1/009	Connection from existing field drain.	
PED1/1.008	500	53.172	OC	2	45.860	32	44.200	PED1/009	280735	299871	46.460	0.600	OCP	PED1/010		
PED1/1.009	500	38.346	OC	2	44.200	21	42.410	PED1/010	280715	299822	44.800	0.600	OCP	PED1/011		
PED1/1.010	500	21.365	OC	2	42.410	21	41.370	PED1/011	280705	299785	43.010	0.600	OCP	PED1/012	Connection from existing field drain.	
PED1/1.011	500	37.182	OC	2	41.370	58	40.730	PED1/012	280699	299766	41.970	0.600	OCP	PED1/013		
PED1/1.012	500	15.849	OC	2	40.730	36	40.290	PED1/013	280678	299736	41.330	0.600	OCP	PED1/014		
Outfall to existing ditch					40.290	-	-	PED1/014	280668	299723	40.890	0.600	OCP	-	Tie in to existing ditch.	

NOTES

1. All levels are in metres above ordnance datum.
2. All dimensions are in metres unless stated otherwise.
3. The design and alignment of the Temporary Diversion Road has been developed in accordance with the Transport Infrastructure Ireland (TII) standards.
4. Drawing to be read in conjunction with drawings KNCN-WSP-HAW-SW-GN-Z-CH-00001-00009
5. for details of drainage apparatus refer to TII RCD 500 Series. If a proprietary product is proposed, to be confirmed by Designer.
6. All cover levels stated denote the verge level, based on the latest road design available at the time of the design (03/10/2021)
7. Coordinates for chambers are given for setting out purposes only, local adjustments to be made as necessary to suit edge of carriageway details made particular to the relevant road geometry.
8. Pipe lengths are noted as centre of chamber to centre of chamber.
9. Upstream chamber depths are to invert of pipe and for catchpits does not include 300mm sump.

PLAN LEGEND:

- R179 TEMPORARY DIVERSION
- FD — FILTER DRAIN
- CD — CARRIER DRAIN
- GRASSED CHANNEL
- EXISTING FIELD DRAIN
- N01/1.000/225 — NETWORK/ PIPE NUMBER/ PIPE DIAMETER
- N01/01 — NETWORK/ CHAMBER NUMBER
- DRAINAGE CHAMBER
- OPEN CHANNEL POINT (OCP)
- FLOW ARROW
- HEADWALL
- EXISTING PIPE CROSSING

Ver	Amendment	By	Checked	Approved	Date
P01	PRELIMINARY DESIGN	RD	EL	BK	04/10/22

DRAWING STATUS: INFORMATION

Shorefield House, 30 Kinnegar Drive, Holywood, County Down, BT18 9JQ, UK
T+ 44 (0) 28 95953020
wsp.com

CLIENT: SAINT-GOBAIN MINING (IRELAND) LTD.

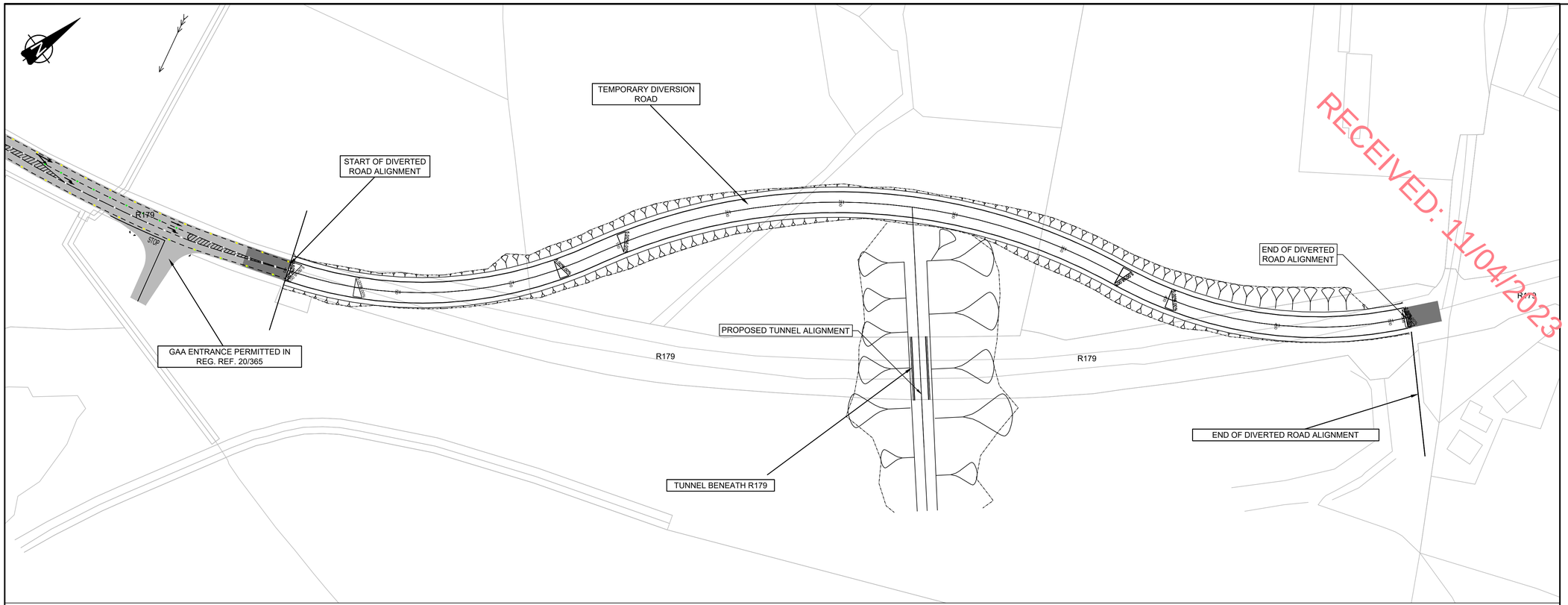
SITE/PROJECT: KNOCKNACRAN WEST

TITLE: DIVERSION ROAD AND TUNNEL DRAINAGE PLAN RFI. 20

SCALE @ A1:	SCALE @ A3:	CHECKED:	APPROVED:
1:250	1:500	EL	BK

PROJECT NO:	DESIGNED:	DRAWN:	DATE:
KNCN	RD	RD	07/10/2022

DRAWING No: KNCN-WSP-HAW-SW-GN-Z-CH-00004 REV: P01



NOTES

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4. Drawing to be read in conjunction with drawings KNCN-WSP-HAW-SW-GN-Z-CH-00001-00009

PLAN LEGEND:

R179 TEMPORARY DIVERSION

PROFILE LEGEND:

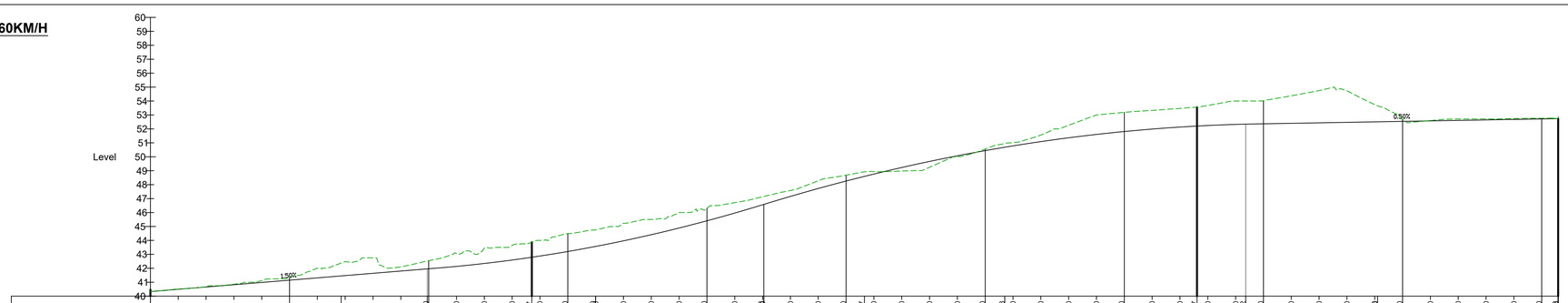
EXISTING GROUND

PROPOSED ROAD PROFILE

RIGHT LANE SUPERELEVATION

LEFT LANE SUPERELEVATION

DESIGN SPEED: 60KM/H



Chainage	0.000	10.000	20.000	30.000	40.000	50.000	60.000	68.638	70.000	80.000	90.000	99.999	110.000	120.000	130.000	137.077	140.000	150.000	159.970	160.000	170.000	180.000	190.000	200.000	210.000	219.453	220.000	230.000	240.000	250.000	255.592	260.000	270.000	280.000	290.000	300.000	307.028	310.000	320.000	330.000	340.000	350.000	376.117	380.000	390.000	393.622	400.000	410.000	420.000	430.000	440.096	450.000	460.000	470.000	480.000	490.000	500.000	505.913
Proposed Levels	40.332	40.615	40.765	40.915	41.065	41.215	41.365	41.463	41.515	41.665	41.815	41.964	42.136	42.345	42.593	42.791	42.879	43.204	43.566	43.569	43.969	44.410	44.889	45.406	45.962	46.517	46.557	47.157	47.724	48.258	48.593	48.760	49.230	49.687	50.071	50.443	50.584	50.762	51.088	51.392	51.604	51.813	52.206	52.323	52.443	52.375	52.425	52.475	52.525	52.595	52.625	52.675	52.725	52.775	52.825	52.875	52.738
Existing Levels	40.331	40.500	40.680	40.856	41.119	41.358	42.000	42.383	42.478	42.750	42.107	42.544	42.544	43.064	43.453	43.647	43.973	44.001	44.469	44.750	45.227	45.505	46.000	46.307	46.710	47.132	47.114	47.580	47.977	48.279	48.921	48.855	48.760	48.976	49.248	50.007	50.554	51.020	51.559	52.260	53.302	53.187	53.329	53.471	53.558	53.684	54.000	54.019	54.375	54.750	54.724	53.644	52.889	52.600	52.711	52.724	52.742	52.761	52.738
Level Difference	0.001	0.115	0.085	0.059	-0.054	-0.143	-0.635	-0.920	-0.963	-1.085	-0.292	-0.437	-0.408	-0.719	-1.060	-1.144	-1.094	-1.203	-1.097	-1.181	-1.257	-1.095	-1.112	-0.900	-0.747	-0.615	-0.557	-0.424	-0.253	-0.421	-0.328	-0.175	0.253	0.419	0.964	-0.436	-0.030	-0.258	-0.470	-0.868	-1.298	-1.375	-1.340	-1.338	-1.354	-1.440	-1.677	-1.657	-1.644	-1.950	-2.275	-2.199	-1.259	-0.064	0.075	0.014	0.051	0.083	0.114	0.002

Horizontal Geometry: R: 180.000 L: 137.077 | R: 255.000 L: 239.041 | R: 180.000 L: 129.796

Vertical Geometry: G =1.500% L =99.506 | R =2594.817 K =25.948 L =120.927 | R =3070.954 K =30.710 L =173.189 | G =0.500% L =112.291

Superelevation: LL -2.5% 0.000 RL -2.5% | LL -2.5% 0.000 -2.5% | LL -5.0% 30.000 RL -5.0% | LL -5.0% 120.000 -5.0% | LL 5.0% 150.000 RL -5.0% | LL 5.0% 150.000 -5.0% | LL 5.0% 376.117 RL -5.0% | LL 5.0% 376.117 5.0% | LL -5.0% 400.000 RL 5.0% | LL -5.0% 400.000 5.0% | LL -2.5% 505.913 RL -2.5% | LL -2.5% 505.913 -2.5%

Ver	Amendment	By	Checked	Approved	Date
P01	PRELIMINARY DESIGN	RJM	EL	BK	29/09/22

DRAWING STATUS: INFORMATION

Shorefield House, 30 Kinnegar Drive, Holywood, County Down, BT18 9JQ, UK
T+ 44 (0) 28 95953020
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CLIENT: SAINT-GOBAIN MINING (IRELAND) LTD.

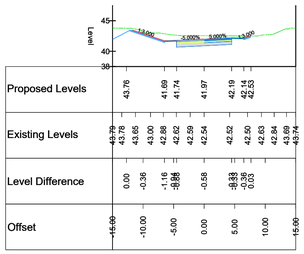
SITE/PROJECT: KNOCKNACRAN WEST

TITLE: DIVERSION ROAD AND TUNNEL PLAN & PROFILE RFI. 20

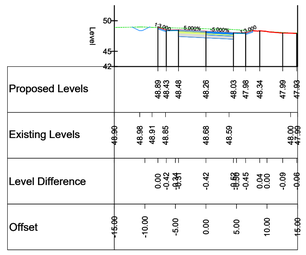
SCALE @ A1:	SCALE @ A3:	CHECKED:	APPROVED:
1:1,000	1:2,000	EL	BK

PROJECT NO:	DESIGNED:	DRAWN:	DATE:
KNCN	WSP	RJM	29/09/22

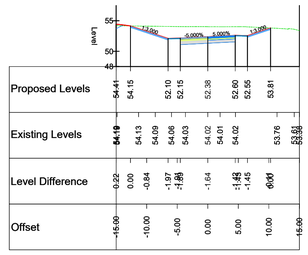
DRAWING No: KNCN-WSP-HAW-SW-GN-Z-CH-00005 REV: 1.0



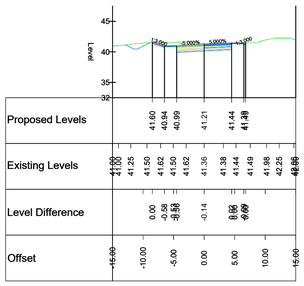
Chainage 100.000



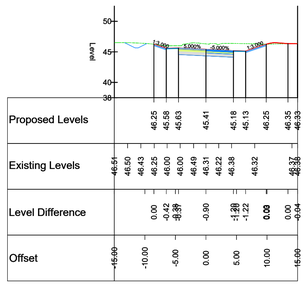
Chainage 250.000



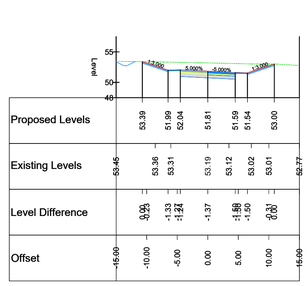
Chainage 400.000



Chainage 50.000



Chainage 200.000



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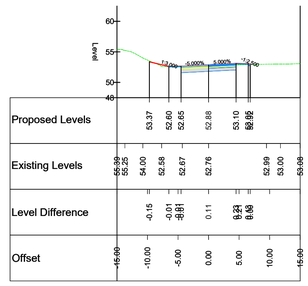

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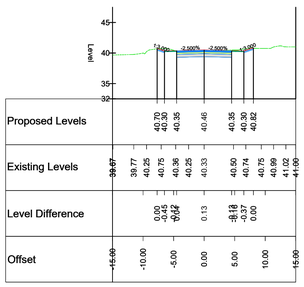
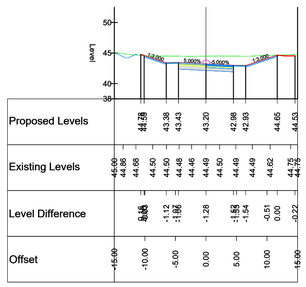
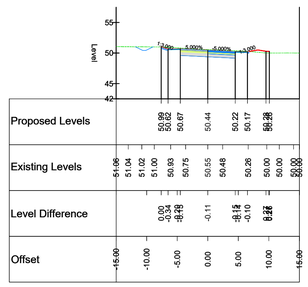


Chainage 0.000



Chainage 150.000



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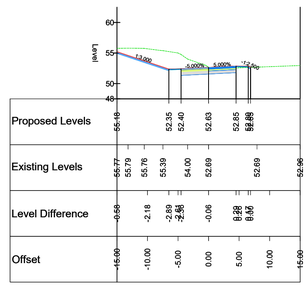


Chainage 450.000

NOTES

1. All levels are in metres above ordnance datum.
2. All dimensions are in metres unless stated otherwise.
3. The design and alignment of the Temporary Diversion Road has been developed in accordance with the Transport Infrastructure Ireland (TTI) standards.
4. Drawing to be read in conjunction with drawings KNCN-WSP-HAW-SW-GN-Z-CH-00001-00009

LEGEND:

EXISTING GROUND LEVEL

PROPOSED GROUND LEVEL

Ver	Amendment	By	Checked	Approved	Date
P01	PRELIMINARY DESIGN	RJM	EL	BK	30/09/22

DRAWING STATUS: INFORMATION

Shorefield House, 30 Kinnegar Drive, Holywood, County Down, BT18 9JQ, UK
T+ 44 (0) 28 95953020
wsp.com

CLIENT: SAINT-GOBAIN MINING (IRELAND) LTD.

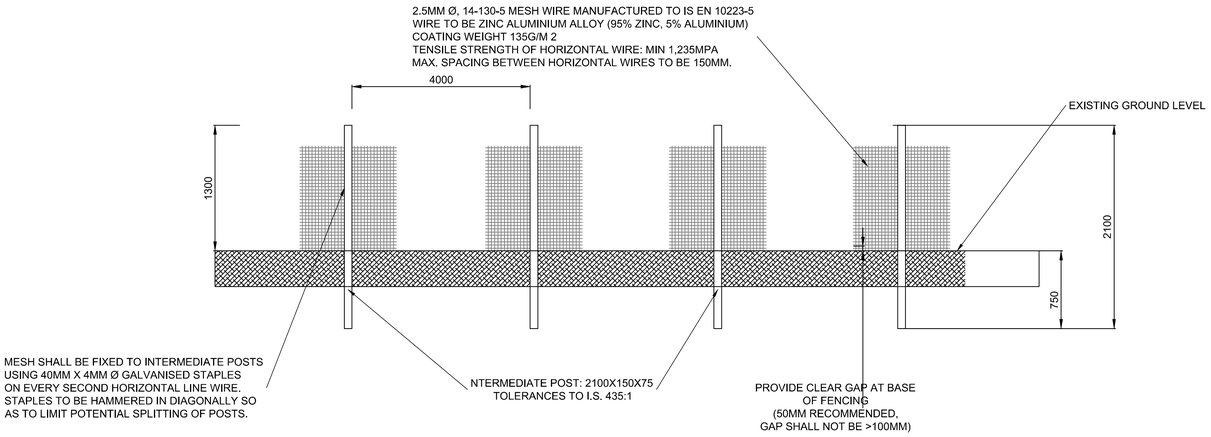
SITE/PROJECT: KNOCKNACRAN WEST

TITLE: DIVERSION ROAD AND TUNNEL CROSS SECTIONS RFI. 20

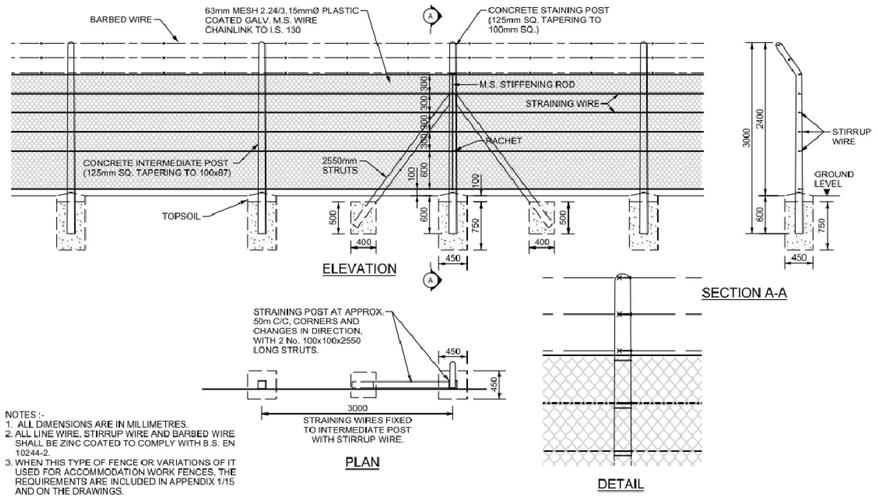
SCALE @ A1:	SCALE @ A3:	CHECKED:	APPROVED:
1:250	1:500	EL	BK

PROJECT NO:	DESIGNED:	DRAWN:	DATE:
KNCN	WSP	RJM	30/09/22

DRAWING No: KNCN-WSP-HAW-SW-GN-Z-CH-00006 REV: 1.0

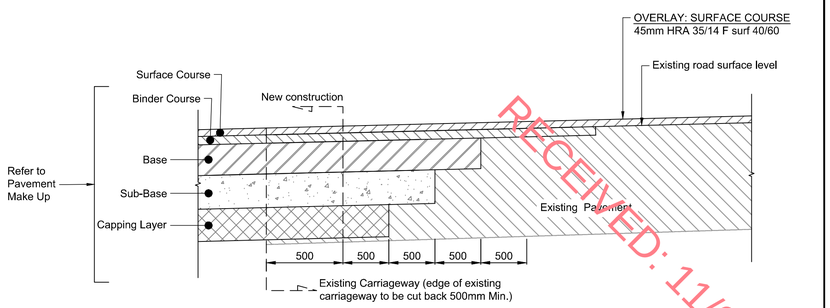


TIMBER POST AND TENSION MESH
NTS

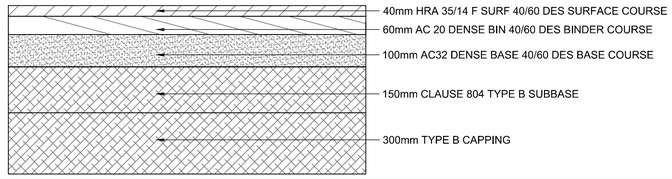


NOTES :-
1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. ALL LINE WIRE, STIRRUP WIRE AND BARBED WIRE SHALL BE ZINC COATED TO COMPLY WITH B.S. EN 10244-2.
3. WHEN THIS TYPE OF FENCE OR VARIATIONS OF IT USED FOR ACCOMMODATION WORK FENCES, THE REQUIREMENTS ARE INCLUDED IN APPENDIX 1/15 AND ON THE DRAWINGS.

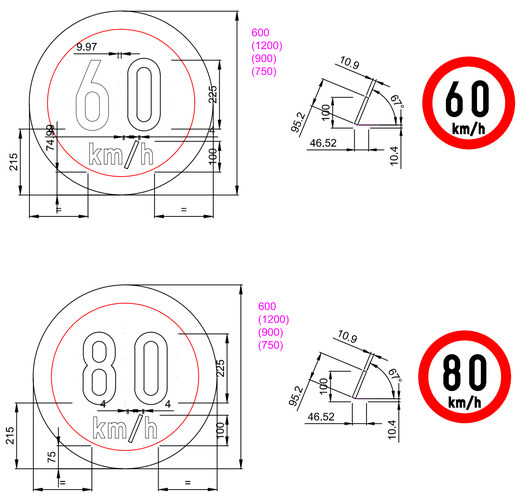
CRANKED CONCRETE POST AND
MESH FENCE
NTS



TRANSVERSE - JOINT BETWEEN NEW & EXISTING CARRIAGEWAY
NTS

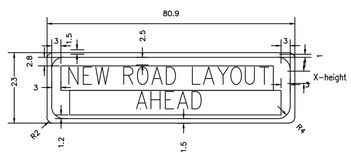


PAVEMENT MAKE UP
NTS



NOTES:
1. All 600mm sign dimensions shall be varied proportionally for the other sign sizes.
2. Centre line, tile marks and dimensions do not form part of the sign.
3. The numeral legend is from the Transport Motorway alphabet, the units from the Transport Heavy alphabet.
4. Tile widths of the km/h units condensed to 80% standard.
5. The tiles for each digit are butted together and offset to the left by 10mm.
6. COLOURS:- Standard
   Border RED
   Background WHITE
   Legend BLACK

SPEED LIMIT SIGNAGE
NTS



NOTES:
1. The legend is from the Transport Heavy alphabet.
2. Centre line, tile marks and dimensions do not form part of the sign.
3. Dimensions for the diamond warning signs are shown on drawing WK000.
4. Sign dimensions are in stroke widths. The table shows the x-heights to be used for each Roundel Diameter, and width and height rounded to the nearest 5mm.
5. COLOURS:- Standard
   Border BLACK
   Background WHITE
   Text BLACK
6. The English Script is condensed to 80% of its normal width.

Diamond S	x-height	W (mm)	H (mm)
600	50	1010	550
750	62.5	1265	690
900	75	1515	825
1200	100	2020	1100
1500	120	2425	1320

NEW ROAD LAYOUT AHEAD

SUPPLEMENTARY SIGN PLATE
NEW ROAD LAYOUT AHEAD
NTS

NOTES

1. All levels are in metres above ordnance datum.
2. All dimensions are in millimetres unless stated otherwise.
3. The design and alignment of the Temporary Diversion Road has been developed in accordance with the Transport Infrastructure Ireland (TTI) standards.
4. Drawing to be read in conjunction with drawings KNCN-WSP-HAW-SW-GN-Z-CH-00001-00010
5. All thickness dimensions are compacted thickness.

Ver	Amendment	By	Checked	Approved	Date
P01	PRELIMINARY DESIGN	RJM	EL	BK	24/10/22

DRAWING STATUS: INFORMATION

wsp
Shorefield House, 30 Kinnegar Drive, Holywood,
County Down, BT18 9JQ, UK
T+ 44 (0) 28 95953020
wsp.com

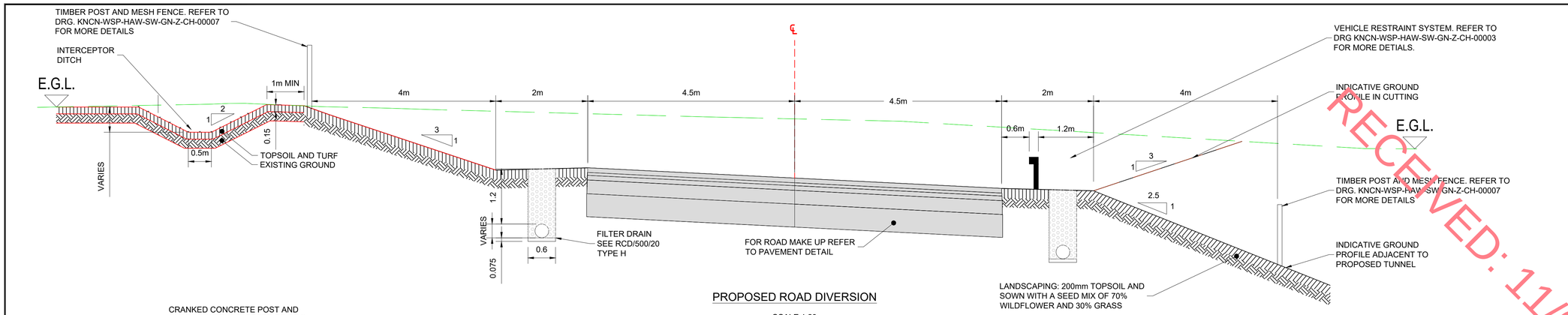
CLIENT: SAINT-GOBAIN MINING (IRELAND) LTD.

SITE/PROJECT: KNOCKNACRAN WEST

TITLE: DIVERSION ROAD AND TUNNEL CONSTRUCTION DETAILS, 1 OF 2 RFI. 20

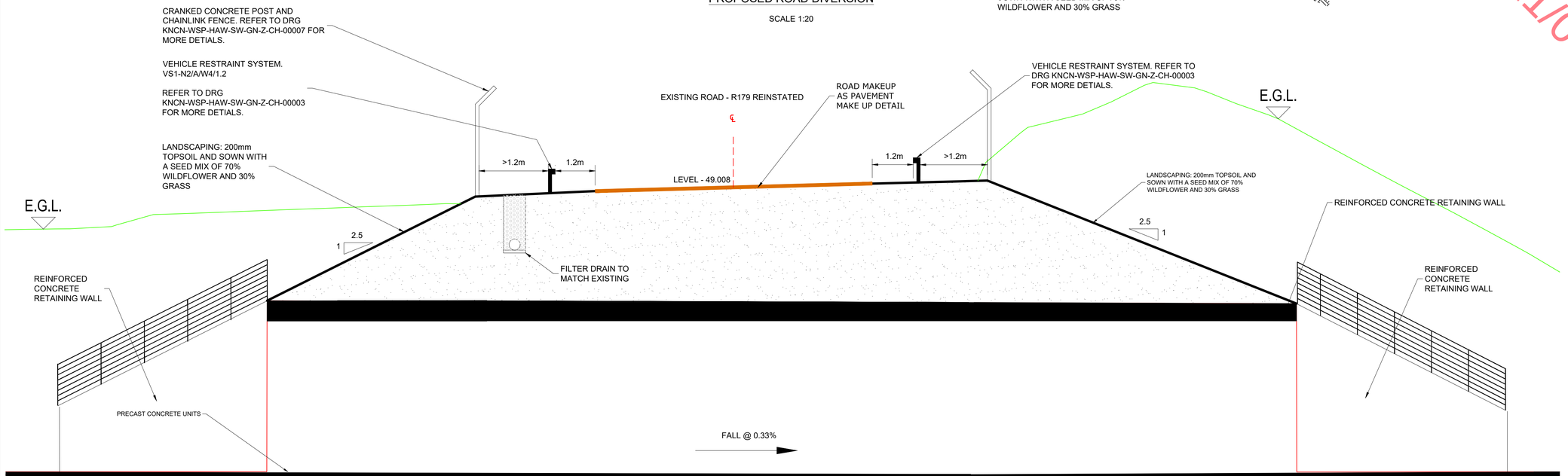
SCALE @ A1: / SCALE @ A3:	CHECKED:	APPROVED:
AS SHOWN	EL	BK
PROJECT NO:	DESIGNED: / DRAWN:	DATE:
KNCN	WSP / RJM	24/10/2022

DRAWING No: KNCN-WSP-HAW-SW-GN-Z-CH-00007 REV: 1.0

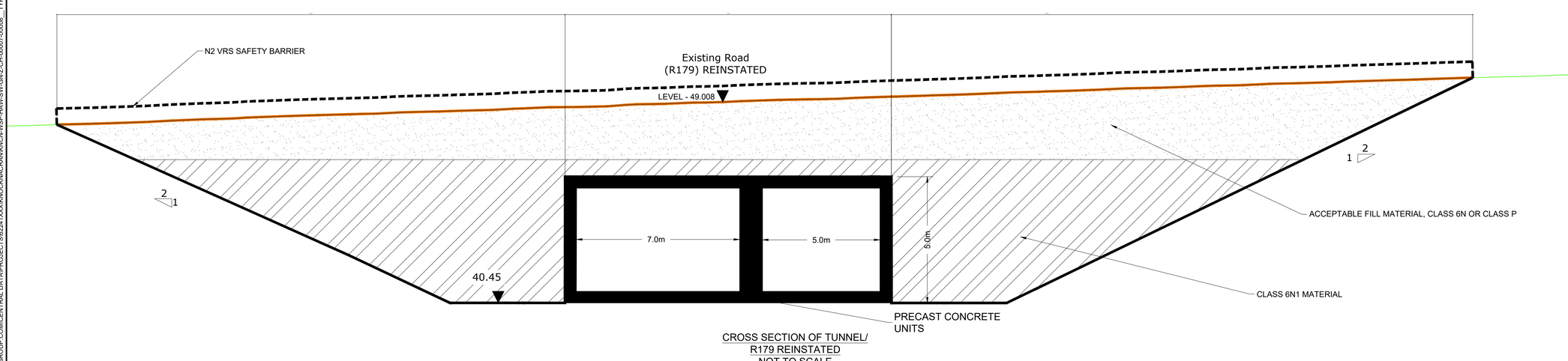


PROPOSED ROAD DIVERSION

SCALE 1:20



POST TUNNEL INSTALLATION & REINSTATED R179
NOT TO SCALE



CROSS SECTION OF TUNNEL/
R179 REINSTATED
NOT TO SCALE

NOTES

1. All levels are in metres above ordnance datum.
2. All dimensions are in metres unless stated otherwise.
3. The design and alignment of the Temporary Diversion Road has been developed in accordance with the Transport Infrastructure Ireland (TTI) standards.
4. Drawing to be read in conjunction with drawings KNCN-WSP-HAW-SW-GN-Z-CH-00001-00010
5. All thickness dimensions are compacted thickness.

Ver	Amendment	By	Checked	Approved	Date
P01	PRELIMINARY DESIGN	RJM	EL	BK	24/10/22

DRAWING STATUS: INFORMATION

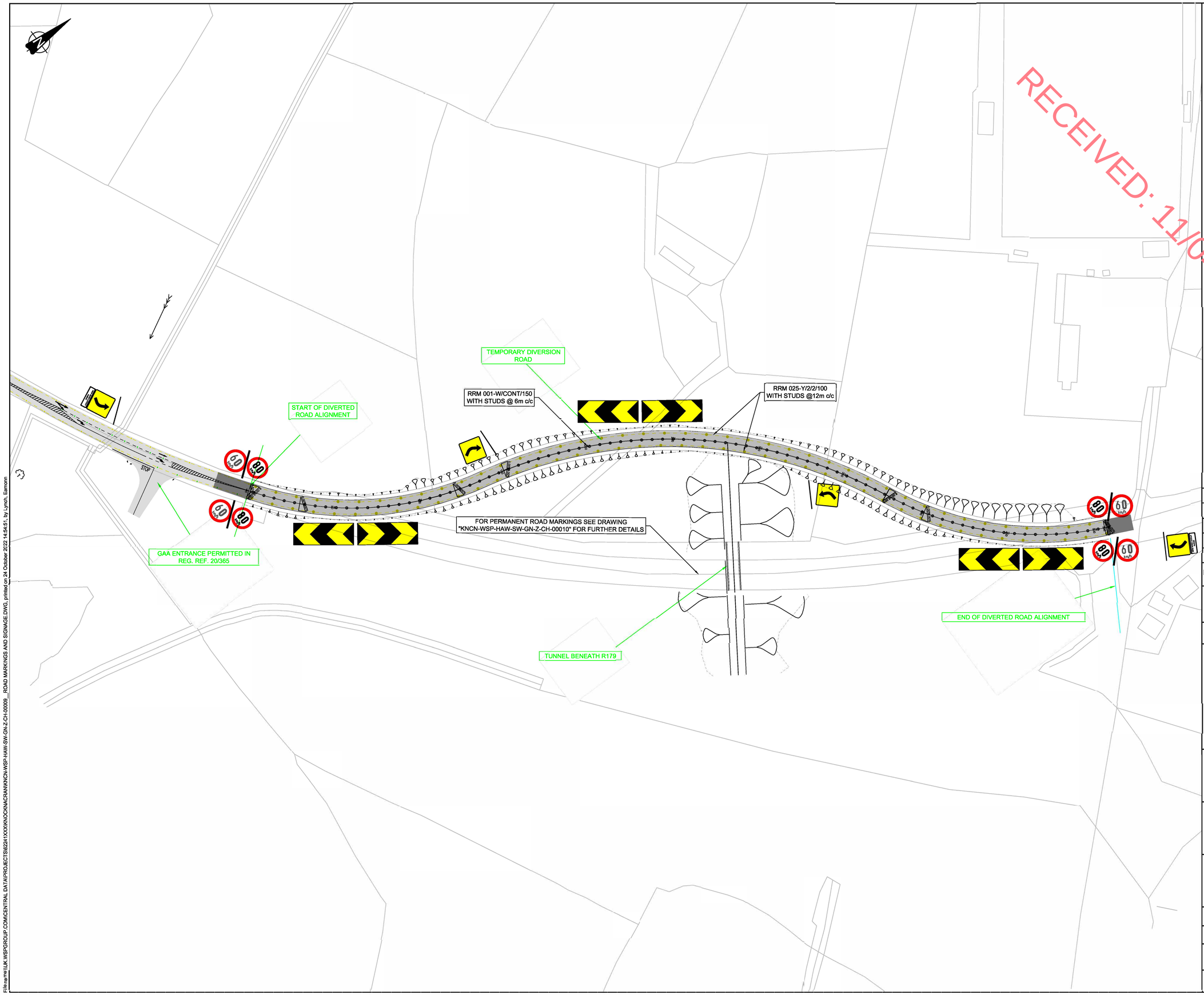
Shorefield House, 30 Kinnegar Drive, Holywood, County Down, BT18 9JQ, UK
T+ 44 (0) 28 95953020
wsp.com

CLIENT: SAINT-GOBAIN MINING (IRELAND) LTD.

SITE/PROJECT: KNOCKNACRAN WEST

TITLE: DIVERSION ROAD AND TUNNEL CONSTRUCTION DETAILS, 2 OF 2 RFI. 20

SCALE @ A1: / SCALE @ A3:	CHECKED:	APPROVED:
AS SHOWN	EL	BK
PROJECT NO: KNCN	DESIGNED: WSP / DRAWN: RJM	DATE: 24/10/2022
DRAWING No: KNCN-WSP-HAW-SW-GN-Z-CH-00008		REV: 1.0



NOTES

1. All levels are in metres above ordnance datum.
2. All dimensions are in metres unless stated otherwise.
3. The design and alignment of the Temporary Diversion Road has been developed in accordance with the Transport Infrastructure Ireland (TTI) standards.
4. Drawing to be read in conjunction with drawings KNCN-WSP-HAW-SW-GN-Z-CH-00001-00010

PLAN LEGEND:

- R179 TEMPORARY DIVERSION
- PAVEMENT TYPE A - 200mm FULLY FLEXIBLE
- PAVEMENT TIE INTO EXISTING ROAD
- CONTINUOUS CENTRE LINE - RRM 001
- EDGE OF CARRIAGEWAY - RRM 025
- ROAD STUDS - WHITE BIDIRECTIONAL
- ROAD STUDS - YELLOW BIDIRECTIONAL
- 60KPH SPEED LIMIT SIGN
- 80KPH SPEED LIMIT SIGN
- SIGN POST
- SHARP BEND LEFT - W051L
- SHARP BEND RIGHT - W051R
- SUPPLEMENTARY PLATE - NEW ROAD LAYOUT AHEAD
- MULTIPLE CHEVRONS - W062L
- MULTIPLE CHEVRONS - W062R

Ver	Amendment	By	Checked	Approved	Date
P01	PRELIMINARY DESIGN	RJM	EL	BK	24/10/22

DRAWING STATUS: INFORMATION

Shorefield House, 30 Kinnegar Drive, Holywood,
County Down, BT18 9JQ, UK
T+ 44 (0) 28 95953020
wsp.com

CLIENT: SAINT-GOBAIN MINING (IRELAND) LTD.

SITE/PROJECT: KNOCKNACRAN WEST

TITLE: DIVERSION ROAD AND TUNNEL ROAD MARKINGS & SIGNAGE RFI. 20

SCALE @ A1:	SCALE @ A3:	CHECKED:	APPROVED:
1:1,000	1:2,000	EL	BK

PROJECT NO.	DESIGNED:	DRAWN:	DATE:
KNCN	WSP	RJM	24/10/2022

DRAWING No: KNCN-WSP-HAW-SW-GN-Z-CH-00009 REV: 1.0

File name:\\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\62241XXX\KNOCKNACRAN\KNCN-WSP-HAW-SW-GN-Z-CH-00009_ROAD MARKINGS AND SIGNAGE.DWG, printed on 24 October 2022 14:54:51, by Lynch, Eamonn

SURFACING AND ROAD MARKINGS TO BE REINSTATED AS PER EXISTING UPON REMOVAL OF TEMPORARY ROAD DIVERSION

NEW CRANKED CONCRETE POST AND MESH FENCE

HEADWALL AND WINGWALLS OF PROPOSED CULVERT

RRM 001-W/100 DOUBLE CENTRELINE WITH STUDS @ 6m c/c

TIE IN TO EXISTING ROAD DRAINAGE

EXISTING FILTER DRAIN TIE IN LOCATION TBC ON SITE

EXISTING CRANKED CONCRETE POST AND MESH FENCE REINSTATED

HEADWALL AND WINGWALLS OF PROPOSED CULVERT

RRM 026-Y/100 WITH STUDS @12m c/c

TIE IN TO EXISTING ROAD DRAINAGE

ROAD TO BE REINSTATED UPON REMOVAL OF TEMPORARY ROAD DIVERSION

EXISTING FILTER DRAIN TIE IN LOCATION TBC ON SITE

VEHICLE RESTRAINT SYSTEM
VS1-N2/A/W4/1.2

R179

FD

STOP

NOTES

1. All levels are in metres above ordnance datum.
2. All dimensions are in millimetres unless stated otherwise.
3. Drawing to be read in conjunction with drawings KNCN-WSP-HAW-SW-GN-Z-CH-00001-00010
4. All thickness dimensions are compacted thickness.
5. All grass verge disrupted by temporary diversion road to be reinstated. Grass verges to have minimum of 200mm topsoil and sown with a seed mix of 70% wild flower and 30% grass.
6. Existing features shown represent expected locations and are to be confirmed on site with adjustments made accordingly to tie in.

PLAN LEGEND:

- NEW / REINSTATED CRANKED CONCTRETE POST AND MESH FENCE
- PAVEMENT TYPE A - 200mm FULLY FLEXIBLE
- REINSTATED GRASS VERGE
- CONTINUOUS CENTRE LINE - RRM 001
- EDGE OF CARRIAGEWAY - RRM 025
- ROAD STUDS - WHITE BIDIRECTIONAL
- ROAD STUDS - YELLOW BIDIRECTIONAL
- N2 VEHICLE RESTRAINT SYSTEM
- T80 TERMINAL
- VS1-N2/A/W4/1.2 — REF-CONTAINMENT / IMPACT SEVERITY / WORKING WIDTH / SETBACK
- FD — FILTER DRAIN
- FD — EXISTING ROAD DRAIN
- REINSTATED FIELD DRAIN
- EXISTING FIELD DRAIN
- DRAINAGE CHAMBER

Ver	Amendment	By	Checked	Approved	Date
P01	PRELIMINARY DESIGN	RJM	EL	BK	24/10/22

DRAWING STATUS: INFORMATION

wsp
Shorefield House, 30 Kinnegar Drive, Holywood, County Down, BT18 9JQ, UK
T+ 44 (0) 28 95953020
wsp.com

CLIENT: SAINT-GOBAIN MINING (IRELAND) LTD.

SITE/PROJECT: KNOCKNACRAN WEST

TITLE: DIVERSION ROAD AND TUNNEL REINSTATEMENT WORKS TO R179 RFI. 20

SCALE @ A1:	SCALE @ A3:	CHECKED:	APPROVED:
1:1000		EL	BK

PROJECT NO:	DESIGNED:	DRAWN:	DATE:
KNCN	WSP	RJM	24/10/2022

DRAWING No: KNCN-WSP-HAW-SW-GN-Z-CH-00010 REV: 1.0

APPENDIX B

VRS Risk Assessment

Risk Assessment Sheet for Vehicle Restraint Systems

Date: 12/10/2022 | **Completed by:** WSP

Location ID/Description: Temporary Diversion Road & Reinstated R179, Knocknacran West, Co. Monaghan

Site Survey Conducted (Y/N): No

	Hazard Type / Description (Start and End Co-Ordinates)	Is Hazard within the Clear Zone? (Y/N)	Can the Hazard be Mitigated? (Y/N)	(1) Hazard Ranking	Sinuosity Index (SI)	(2) Sinuosity Ranking	(3a) Collision Rate Threshold	(3b) Collsion Rate Ranking	(4) Risk of a Vehicle Leaving the Road	(5) Overall Risk Rating	Distance to Hazard (m)	VRS to be Installed (Y/N) Start and End Co-Ordinates	Reaons for Installing / Not Installing the VRS
1	Chainage 0 Drainage Culvert Headwall	N	Y	M	1.010	M	Above Expected Rate	M	M	M	4.5	N	The headwall pertrudes approx 150mm above the existing ground level. The headwall is located outside of Clear Zone and behind the boundary fence.
2	Chainage 250 - 325 Cut slope to south east of Temporary Diversion Road	Y	N	M	1.034	H	Above Expected Rate	M	H	H	2	Y	Overall risk rating is medium, small distance to start of hazard, inside Clear Zone & no existing hazard mitigation feasible.
3	Chainage - throughout scheme (Temporary Diversion Road) Boundary Fencing	N	Y	H	1.034	H	Above Expected Rate	M	H	H	≥ 4	N	All boundary fencing will be Timber Post & Tension Mesh and outside Clear Zone.
4	Cut slope towards Headwall of Culvert/Tunnel	Y	N	M	1.010	M	Above Expected Rate	M	M	M	2.5	Y	Although the overall risk rating is medium, the level difference between the carriageway and the bottom of the cut slope is significant.
5	Headwall of Culvert / Tunnel (Reinstated R179)	N	N	M	1.010	M	Above Expected Rate	M	M	M	15	N	The overall risk rating is low, and the hazard is outside the clear zone.
5	Chainage - throughout scheme (Reinstated R179) Boundary Fencing	N	Y	H	1.015	M	Above Expected Rate	M	M	H	≥ 4	N	All boundary fencing will be outside Clear Zone.

L = Low, M = Medium, H = High

(1) Hazard Ranking as per Appendix D
High (H) as per Appendix D
Medium (M) as per Appendix D
Low (L) as per Appendix D

(2) Sinuosity Ranking
High (H) > 1.02
Medium (M) = 1.004 ≤ SI ≤ 1.02
Low (L) <1.004

(3a) Collision Rate Threshold
(1) Twice above Expected Rate
(2) Above Expected Rate
(3) Below Expected Rate
(4) Twice Below Expected Rate

(3b) Collision Rate Ranking
High (H) = Twice above Expected Rate
Medium (M) = Above Expected Rate
Low (L) = Below Expected Rate and Twice Below Expected Rate

(4) Risk of a Vehicle Leaving the Road

Risk of a Vehicle Leaving the Road	*Collision Rate Ranking*		
Sinuosity Ranking	H	M	L
H	H	H	M
M	H	M	L
L	M	L	L

(5) Overall Risk Rating

Overall Risk Rating	*Hazard Ranking*		
Risk of a Vehicle Leaving the Road	H	M	L
H	H	H	M
M	H	M	L
L	M	L	L

Assumptions:
Collision Rate Threshold - the road collisions for Monghan covering 2015 - 2016 is (148 + 119) 267. The number of collisions on this section of the R179 is 2 between 2005 - 2016. This information was the best information available at the time it is not detailed enough for the specific location where this risk assessment is being undertaken. To be conservative, it has been assumed that the Collision Rate Ranking is "Above Expected Rate".

APPENDIX C

Cut-and-Cover Tunnel Structural Design

BANAGHER PRECAST CONCRETE

UonU CULVERT DESIGN

Job Number:	**19.852**		
Job Title:	**R179 Carrickmackross & Kingscourt**		
Structure =	**U on U_Large Structure**		
Culvert Type =	**7 m x 5 m x 500 mm x 1.99 m**		
Total L =	**35.915m**		
Culvert Length =	**1.99 m**		
Number of units required =	**18 Nr**		
Designed to:	**Eurocode 1 "Actions on structures – Part 2: Traffic loads on bridges". Eurocode 2 "Design of concrete structures" and PD6694 "Recommendations for the design for structures subject to traffic loading"**		
Designed by:	**Adrian Pilch**	DATE:	**29/11/2019**
Checked by:		DATE:	

Revision	Description	By	Date
C01	First draft - For approval	A Pilch	29/11/2019

Irl: Banagher, Co. Offaly, Ireland
UK: Mundford Road, Weeting, Norfolk, IP27 0PL
Tel Irl: +353 (0)57 9151417
Tel UK: 0161 300 0513
web: www.bancrete.com

PRECAST CONCRETE SPECIALISTS

Box Culvert Design Sheet - per m length

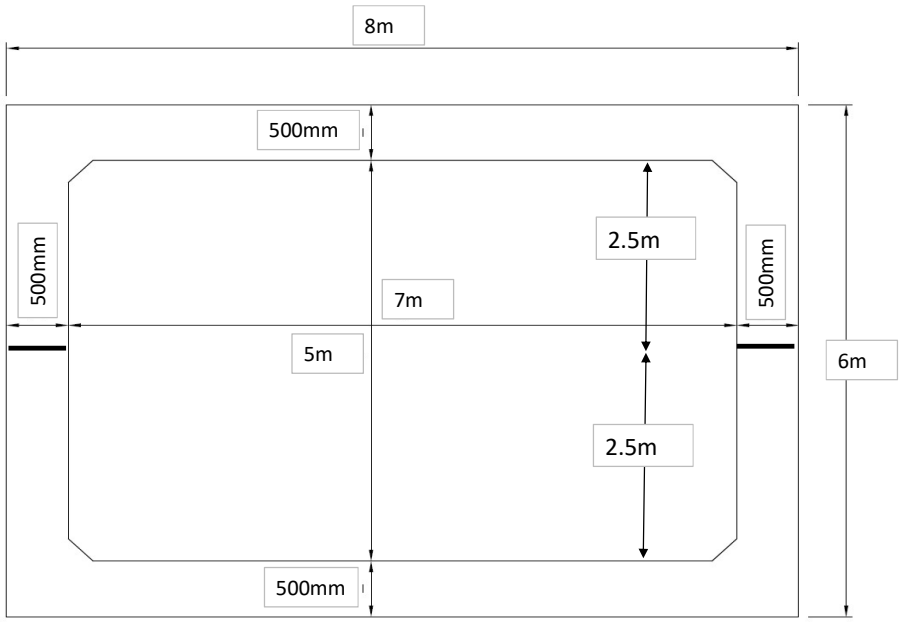
Project Details:

Job Title:	R179 Carrickmackross & Kingscou	Date :	29/11/19	Revision :	C01
Structure:	U on U_Large Structure	Job No:	19.852	Status:	For Approval
Client:	Golder	No Required:	18	PO:	GAIRL 001432
Insertion site:	Ireland	Total length:	35.915m		

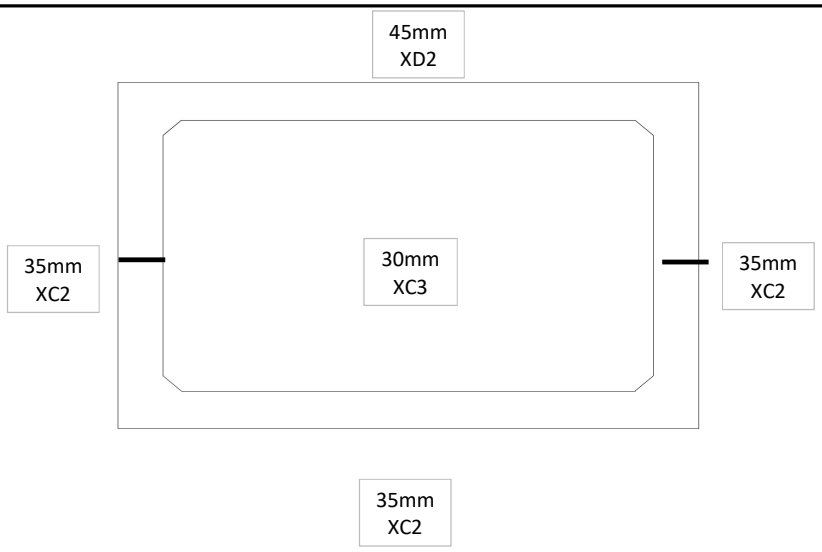
Culvert Dimensions:

Width	7.0 m	Ext Roof Cover	45 mm	Roof Exposure	XD2		
Height	5.0 m	Ext Wall Cover	35 mm	Wall Exposure	XC2		
Design Length	1.0 m	Internal Cover	30 mm	Internal Exposure	XC3		
Unit Length	1.99 m	Ext Base Cover	35 mm	Base Exposure	XC2		
Roof/floor thickness	500 mm	Mix Design Constituents for 100yr design life as per BD57/10					
Sidewall thickness	500 mm	Concrete Grade =	C50/60				
Chamfer	200 mm	Cement Type =	CEM I	GGBS Content:	0 %		
		Max W/C ratio =	0.4	Min. Cement =	440 kgs		

Max fill depth = 3 m (In general)
Min fill depth = 3 m (Between culvert roof and carriageway)



SECTION THROUGH BOX CULVERT SHOWING DIMENSIONS



SECTION THROUGH BOX CULVERT SHOWING EXPOSURE CLASS AND NOMINAL COVER

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Span	Height	Wall Thick.	Roof Thick.	Length	Soil Density	Surfacing Density
7.00	5.00	0.50	0.50	1.99	19	23.00

MAX FILL = 3 m Surfacing = 0.2 m
MIN FILL = 3 m

β = 1.15+0.35(H_c-8)/3 but not less than 1.15
β_{max} = 1.15
β_{min} = 1.15

Loadings

1 Self weight
= Slab Thick x Density of Concrete x unit length
= 12.5 kN/m

2 Surfacing
= Surfacing Thick x Density of Surfacing x Arching Factor x 40% future addition x unit length
= 7.406 kN/m

3 Soil (max)
= Soil Thick x Density of Soil x Arching Factor x unit length
= 61.18 kN/m

4 Soil (min)
= Soil Thick x Density of Soil x Arching Factor x unit length
= 61.18 kN/m

5 Horz. Earth Pressure (Triangular Load Block)
= Depth of box from centre line of roof/base x Density of Soil x unit length
= 99.75 kN/m

6 Horz. Earth Pressure due to fill over box(max)
= Depth of soil from centre line of roof to road level x Density of Soil/surfacing x unit length
= 59.7 kN/m

7 Horz. Earth Pressure due to fill over box(min)
= Depth of soil from centre line of roof to road level x Density of Soil/surfacing x unit length
= 59.7 kN/m

8 Internal Water Pressure N/A
= Depth of box x Density of water x unit length all divided by 2
= 25 kN/m

9 Horizontal Traffic Surcharge Loading for LM1 Vehicles - UDL
= 20KdR(kN/m2) as per Table 7 of PD6694-1:2011
= 20*Ko*3/Weff
= 10 kN/m2 - for Ko = 0.5 as per SLS Loading Combination
= 15 kN/m2 - for Ko = 0.729 as per EQU Loading Combination
= 14 kN/m2 - for Ko = 0.675 as per STR/GEO1 Loading Combination
= 13 kN/m2 - for Ko = 0.667 as per STR/GEO Loading Combination

10 Horizontal Traffic Surcharge Loading for LM1 Vehicles - Line Load(Min Fill)
= 330KdDf(kN/m) as per Table 7 of PD6694-1:2011

Where;
Df = (1+z/2)/(1+z)
= z = 3
= 0.625
Reduction Factor = (1-Hc/2)^2
= Hc = 3
= 0.250

= 330*Ko*Df*Reduction Factor
= 51.5625 Ko **Can Be Ignored as Fill is Greater than 2.0m**

11 Horizontal Traffic Surcharge Loading for LM1 Vehicles - Line Load(Max Fill)
= 330KdDf(kN/m) as per Table 7 of PD6694-1:2011

Where;
Df = (1+z/2)/(1+z)
= z = 3.0
= 0.625
Reduction Factor = (1-Hc/2)^2
= Hc = 3.0
= 0.250

= 330*Ko*Df*Reduction Factor
= 51.5625 Ko **Can Be Ignored as Fill is Greater than 2.0m**

12 Horizontal Traffic Surcharge Loading for LM3 Vehicles - UDL
= 30Kd(kN/m2) as per Table 7 of PD6694-1:2011
= 30*Ko
= 15 kN/m2 - for Ko = 0.5 as per SLS Loading Combination
= 22 kN/m2 - for Ko = 0.729 as per EQU Loading Combination
= 20 kN/m2 - for Ko = 0.675 as per STR/GEO1 Loading Combination
= 20 kN/m2 - for Ko = 0.675 as per STR/GEO1 Loading Combination

13 Horizontal Traffic Surcharge Loading for LM3 Vehicles - Line Load(Min Fill)
= 51.5625 Ko **Can Be Ignored as Fill is Greater than 2.0m**
14 Horizontal Traffic Surcharge Loading for LM3 Vehicles - Line Load(Max Fill)
= 51.5625 Ko **Can Be Ignored as Fill is Greater than 2.0m**

15 Horizontal Braking & Acceleration Loading for LM1 Vehicles - Point Load(min Fill)
= (360+2.7L)/3.0 (kN) as per 10.2.8.2 of PD6694-1:2011 & 4.4.1 of I.S. EN 1991-2:2003
Where;
L = External width of the structure
= 8.00 m

Reduction Factor, n = (LL-Hc)/(LL-0.6)
LL = 8.00 m
Hc = 3.00 m
= 0.675676
= ((360+2.7*Hc)/3.0)*n
= 82.905 kN

16 Horizontal Braking & Acceleration Loading for LM1 Vehicles - Point Load(max Fill)
= (360+2.7L)/3.0 (kN) as per 10.2.8.2 of PD6694-1:2011 & 4.4.1 of I.S. EN 1991-2:2003
Where;
L = External width of the structure
= 8.00 m

Reduction Factor, n = (LL-Hc)/(LL-0.6)
LL = 8.00 m
Hc = 3.00 m
= 0.675676
= ((360+2.7*Hc)/3.0)*n
= 82.905 kN

17 Horizontal Braking & Acceleration Loading for LM3 Vehicles - Point Load
as per 10.2.8.2 of PD6694-1:2011 & NA.2.18.1 of I.S. EN 1991-2:2003
= QLK,S = δw
Where;
δ = Deceleration Factor 0.5
w = The basic axle load of the relevant SV Vehicle x its DAF factor
= DAF x Total Load
= 1055.600

QLK,S = (δ*w)/3.0
= 176 kN

Loaded Length =	7.5	m		
No. Axles =	7	nr		
Total Load =	910	kN		
Braking pace =	455	kN		
Vehicle Type =	SV80		*(Forces greater than for SV196)*	
DAF =	1.16			

Reduction Factor =
Max fill = 0.652174
Min fill = 0.652174

Therefore the horizontal load is as follows:
Max fill = 115 kN/m
Min fill = 115 kN/m

or

10% of the Force
= (0.1*w)/3.0
= 35.19 kN

Live Load to EC2

Date:	05/12/2019
Prepared by:	A Pilch
Checked by:	

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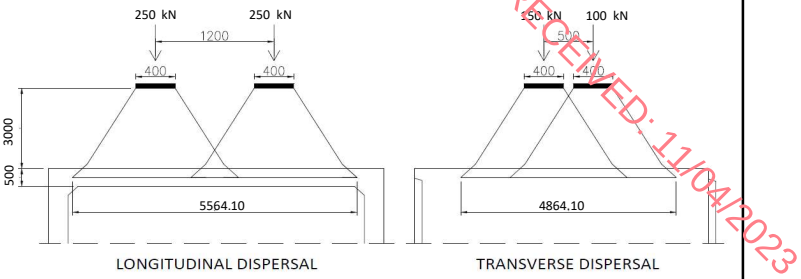
Live Load = LM1 as per Eurocode:

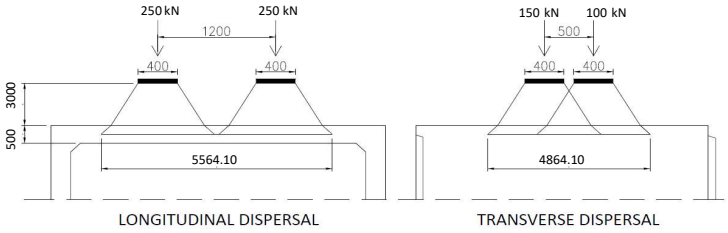
I. Maximum Fill

Max Fill =	3000	mm
Roof thickness =	500	mm
Load =	250	kN
Longitudinal Dispersal =	5564.10	mm
Transverse Dispersal =	4864.10	mm
UDL Load TS=	18.47	kN/m^2
UDL Load =	5.5	kN/m^2
Total UDL =	23.97	kN/m^2



II. Minimum Fill

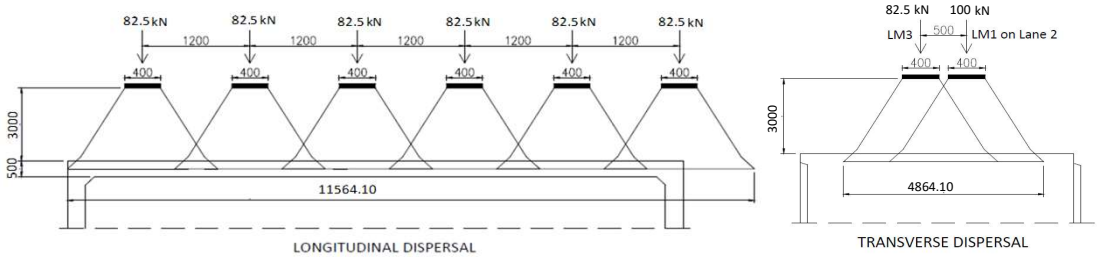
Min Fill =	3000	mm
Roof thickness =	500	mm
Load =	250	kN
Longitudinal Dispersal =	5564.10	mm
Transverse Dispersal =	4864.10	mm
UDL Load TS=	18.47	kN/m^2
UDL Load =	5.5	kN/m^2
Total UDL =	23.97	kN/m^2



Live Load = LM3 as per Eurocode:

I. Maximum Fill

Max Fill =	3000	mm	Dynamic factor =	1.12
Roof thickness =	500	mm		
External Unit Width =	8000	mm		
Load LM3 =	82.5	kN	No. point loads =	7
Load LM1 =	100	kN	No. point loads =	2
Longitudinal Dispersal =	11564.10	mm		
Transverse Dispersal =	4864.10	mm		
UDL Load =	15.05	kN/m^2		



II. Minimum Fill

Min Fill =	3000	mm	Dynamic factor =	1.12
Roof thickness =	500	mm		
External Unit Width =	8000	mm		
Load LM3 =	82.5	kN	No. point loads =	7
Load LM1 =	100	kN	No. point loads =	2
Longitudinal Dispersal =	11564.10	mm		
Transverse Dispersal =	4864.10	mm		
UDL Load =	15.05	kN/m^2		

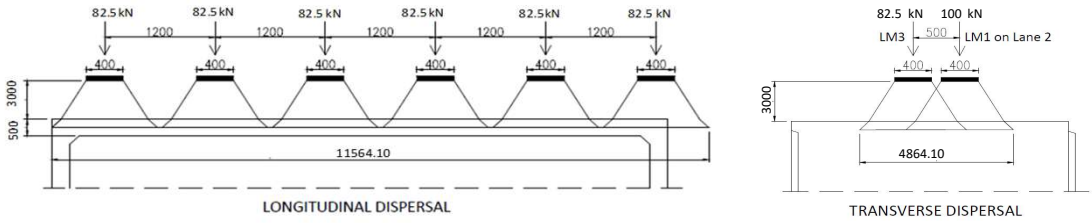
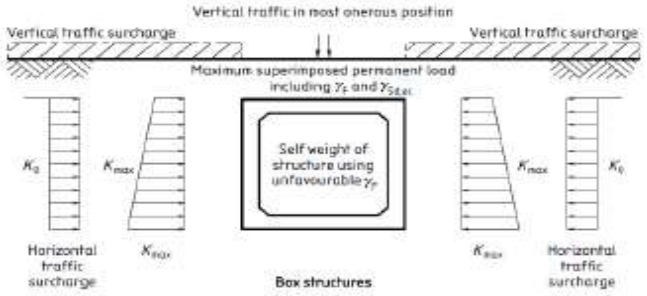


Table B.1 – Maximum vertical load with maximum horizontal load



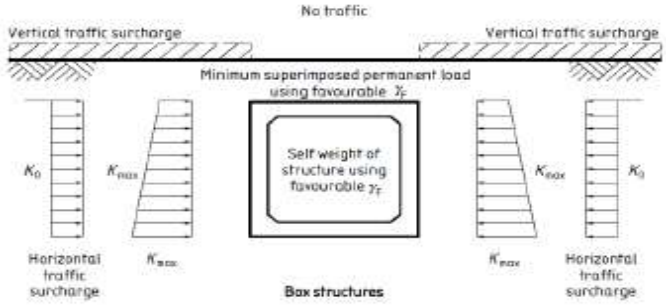
B1 - Max vert + Max Horiz									
	Surcharge	Soil-Horiz	traffic loads						
Limit state	K_0	K_{max}	gr1a(LM1)	gr5(LM3)**	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.5	0.6	1	1	1	1	1	0.6	1
EQU	0.729	0.8085	1.35	1.35	1.05	1.05	1.05	0.93	0
STR/GEO 1	0.675	0.972	1.35	1.35	1.35	1.2	1.35	0.93	1.2
STR/GEO 2	0.667	0.84	1.15	1.15	1	1	1	0.78	1

Note: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,K}$

* Load value to include supplementary model factor for arching action $\gamma_{Sd,inf}$

**LM3 load values multiplied by DAF(SV80=1.16; SV100 & SV196=1.12)

Table B.2 – Minimum vertical load with maximum horizontal load

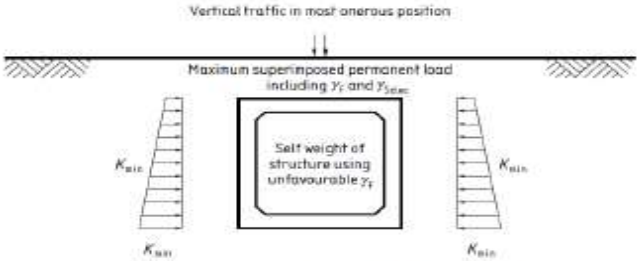


B2 - Min Vert + Max Horiz							
	Surcharge	Soil-Horiz					
Limit state	K_0	K_{max}	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.5	0.6	1	1	1	0.6	1
EQU	0.729	0.8085	0.95	0.95	0.95	0.93	0
STR/GEO 1	0.675	0.972	0.95	0.95	0.95	0.93	1.2
STR/GEO 2	0.667	0.84	1	1	1	0.78	1

Note: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,K}$

* Load value to include supplementary model factor for arching action $\gamma_{Sd,inf}$

Table B.3 – Maximum vertical load with minimum horizontal load



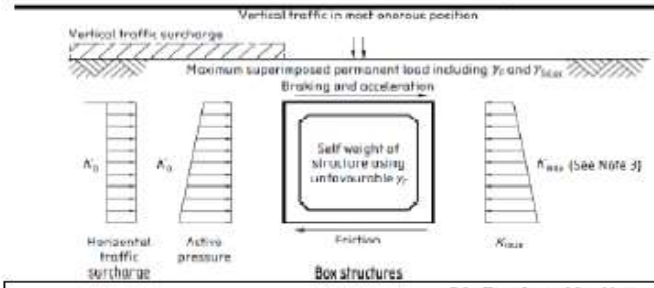
B3 - Max Vert + Min Horiz								
	Soil-Horiz	traffic loads						
Limit state	K_{min}	gr1a(LM1)	gr5(LM3)**	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.2	1	1	1	1	1	0.6	1
EQU	0.171	1.35	1.35	1.05	1.05	1.05	0.93	0
STR/GEO 1	0.19	1.35	1.35	1.35	1.2	1.35	0.93	1.2
STR/GEO 2	0.16	1.15	1.15	1	1	1	0.78	1

Note: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,K}$

* Load value to include supplementary model factor for arching action $\gamma_{Sd,inf}$

**LM3 load values multiplied by DAF(SV80=1.16; SV100 & SV196=1.12)

Table B.4 – Traction with maximum vertical load and active pressure



B4 - Traction + Max Vert + Active pressure											
	Surcharge	Soil-Horiz	Soil-Horiz	traffic loads							
Limit state	K_a	K_a	K_{max}	gr2/6 Horiz	gr2 vert***	gr6 vert**	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.33	0.33	0.6	1	0.75	1	1	1	1	0.6	1
EQU	0.4995	0.462	0.8085	1.35	1.0125	1.35	1.05	1.05	1.05	0.93	0
STR/GEO 1	0.4455	0.54	0.972	1.35	1.0125	1.35	1.35	1.2	1.35	0.93	1.2
STR/GEO 2	0.4715	0.49	0.84	1.15	0.8625	1.15	1	1	1	0.78	1

Note1: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,E}$

Note2: if the strucutre sways towards the active side the loadcase can be ignored

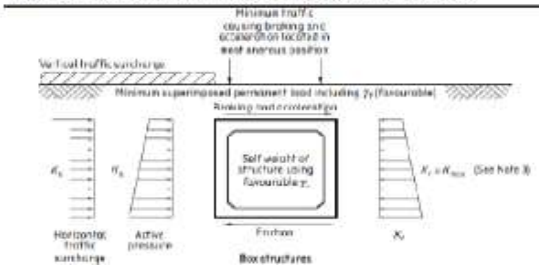
Note3:The earth pressure coefficient for the passive wall may be taken as greater than Kmax for bearing, sliding and overturning provided the associated displacments are acceptable at the relevant limt state

* Load value to include supplementary model factor for arching action $\gamma_{Sd,arc}$

**LM3 load values multiplied by DAF(SV80=1.16; SV100 & SV196=1.12)

*** frequent LM1 values used: ψ=0.75

Table B.5 – Traction with minimum vertical load and active pressures



B5 - Traction + Min Vert + Active pressure											
	Surcharge	Soil-Horiz	Soil-Horiz	Traffic Loads							
Limit state	K_a	K_a	K_{max}	gr2/6 Horiz	gr2 vert***	gr6 vert**	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.33	0.33	0.6	1	0.75	1	1	1	1	0.6	1
EQU	0.4995	0.462	0.8085	1.35	1.0125	1.35	0.95	0.95	0.95	0.93	0
STR/GEO 1	0.4455	0.54	0.972	1.35	1.0125	1.35	0.95	0.95	0.95	0.93	1.2
STR/GEO 2	0.4715	0.49	0.84	1.15	0.8625	1.15	1	1	1	0.78	1

Note1: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,E}$

Note2: if the strucutre sways towards the active side the loadcase can be ignored

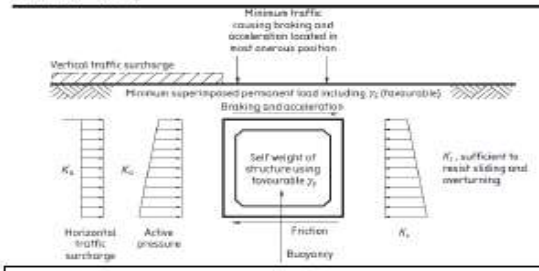
Note3:The earth pressure coefficient for the passive wall may be taken as greater than Kmax for bearing, sliding and overturning provided the associated displacments are acceptable at the relevant limt state

* Load value to include supplementary model factor for arching action $\gamma_{Sd,arc}$

**LM3 load values multiplied by DAF(SV80=1.16; SV100 & SV196=1.12)

*** frequent LM1 values used: ψ=0.75

Table B.6 – Sliding



B6 - Sliding											
	Surcharge	Soil-Horiz	Soil-Horiz	traffic loads							
Limit state	K_a	K_a	K_r	gr2/6 Horiz	gr2 vert***	gr6 vert**	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.33	0.33	K_r	1	0.75	1	1	1	1	0.6	1
EQU	0.4995	0.462	K_r	1.35	1.0125	1.35	0.95	0.95	0.95	0.93	0
STR/GEO 1	0.4455	0.54	K_r	1.35	1.0125	1.35	0.95	0.95	0.95	0.93	1.2
STR/GEO 2	0.4715	0.49	K_r	1.15	0.8625	1.15	1	1	1	0.78	1

Note1: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,E}$

* Load value to include supplementary model factor for arching action $\gamma_{Sd,arc}$

**LM3 load values multiplied by DAF(SV80=1.16; SV100 & SV196=1.12)

*** frequent LM1 values used: ψ=0.75

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

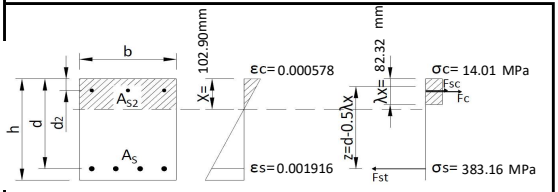
Flexure Design - Roof Sagging Steel

Design Moment		
828.00	1.000	828 kNm

Step 1:-

$K = M/bd^2f_{ck}$	0.0840	no compression steel req

Step 2:-



$z = d - 0.5\lambda x$	=	421.80 mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$	4514.936 mm^2

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$	946.608 mm^2	ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$	577.2 mm^2	ok

Step 6:- (Max Longitudinal Steel)

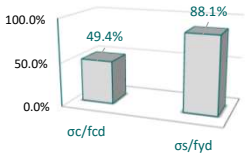
$A_{smax} = 0.04A_c$	17760 mm^2	ok

Height of Concrete Section, h =	500	mm
Width of Concrete Section, b =	1000	mm
Exposure Class=	XC3	
Cover to Tension Steel =	40	mm
Effective Depth, d =	444	mm
Concrete Grade =	C50/60	
Type of Cement =	R	
Age of the Concrete in Days, t =	28	days
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm²
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm²
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm²
Yield strength,fy =	500	N/mm²
Max stress in steel, f_{yd} =	434.78	MPa
Max Steel Strain, ϵ_{st} =	0.002173913	
Max Concrete Strain, ϵ_{cu2} =	0.0035	
Modulus od Elasticity of Steel, E_s =	200000	N/mm²
λ =	0.8	
η=	1	
α =	0.85	
Yc=	1.5	
Ys=	1.15	
Ø =	0.666666667	
α_{cw} =	1	

Tension Steel

Bar	32	mm
Area	804.25	mm²
No req	5.61	
No used	6.67	
As Prov	5364.33	mm²
M_R	939.55	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	16	mm
Area	201.06	mm²
No req	2.87	
No used	5	
As Prov	1005.31	mm²

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x =	0.337837838	therefore compression steel has yielded
x =	199.8 mm	
z =	364.08 mm	

If compression reinforcement is required then $x = x_{bal} = 0.45d$

If compression reinforcement is required then z = 0.82d

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$	0 mm^2
$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$	0 mm^2

Compression Steel

Bar	25	mm
Area	490.87	mm²
No req	0.00	
No used	6.67	
As Prov	3274.13	mm²
cover to CS =	55	mm
d_2 =	67.5	mm

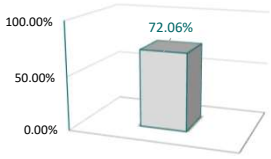
Shear Design - Roof Sagging Steel

V_{Ed} =	472 kN

Shear Width =	1000 mm

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	348.8899217 kN	Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.671156055	**USE THIS VALUE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.012081829	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.534661062 MPa	**IGNORE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	237.3895116 kN	Shear links Req



Capacity with Shear links

Step 7:-

Max Allowable Shear Force -	$v_1 = 0.6.[1-(fck/250)]$	0.48 MPa	θ = 22
$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$	$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4 MPa - **Maximum Allowable Shear Stress**	cotθ = 2.475086853
1992.446924 kN	$v = (Vx10^3)/A_{sh}$	1.063 MPa - **Actual Shear Stress**	
			θ = 22
Step 8:-			tanθ = 0.404026226

To Calculate Links -	Use	4	10 mm Links per meter	θ = 22°	cotθ = 2.5
$V_{Rd,s} = (A_{sw}/s)\,z\,f_{ywd}\cot\theta$	As prov =	314 mm2/m		θ = 45°	cotθ = 1.0
Shear Reinforcement -	C/C's =	200 mm	> Max Spacing = 333mm	per unit length	8
$A_{sv}/s = V/(\cot\theta.0.9.d.0.87.f_{yv})$	Asv/sv =	1.57 OK	> Min Asv/sv = 1.13		
1.097076264	No. rows req =	26	Max transverse spacing 666 mm	Transverse spacing	248.8 mm
(i.e. 1 leg B12 -200 c/c's = 0.565)	Links Only Req in unit where shear is greater than shear capacity of			348.889922 kN	

Shear Links Curtailment:	
1/2 Span =	3.5 m
distance back from midspan	1 m
shear force at this location	134.857143 kN

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

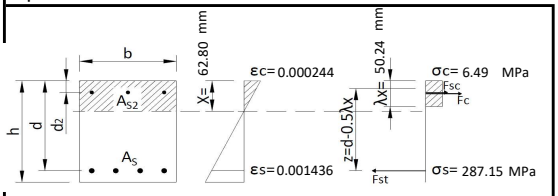
Flexure Design - Roof Hogging Steel

Design Moment		
383.00	1.000	383 kNm

Step 1:-

$K = M/bd^2f_{ck}$	0.0410	no compression steel req

Step 2:-



$z = d - 0.5\lambda x$ = 407.38 mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$	2162.3609 mm²	

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$	922.09 mm²	ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$	562.25 mm²	ok

Step 6:- (Max Longitudinal Steel)

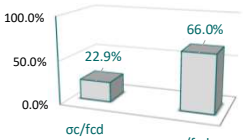
$A_{smax} = 0.04A_c$	17300 mm²	ok

Height of Concrete Section, h =	500	mm
Width of Concrete Section, b =	1000	mm
Exposure Class=	XD2	
Cover to Tension Steel =	55	mm
Effective Depth, d =	432.5	mm
Concrete Grade =	C50/60	
Type of Cement =	R	
Age of the Concrete in Days, t =	28	days
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm²
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm²
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm²
Yield strength,fy =	500	N/mm²
Max stress in steel, f_{yd} =	434.78	MPa
Max Steel Strain, ϵ_{st} =	0.002173913	
Max Concrete Strain, ϵ_{cu2} =	0.0035	
Modulus od Elasticity of Steel, E_s =	200000	N/mm²
λ =	0.8	
η=	1	
α =	0.85	
Yc=	1.5	
Ys=	1.15	
Ø =	0.666666667	
α_{cw} =	1	

Tension Steel

Bar	25	mm
Area	490.87	mm²
No req	4.41	
No used	6.67	
As Prov	3274.13	mm²
M_R	579.92	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	16	mm
Area	201.06	mm²
No req	2.80	
No used	5	
As Prov	1005.31	mm²

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x = 0 therefore compression steel has yielded

If compression reinforcement is required then $x = x_{bal} = 0.45d$: x = 194.625 mm

If compression reinforcement is required then z = 0.82d : z = 354.65 mm

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$	0 mm²	
$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$	0 mm²	

Compression Steel

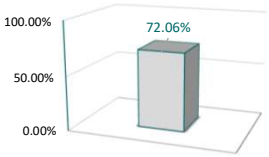
Bar	32	mm
Area	804.25	mm²
No req	0.00	
No used	6.67	
As Prov	0.00	mm²
cover to CS =	40	mm
d_2 =	0	mm

Shear Design - Roof Hogging Steel

V_{Ed} =	472 kN	Shear Width =	1000 mm

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	292.403407 kN	Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.680020401	**USE THIS VALUE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.00757024	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.538920718 MPa	**IGNORE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	233.0832106 kN	Shear links Req



Capacity with Shear links

Step 7:-

Max Allowable Shear Force -	$v_1 = 0.6.[1-(fck/250)]$	0.48 MPa	
$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$	$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4 MPa	**- Maximum Allowable Shear Stress**
1924.325876 kN	$v = (Vx10^3)/A_{sh}$	1.091 MPa	**- Actual Shear Stress**

θ =	22
cotθ =	2.475086853
θ =	22
tanθ =	0.404026226
θ = 22°	cotθ = 2.5
θ = 45°	cotθ = 1.0

Step 8:-

To Calculate Links -	Use	4	10 mm Links	per meter
$V_{Rd,s} = (A_{sw}/s)\,z\,f_{ywd}.\cot\theta$	As prov =	314 mm2/m		
Shear Reinforcement -	C/C's =	200 mm	> Max Spacing = 324.375mm	
$A_{sv}/s = V/(\cot\theta.0.9.d.0.87.f_{yv})$	Asv/sv =	1.57 OK	> Min Asv/sv = 1.13	
1.126247078	No. rows req =	26		
(i.e. 1 leg B12 -200 c/c's = 0.565)	Links Only Req in unit where shear is greater than shear capacity of			292.40341 kN

Step 9:-

Additional Longitudinal Reinforcement -			Shear Links Curtailment:
$\Delta F_{td} = 0.5V_{Ed}\cot\theta$			1/2 Span = 3.5 m
584.1204974 kN			distance back from midspan 1 m
1342.805741 mm²	not ok,add more main steel	Ok - sag B20 @150 extended	shear force at this location 134.85714 kN

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

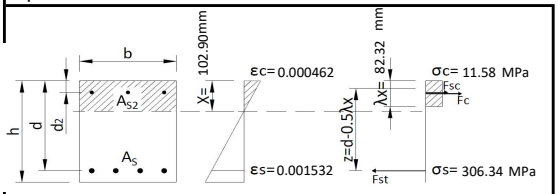
Flexure Design - Base Sagging Steel

Design Moment: 662.00 × 1.000 = 662 kNm

Step 1:-

$K = M/bd^2f_{ck}$ = 0.0672 — no compression steel req

Step 2:-



$z = d - 0.5\lambda x$ = 402.84 mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$ = 3779.6509 mm²

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$ = 946.608 mm² — ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$ = 577.2 mm² — ok

Step 6:- (Max Longitudinal Steel)

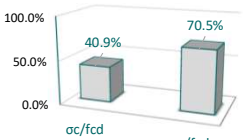
$A_{smax} = 0.04A_c$ = 17760 mm² — ok

Height of Concrete Section, h =	500	mm
Width of Concrete Section, b =	1000	mm
Exposure Class=	XC3	
Cover to Tension Steel =	40	mm
Effective Depth, d =	444	mm
Concrete Grade =	C50/60	
Type of Cement =	R	
Age of the Concrete in Days, t =	28	days
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm²
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm²
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm²
Yield strength,fy =	500	N/mm²
Max stress in steel, f_{yd} =	434.78	MPa
Max Steel Strain, ϵ_{st} =	0.002173913	
Max Concrete Strain, ϵ_{cu2} =	0.0035	
Modulus od Elasticity of Steel, E_s =	200000	N/mm²
λ =	0.8	
η=	1	
α =	0.85	
Yc=	1.5	
Ys=	1.15	
Ø =	0.666666667	
α_{cw} =	1	

Tension Steel

Bar	32	mm
Area	804.25	mm²
No req	4.70	
No used	6.67	
As Prov	5364.33	mm²
M_R	939.55	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	16	mm
Area	201.06	mm²
No req	2.87	
No used	5	
As Prov	1005.31	mm²

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x = 0 — therefore compression steel has yielded

If compression reinforcement is required then $x = x_{bal}$ = 0.45d

x = 199.8 mm

If compression reinforcement is required then z = 0.82d

z = 364.08 mm

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$ = 0 mm²

$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$ = 0 mm²

Compression Steel

Bar	25	mm
Area	490.87	mm²
No req	0.00	
No used	6.67	
As Prov	0.00	mm²
cover to CS =	45	mm
d_2 =	0	mm

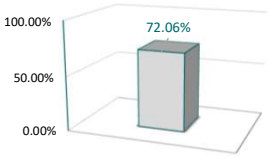
Shear Design - Base Sagging Steel

V_{Ed} = 443 kN

Shear Width = 1000 mm

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	348.8899217 kN	Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.671156055	**USE THIS VALUE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.012081829	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.534661062 MPa	**IGNORE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	237.3895116 kN	Shear links Req



Capacity with Shear links

Step 7:-

Max Allowable Shear Force -

$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$

1902.892813 kN

$v_1 = 0.6.[1-(fck/250)]$	0.48 MPa	
$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4 MPa	**- Maximum Allowable Shear Stress**
$v = (Vx10^3)/A_{sh}$	0.998 MPa	**- Actual Shear Stress**

θ =	22
cotθ =	2.475086853
θ =	22
tanθ =	0.404026226
θ = 22°	cotθ = 2.5
θ = 45°	cotθ = 1.0

Step 8:-

To Calculate Links -

$V_{Rd,s} = (A_{sw}/s)\,z\,f_{ywd}\cot\theta$

Shear Reinforcement -

$A_{sv}/s = V/(\cot\theta.0.9.d.0.87.f_{yv})$

1.029671154

(i.e. 1 leg B12 -200 c/c's = 0.565)

Use	4	10 mm Links	per meter
As prov =	314	mm2/m	
C/C's =	200	mm	> Max Spacing = 333mm
Asv/sv =	1.57	OK	> Min Asv/sv = 1.13
No. rows req =	26		

Links Only Req in unit where shear is greater than shear capacity of 348.88992 kN

Step 9:-

Additional Longitudinal Reinforcement -

$\Delta F_{td} = 0.5V_{Ed}\cot\theta$

548.231738 kN

1260.302846 mm² — ok, steel adequate — Don't Ignore

Shear Links Curtailment:

1/2 Span =	3.5	m
distance back from midspan	1	m
shear force at this location	126.57143	kN

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

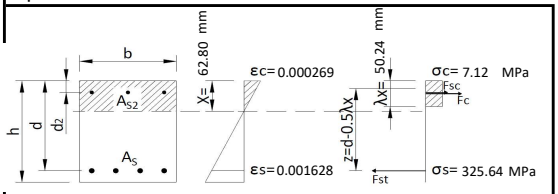
Flexure Design - Base Hogging Steel

Design Moment		
445.00	1.000	445 kNm

Step 1:-

$K = M/bd^2f_{ck}$ 0.0455 no compression steel req

Step 2:-



$z = d - 0.5\lambda x$ = 417.38 mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$ 2452.2088 mm²

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$ 943.41 mm² ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$ 575.25 mm² ok

Step 6:- (Max Longitudinal Steel)

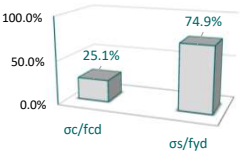
$A_{smax} = 0.04A_c$ 17700 mm² ok

Height of Concrete Section, h =	500	mm	
Width of Concrete Section, b =	1000	mm	
Exposure Class=	XC2		
Cover to Tension Steel =	45	mm	
Effective Depth, d =	442.5	mm	
Concrete Grade =	C50/60		
Type of Cement =	R		
Age of the Concrete in Days, t =	28	days	
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm²	
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm²	
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa	
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa	
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm²	
Yield strength,fy =	500	N/mm²	
Max stress in steel, f_{yd} =	434.78	MPa	
Max Steel Strain, ϵ_{st} =	0.002173913		
Max Concrete Strain, ϵ_{cu2} =	0.0035		
Modulus od Elasticity of Steel, E_s =	200000	N/mm²	
λ =	0.8		
η=	1		
α =	0.85		
Yc=	1.5		
Ys=	1.15		
Ø =	0.666666667		
α_{cw} =	1		

Tension Steel

Bar	25	mm
Area	490.87	mm²
No req	5.00	
No used	6.67	
As Prov	3274.13	mm²
M_R	594.15	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	16	mm
Area	201.06	mm²
No req	2.86	
No used	5	
As Prov	1005.31	mm²

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x = 0 therefore compression steel has yielded

If compression reinforcement is required then $x = x_{bal} = 0.45d$ x = 199.125 mm

If compression reinforcement is required then z = 0.82d z = 362.85 mm

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$ 0 mm²

$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$ 0 mm²

Compression Steel

Bar	32	mm
Area	804.25	mm²
No req	0.00	
No used	6.67	
As Prov	0.00	mm²
cover to CS =	40	mm
d_2 =	0	mm

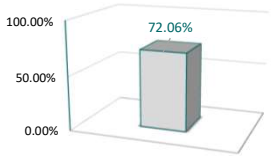
Shear Design - Base Hogging Steel

V_{Ed} = 443 kN

Shear Width = 1000 mm

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	295.5299979 kN	Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.672292645	**USE THIS VALUE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.007399161	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.535206607 MPa	**IGNORE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	236.8289237 kN	Shear links Req



Capacity with Shear links

Step 7:-

Max Allowable Shear Force -

$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$

1971.562645 kN

$v_1 = 0.6.[1-(fck/250)]$	0.48 MPa	
$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4 MPa	**- Maximum Allowable Shear Stress**
$v = (Vx10^3)/A_{sh}$	1.001 MPa	**- Actual Shear Stress**

θ =	22
cotθ =	2.475086853
θ =	22
tanθ =	0.404026226
θ = 22°	cotθ = 2.5
θ = 45°	cotθ = 1.0

Step 8:-

To Calculate Links -

$V_{Rd,s} = (A_{sw}/s)\,z\,f_{ywd}.\cot\theta$

Shear Reinforcement -

$A_{sv}/s = V/(\cot\theta.0.9.d.0.87.f_{yv})$

1.033161565

(i.e. 1 leg B12 -200 c/c's = 0.565)

Use	4	10 mm Links	per meter
As prov =	314	mm2/m	
C/C's =	200	mm	> Max Spacing = 331.875mm
Asv/sv =	1.57	OK	> Min Asv/sv = 1.13
No. rows req =	26		

Links Only Req in unit where shear is greater than shear capacity of 295.53 kN

Step 9:-

Additional Longitudinal Reinforcement -

$\Delta F_{td} = 0.5V_{Ed}\cot\theta$

548.231738 kN

1260.302846 mm² not ok,add more main steel

Ok - sag B20 @150 extended

Shear Links Curtailment:

1/2 Span =	3.5	m
distance back from midspan	1	m
shear force at this location	126.57143	kN

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

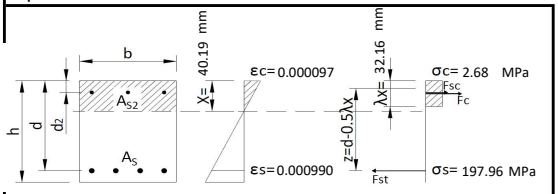
Flexure Design - Wall Sagging Steel

Design Moment		
180.00	1.000	180 kNm

Step 1:-

$K = M/bd^2f_{ck}$	0.0178	no compression steel req

Step 2:-



$z = d - 0.5\lambda x$ = 427.50 mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$	968.42105 mm^2	

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$	959.4 mm^2	ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$	585 mm^2	ok

Step 6:- (Max Longitudinal Steel)

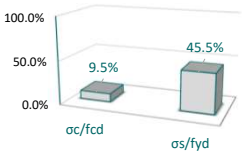
$A_{smax} = 0.04A_c$	18000 mm^2	ok

Height of Concrete Section, h =	500	mm
Width of Concrete Section, b =	1000	mm
Exposure Class=	XC3	
Cover to Tension Steel =	40	mm
Effective Depth, d =	450	mm
Concrete Grade =	C50/60	
Type of Cement =	R	
Age of the Concrete in Days, t =	28	days
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm^2
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm^2
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm^2
Yield strength,fy =	500	N/mm^2
Max stress in steel, f_{yd} =	434.78	MPa
Max Steel Strain, ϵ_{st} =	0.002173913	
Max Concrete Strain, ϵ_{cu2} =	0.0035	
Modulus od Elasticity of Steel, E_s =	200000	N/mm^2
λ =	0.8	
η=	1	
α =	0.85	
Yc=	1.5	
Ys=	1.15	
Ø =	0.666666667	
α_{cw} =	1	

Tension Steel

Bar	20	mm
Area	314.16	mm^2
No req	3.08	
No used	6.67	
As Prov	2095.44	mm^2
M_R	395.33	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	16	mm
Area	201.06	mm^2
No req	2.91	
No used	5	
As Prov	1005.31	mm^2

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x = 0 therefore compression steel has yielded

If compression reinforcement is required then $x = x_{bal} = 0.45d$

x = 202.5 mm

If compression reinforcement is required then z = 0.82d

z = 369 mm

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$	0 mm^2	
$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$	0 mm^2	

Compression Steel

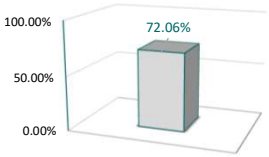
Bar	25	mm
Area	490.87	mm^2
No req	0.00	
No used	6.67	
As Prov	0.00	mm^2
cover to CS =	45	mm
d_2 =	0	mm

Shear Design - Wall Sagging Steel

V_{Ed} =	322 kN	Shear Width =	1000 mm

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	256.7228729 kN	Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.666666667	**USE THIS VALUE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.004656538	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.532508042 MPa	**IGNORE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	239.6286189 kN	Shear links Req



Capacity with Shear links

Step 7:-

Max Allowable Shear Force -	$v_1 = 0.6.[1-(fck/250)]$	0.48 MPa	
$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$	$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4 MPa	**- Maximum Allowable Shear Stress**
2019.371883 kN	$v = (Vx10^3)/A_{sh}$	0.716 MPa	**- Actual Shear Stress**

θ =	22	
cotθ =	2.475086853	
θ =	22	
tanθ =	0.404026226	

Step 8:-

To Calculate Links -	Use	4	10 mm Links	per meter	θ = 22° cotθ = 2.5
$V_{Rd,s} = (A_{sw}/s)\,z\,f_{ywd}\cot\theta$	As prov =	314	mm2/m		θ = 45° cotθ = 1.0
Shear Reinforcement -	C/C's =	200	mm	> Max Spacing = 337.5mm	
$A_{sv}/s = V/(\cot\theta.0.9.d.0.87.f_{yv})$	Asv/sv =	1.57	OK	> Min Asv/sv = 1.13	
0.738450091	No. rows req =	26			
(i.e. 1 leg B12 -200 c/c's = 0.565)	Links Only Req in unit where shear is greater than shear capacity of				256.72287 kN

Step 9:-

Additional Longitudinal Reinforcement -		
$\Delta F_{td} = 0.5V_{Ed}\cot\theta$		
398.4889834 kN		
916.0666285 mm^2	ok, steel adequate	

Shear Links Curtailment:		
1/2 Span =	2.5	m
distance back from midspan	0	m
shear force at this location	#DIV/0!	kN

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

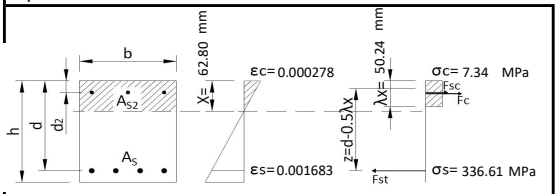
Flexure Design - Wall Hogging Steel

Design Moment		
460.00	1.000	460 kNm

Step 1:-

$K = M/bd^2f_{ck}$	0.0470	no compression steel req

Step 2:-



$z = d - 0.5\lambda x$ = 417.38 mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$	2534.8676 mm²	

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$	943.41 mm²	ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$	575.25 mm²	ok

Step 6:- (Max Longitudinal Steel)

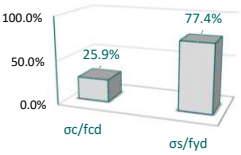
$A_{smax} = 0.04A_c$	17700 mm²	ok

Height of Concrete Section, h =	500	mm
Width of Concrete Section, b =	1000	mm
Exposure Class=	XC2	
Cover to Tension Steel =	45	mm
Effective Depth, d =	442.5	mm
Concrete Grade =	C50/60	
Type of Cement =	R	
Age of the Concrete in Days, t =	28	days
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm²
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm²
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm²
Yield strength,fy =	500	N/mm²
Max stress in steel, f_{yd} =	434.78	MPa
Max Steel Strain, ϵ_{st} =	0.002173913	
Max Concrete Strain, ϵ_{cu2} =	0.0035	
Modulus od Elasticity of Steel, E_s =	200000	N/mm²
λ =	0.8	
η=	1	
α =	0.85	
Yc=	1.5	
Ys=	1.15	
Ø =	0.666666667	
α_{cw} =	1	

Tension Steel

Bar	25	mm
Area	490.87	mm²
No req	5.16	
No used	6.67	
As Prov	3274.13	mm²
M_R	594.15	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	16	mm
Area	201.06	mm²
No req	2.86	
No used	5	
As Prov	1005.31	mm²

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x = 0 therefore compression steel has yielded

If compression reinforcement is required then $x = x_{bal} = 0.45d$: x = 199.125 mm

If compression reinforcement is required then z = 0.82d : z = 362.85 mm

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$	0	mm²
$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$	0	mm²

Compression Steel

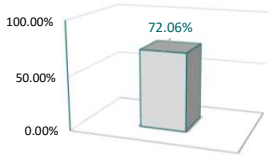
Bar	20	mm
Area	314.16	mm²
No req	0.00	
No used	6.67	
As Prov	0.00	mm²
cover to CS =	40	mm
d_2 =	0	mm

Shear Design - Wall Hogging Steel

V_{Ed} =	322	kN	
Shear Width =	1000	mm	

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	295.5299979 kN	Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.672292645	**USE THIS VALUE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.007399161	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.535206607 MPa	**IGNORE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	236.8289237 kN	Shear links Req



Capacity with Shear links

Step 7:-

Max Allowable Shear Force -	$v_1 = 0.6.[1-(fck/250)]$	0.48 MPa	
$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$	$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4 MPa	**- Maximum Allowable Shear Stress**
1971.562645 kN	$v = (Vx10^3)/A_{sh}$	0.728 MPa	**- Actual Shear Stress**

θ =	22
cotθ =	2.475086853
θ =	22
tanθ =	0.404026226
θ = 22°	cotθ = 2.5
θ = 45°	cotθ = 1.0

Step 8:-

To Calculate Links -	Use	4	10 mm Links	per meter
$V_{Rd,s} = (A_{sw}/s)\,z\,f_{ywd}.\cot\theta$	As prov =	314	mm2/m	
Shear Reinforcement -	C/C's =	200	mm	> Max Spacing = 331.875mm
$A_{sv}/s = V/(\cot\theta.0.9.d.0.87.f_{yv})$	Asv/sv =	1.57	OK	> Min Asv/sv = 1.13
0.750966194	No. rows req =	26		
(i.e. 1 leg B12 -200 c/c's = 0.565)	Links Only Req in unit where shear is greater than shear capacity of			295.53 kN

Step 9:-

Additional Longitudinal Reinforcement -			Shear Links Curtailment:
$\Delta F_{td} = 0.5V_{Ed}\cot\theta$			1/2 Span = 2.5 m
398.4889834 kN			distance back from midspan 0 m
916.0666285 mm²	not ok,add more main steel	Ok - sag B32 @150 extended	shear force at this location #DIV/0! kN

Crack Width Calculation to EC2	Date:	05/12/2019
Rectangular Cross - Section	Prepared by:	Adrian Pilch
Roof Sagging	Checked by:	0

BANAGHER PRECAST CONCRETE

Design Data:

Insertion site: Ireland

Concrete Grade =		C50/60	
Actual Concrete Cover to Tension Reinforcement: C_{nom} =		40	mm
Width of Concrete Section Being Considered: b =		1000	mm
Height of Concrete Section Being Considered: h=		500	mm
Effective Depth, d =		444	mm
Depth to Compression Steel, d_2=		67.5	mm
Quasi Permanent Moment, M =		460	kNm/m width
Exposure Class =		XC3	
Allowable Crack Width, w_{cr} =		0.25	mm
Modulus of Elasticity of Reinforcement, E_s =		200	kN/mm^2
Age of Concrete in Days, t=		28	days
Mean Value of the Concrete Tensile Strength at an Age t, fctm (t) =		4.10	Mpa
Modulus of Elasticity of Concrete at Age t, E_{cm} =		37.00	kN/mm^2
Final Value of Creep Coefficient, φ =		1	
Efective Modulus of Elasticity of Concrete, Eceff(t) = Ecm(t)/(1+φ)=		18.500	kN/mm^2
Modular Ratio with Eceff, αeff=Es/Eceff(t), αeff =		10.811	
Tension steel	A_s provided =	5364.33	mm^2
	Consisting of =	6.67	nr
		32	mm
Compression steel	A_{s2} provided =	3274.13	mm^2
Center of Gravity - Uncraked Section , x_1=		258.07	mm
Section Modulus about the Tension Side, Wts =		56792127.63	mm^4
Cracking Moment Mcr= Wts * fctm (t) =		232.85	kNm
Cracking Moment is lower than Quasi Permanent Moment - Crack Width should be calculate			

Equation of Total of Static Moments about the Neutral Axis After Cracked:

$b*x_2*0.5x_2 + \alpha eff*A_{s2}(x2 - d_2) = \alpha eff*A_s(d-x_2)$ $\quad x_2$= 161.56 mm

Tensile Stress in Steel, σ_s = $M/(d-x_2/3)A_s$ = 219.7927 N/mm2

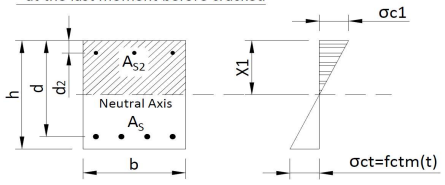
Calculated Crack Width, $W_k = S_{r\,max}(\epsilon_{sm} - \epsilon_{cm})$

= 0.221 mm OK

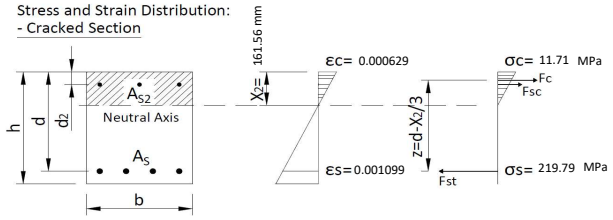
NA to I.S.EN 1992-2:2005 Tab NA.2	
Exposure Class	W_{max}
X0,XC1	0.25
XC2,XC3,XC4	0.25
XD1,XD2,XD3,XS1,XS2,XS3	0.1

B.S.EN 1992-2:2005 Table 7.101N	
Exposure Class	W_{max}
X0,XC1	0.3
XC2,XC3,XC4	0.3
XD1,XD2,XD3,XS1,XS2,XS3	0.3

Stress Distribution:
- at the last moment before cracked



Stress and Strain Distribution:
- Cracked Section



The strain difference (ε_{sm}-ε_{cm}) may be calculated from the expression:

$$(\varepsilon_{sm}-\varepsilon_{cm}) = \frac{\sigma_s}{E_s} - k_t\cdot\varepsilon_{sr} = \frac{\sigma_s - k_t\frac{f_{cm}}{\rho_{eff}}(1+\alpha\rho_{eff})}{E_s} \geq 0.6\frac{\sigma_s}{E_s} \quad (1.31)$$

$\epsilon_{sm} - \epsilon_{cm}$ = 0.00088219

where

σ_s stress in the tension reinforcement assuming a cracked section. — σ_s = 219.79 N/mm2; σ_c = 11.71 N/mm2

ε_{sr} $\varepsilon_{sr} = \frac{\sigma_{sr}}{E_s} \approx \frac{\frac{f_{cm}}{\rho_{eff}}(1+\alpha\rho_{eff})}{E_s}$. This is a simplification which is exact for pure tension but not for bending. However, this simplification makes it easier to apply the model in practical cases and does not imply any significant loss of accuracy as is shown below. — ϵ_s = 0.001099; therefore:, ϵ_c = 0.000629

α_e ratio E_s/E_c — α_e = 5.405

$\rho_{p,eff} = \frac{A_s}{A_{c,eff}}$ — $\rho_{P,\,eff}$ = 0.047550142

$A_{c,eff}$ effective tension area. $A_{c,eff}$ is the area of concrete surrounding the tension reinforcement of depth, $h_{c,ef}$, where $h_{c,ef}$ is the lesser of $2.5(h-d)$, $(h-x)/3$ or $h/2$ (see figure). — $A_{c,eff}$ = 112814.2212 mm^2; $h_{c,ef}$ = 112.8142212 mm

k_t factor dependent on the duration of the load; k_t = 0,6 for short term loading; k_t = 0,4 for long term loading — k_t = 0.4

In situations, where bonded reinforcement is fixed at reasonably close spacing within the tension zone (spacing ≤ 5(c+ϕ/2), the maximum final crack spacing can be calculated from the expression:

5(c+Ø/2)= 280 mm; spacing= 31.25 mm; spacing ≤ 5(c+Ø/2); hence, Formula (1.32) is using

$$s_{r\,max} = 3.4c + 0.425k_1k_2\frac{\phi}{\rho_{p,eff}} \quad (1.32)$$

$S_{r\,max}$ = 250.41 mm

where

ϕ bar diameter. — Ø = 32 mm

c cover to the reinforcement — c = 40 mm

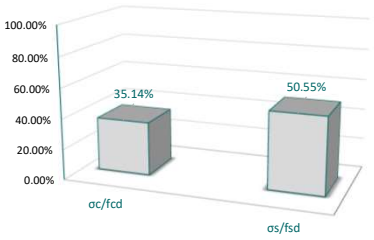
k_1 coefficient which takes account of the bond properties of the bonded reinforcement; = 0.8 for high bond bars; = 1.6 for bars with an effectively plain surface — k_1 = 0.8 for ribbed bars

k_2 coefficient which takes account of the distribution of strain; k_2 = 0.5 for bending; = 1.0 for pure tension; For cases of eccentric tension or for local areas, intermediate values of k_2 should be used which can be calculated from the relation: $k_2 = \frac{(\varepsilon_1+\varepsilon_2)}{2\varepsilon_1}$; Where ε_1 is the greater and ε_2 is the lesser tensile strain at the boundaries of the section considered, assessed on the basis of a cracked section. — k_2 = 0.5 for flexure

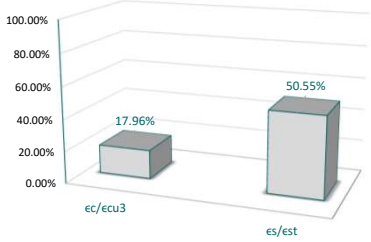
Where the spacing of the bonded reinforcement exceeds 5(c+ϕ/2) (see Figure 7.2) or where there is no bonded reinforcement within the tension zone, an upper bound to the crack width may be found by assuming a maximum crack spacing:

$s_{r,max} = 1.3\,(h - x)$ (7.14)

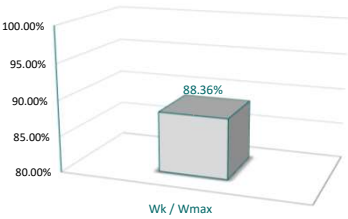
Percent of allowable stresses -post crack



Percent of allowable strains -post crack



Relation of W_k to W_{max}



Crack Width Calculation to EC2	Date:	05/12/2019
Rectangular Cross - Section	Prepared by:	Adrian Pilch
Roof Hogging	Checked by:	0

BANAGHER PRECAST CONCRETE

Design Data:

Insertion site: Ireland

Concrete Grade =		C50/60	
Actual Concrete Cover to Tension Reinforcement: C_{nom} =		55	mm
Width of Concrete Section Being Considered: b =		1000	mm
Height of Concrete Section Being Considered: h=		500	mm
Effective Depth, d =		432.5	mm
Depth to Compression Steel, d_2=		0	mm
Quasi Permanent Moment, M =		98	kNm/m width
Exposure Class =		XD2	
Allowable Crack Width, w_{cr} =		0.1	mm
Modulus of Elasticity of Reinforcement, E_s =		200	kN/mm^2
Age of Concrete in Days, t=		28	days
Mean Value of the Concrete Tensile Strength at an Age t, fctm (t) =		4.10	Mpa
Modulus of Elasticity of Concrete at Age t, E_{cm} =		37.00	kN/mm^2
Final Value of Creep Coefficient, φ =		1	
Efective Modulus of Elasticity of Concrete, Eceff(t) = Ecm(t)/(1+φ)=		18.500	kN/mm^2
Modular Ratio with Eceff, αeff=Es/Eceff(t), αeff =		10.811	
Tension steel	A_s provided =	3274.13	mm^2
	Consisting of =	6.67	nr
		25	mm
Compression steel	A_{s2} provided =	0.00	mm^2
Center of Gravity - Uncraked Section , x_1=		262.07	mm
Section Modulus about the Tension Side, Wts =		48406724.16	mm^4
Cracking Moment Mcr= Wts * fctm (t) =		198.47	kNm
Cracking Moment is bigger than Quasi Permanent Moment - Cross section does not crack			

Equation of Total of Static Moments about the Neutral Axis After Cracked:

$b*x_2*0.5x_2 + \alpha eff*A_{s2}(x2 - d_2) = \alpha eff*A_s(d-x_2)$ $\quad x_2$= mm

Tensile Stress in Steel, σ_s = $M/(d-x_2/3)A_s$ N/mm2

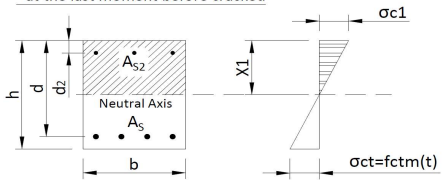
Calculated Crack Width, $W_k = S_{r\,max}(\epsilon_{sm} - \epsilon_{cm})$

= mm

NA to I.S.EN 1992-2:2005 Tab 7.NA.2	
Exposure Class	W_{max}
X0,XC1	0.25
XC2,XC3,XC4	0.25
XD1,XD2,XD3,XS1,XS2,XS3	0.1

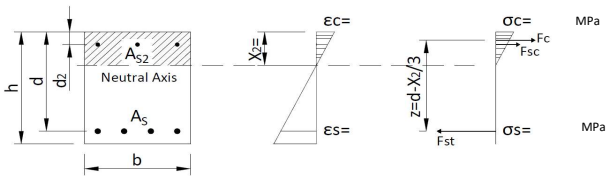
B.S.EN 1992-2:2005 Table 7.101N	
Exposure Class	W_{max}
X0,XC1	0.3
XC2,XC3,XC4	0.3
XD1,XD2,XD3,XS1,XS2,XS3	0.3

Stress Distribution:
- at the last moment before cracked



Stress and Strain Distribution:
- Cracked Section

mm



The strain difference (ε_{sm}-ε_{cm}) may be calculated from the expression:

$$(\varepsilon_{sm}-\varepsilon_{cm}) = \frac{\sigma_s}{E_s} - k_t\cdot\varepsilon_{sr} = \frac{\sigma_s - k_t\frac{f_{c.eff}}{\rho_{p.eff}}(1+\alpha\rho_{p.eff})}{E_s} \geq 0.6\frac{\sigma_s}{E_s} \quad (1.31)$$

$\epsilon_{sm} - \epsilon_{cm}$ =

where

σ_s	stress in the tension reinforcement assuming a cracked section.	σ_s =	N/mm2
		σ_c =	N/mm2
ε_{sr}	$\varepsilon_{sr} = \frac{\sigma_{sr}}{E_s} \approx \frac{\frac{f_{c.eff}}{\rho_{p.eff}}(1+\alpha\rho_{p.eff})}{E_s}$. This is a simplification which is exact for pure tension but not for bending. However, this simplification makes it easier to apply the model in practical cases and does not imply any significant loss of accuracy as is shown below.	ϵ_s =	
		therefore:, ϵ_c =	
α_e	ratio E_s/E_c	α_e =	
$\rho_{p,eff}$	$= \frac{A_s}{A_{c,eff}}$	ρ_P, eff =	
$A_{c,eff}$	effective tension area. $A_{c,eff}$ is the area of concrete surrounding the tension reinforcement of depth, $h_{c,ef}$, where $h_{c,ef}$ is the lesser of 2,5(h-d), (h-x)/3 or h/2 (see figure).	$A_{c,eff}$ =	mm^2
		$h_{c,ef}$ =	mm
k_t	factor dependent on the duration of the load k_t = 0,6 for short term loading k_t = 0,4 for long term loading	k_t =	0.4

In situations, where bonded reinforcement is fixed at reasonably close spacing within the tension zone (spacing ≤ 5(c+ϕ/2), the maximum final crack spacing can be calculated from the expression:

5(c+Ø/2)= mm

spacing= mm

spacing

$$s_{r\,max} = 3.4c + 0.425k_1k_2\frac{\phi}{\rho_{p,eff}} \quad (1.32)$$

$S_{r\,max}$ = mm

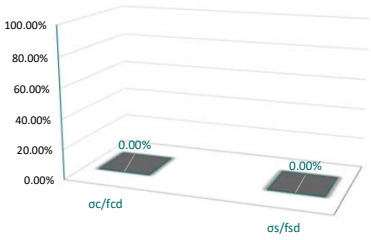
where

ϕ	bar diameter.	Ø =	25 mm
c	cover to the reinforcement	c =	55 mm
k_1	coefficient which takes account of the bond properties of the bonded reinforcement; = 0.8 for high bond bars = 1.6 for bars with an effectively plain surface	k_1 =	0.8 for ribbed bars
k_2	coefficient which takes account of the distribution of strain; k_2 = 0.5 for bending = 1.0 for pure tension For cases of eccentric tension or for local areas, intermediate values of k_2 should be used which can be calculated from the relation: $k_2 = \frac{(\varepsilon_1+\varepsilon_2)}{2\varepsilon_1}$ Where ε_1 is the greater and ε_2 is the lesser tensile strain at the boundaries of the section considered, assessed on the basis of a cracked section.	k_2 =	0.5 for flexure

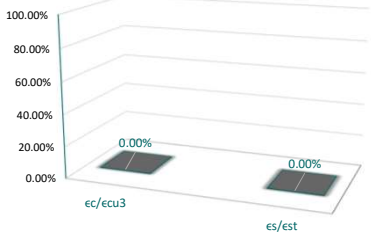
Where the spacing of the bonded reinforcement exceeds 5(c+ϕ/2) (see Figure 7.2) or where there is no bonded reinforcement within the tension zone, an upper bound to the crack width may be found by assuming a maximum crack spacing:

$s_{r,max}$ = 1,3 (h - x) (7.14)

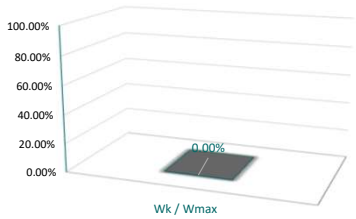
Percent of allowable stresses
-post crack



Percent of allowable strains
-post crack



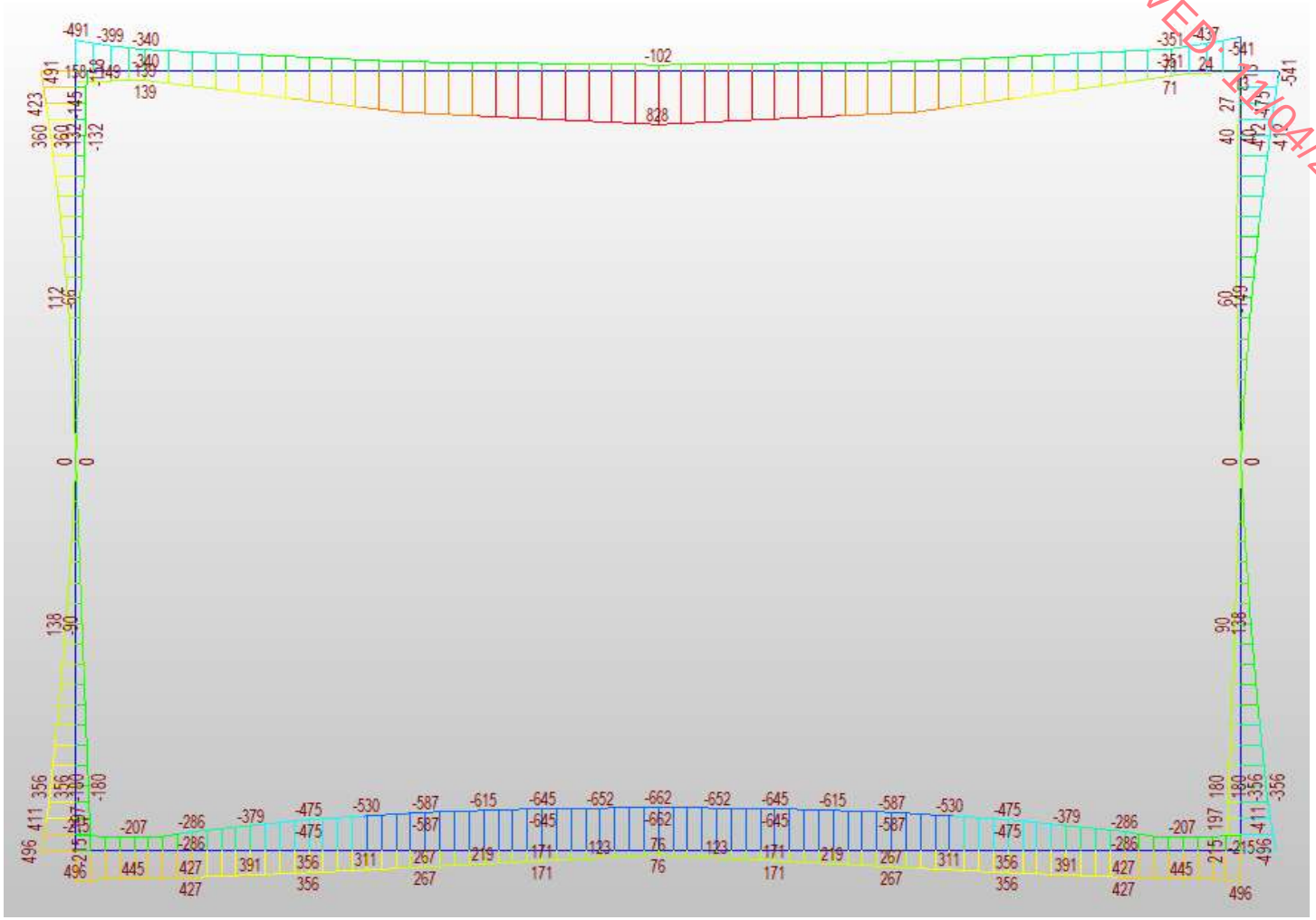
Relation of W_k to W_{max}



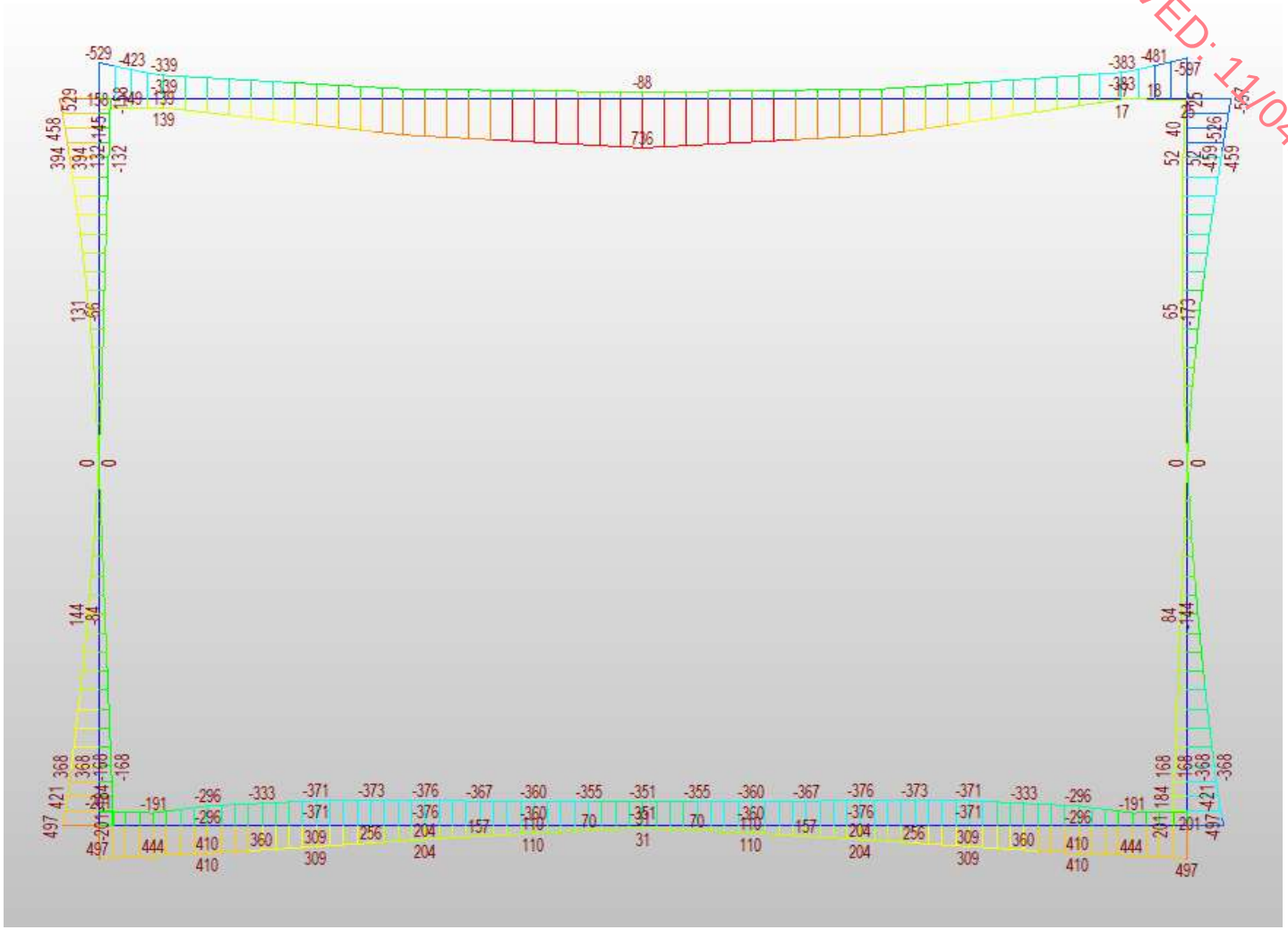
BANAGHER PRECAST CONCRETE

APPENDIX

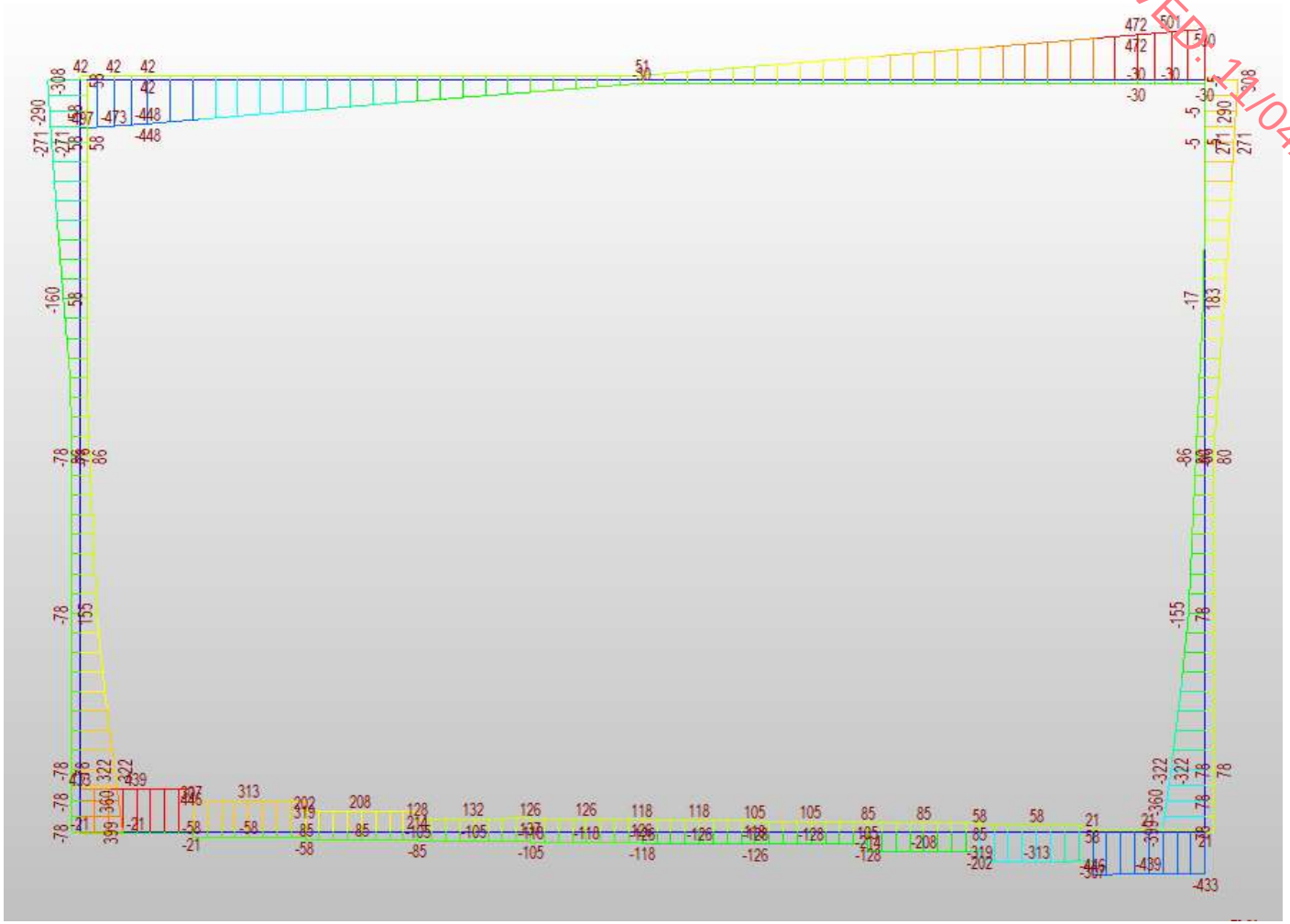
Bending Moment & Shear Force Diagrams
Design Risk Assessment
Permanent Works Design Cert
Lifting Calculations
Spring Stiffness Calculation
Bearing Pressure Calculation
Rebar Sketch



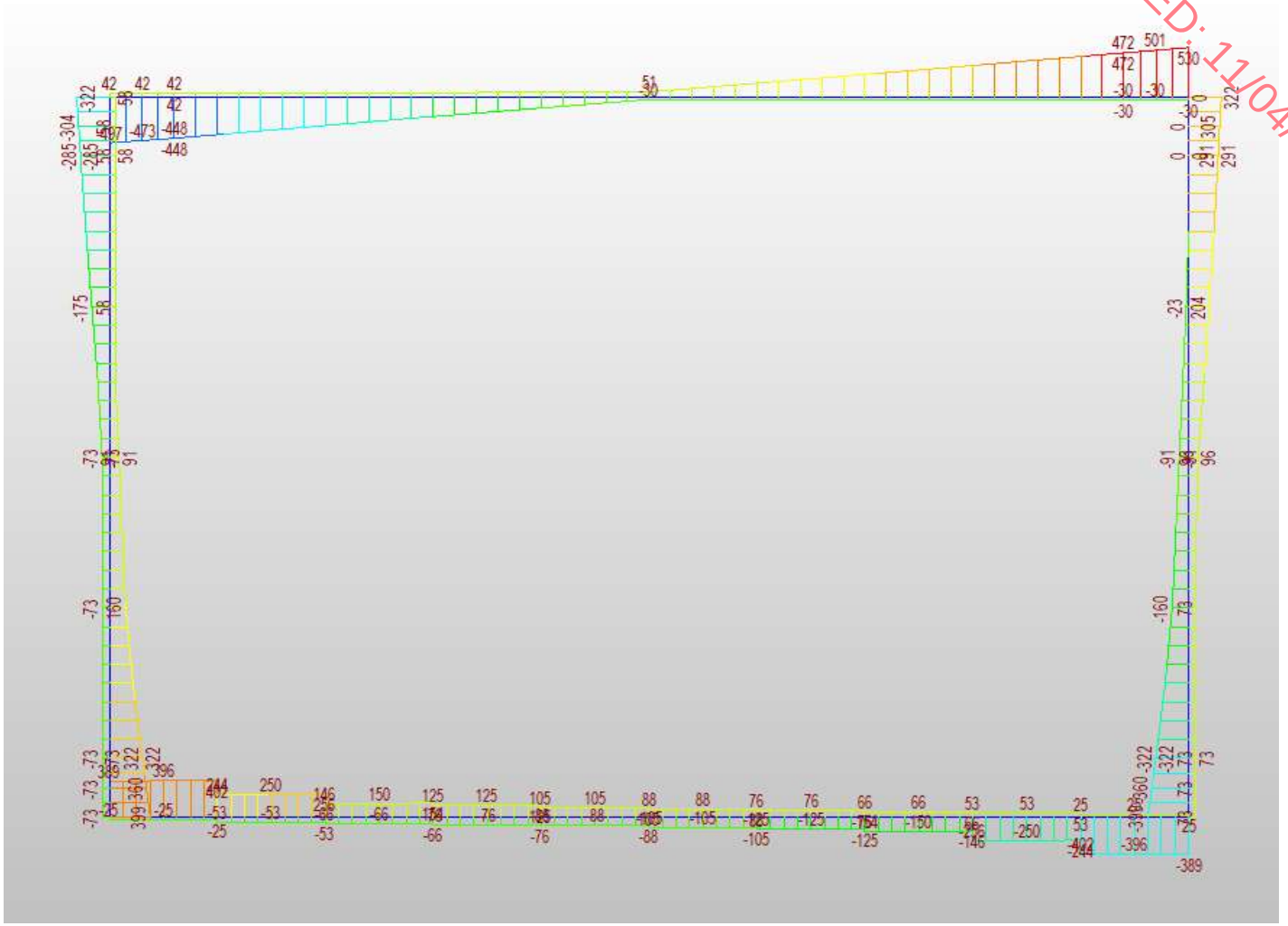
BENDING MOMENT DIAGRAM , E=32 MPa



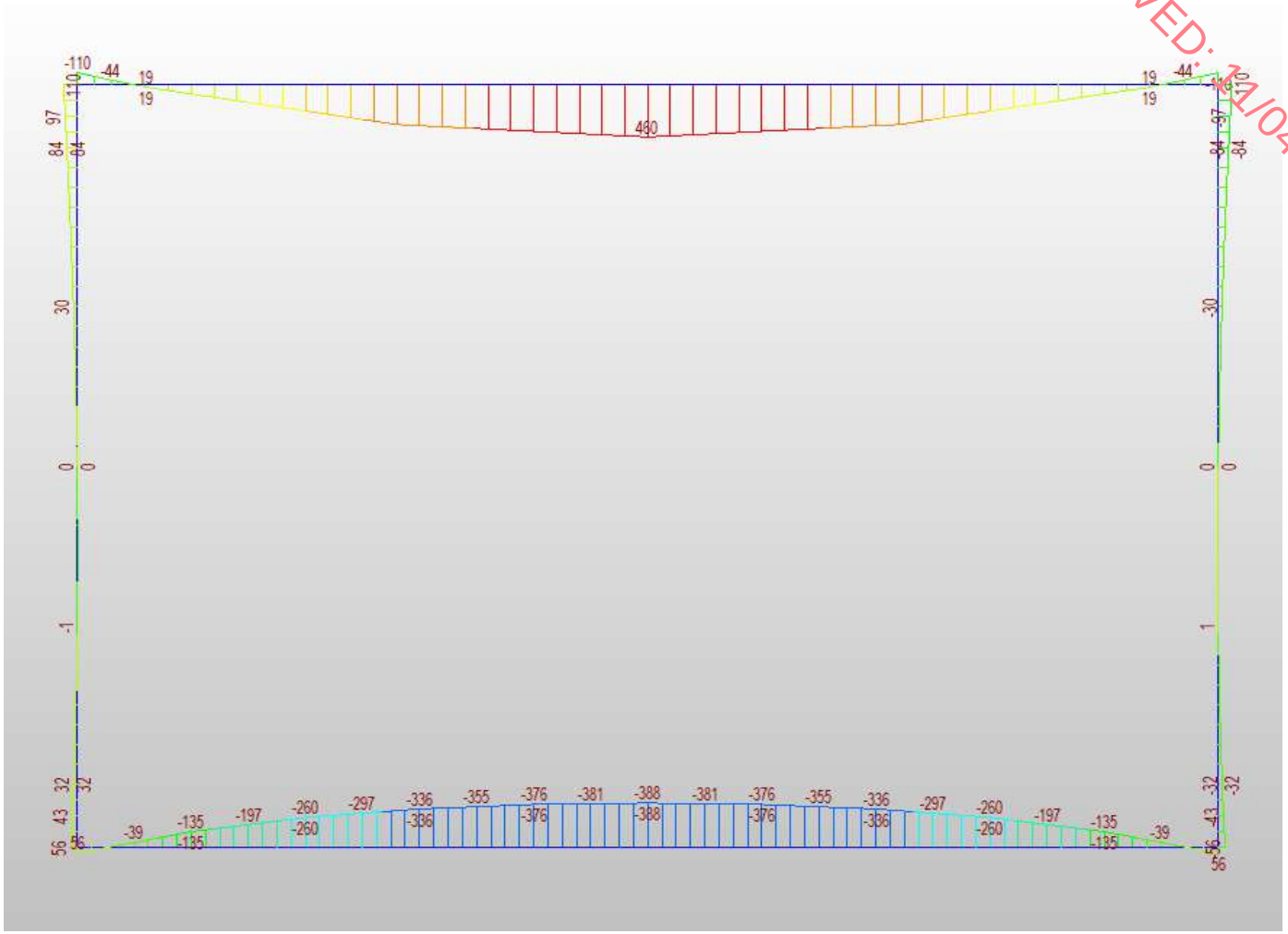
BENDING MOMENT DIAGRAM , E=117 MPa



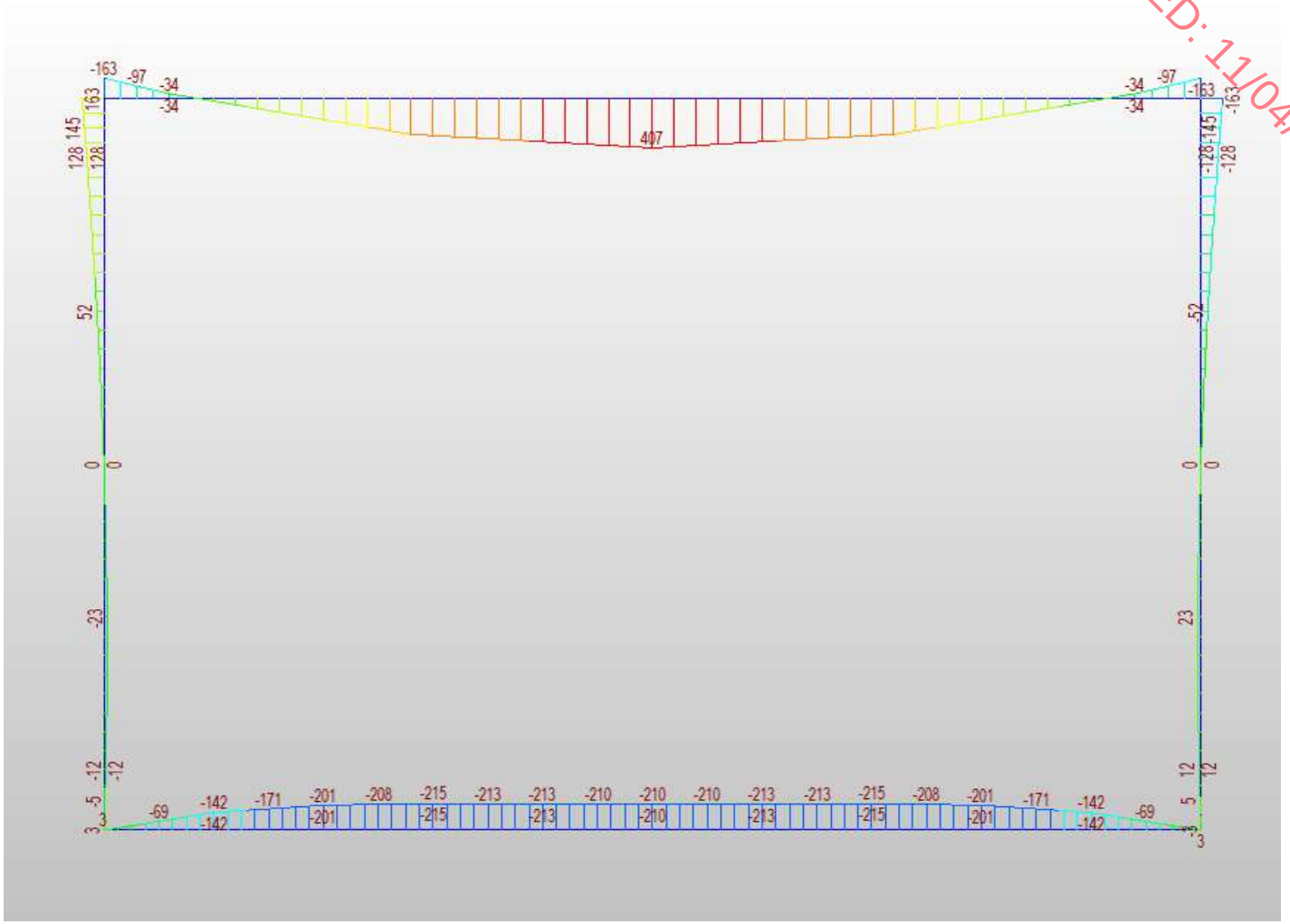
SHEAR FORCE DIAGRAM , E=32 MPa



SHEAR FORCE DIAGRAM , E=117 MPa



QUASI PERMANENT BENDING MOMENT DIAGRAM , E=32 MPa



QUASI PERMANENT BENDING MOMENT DIAGRAM , E=117 MPa

BANAGHER PRECAST CONCRETE

Design Risk Assessment

Job Title:	R179 Carrickmackross & Kingscourt	Prepared by:	AP
Date:	29/11/2019	Checked by:	

This DRA assumes that competent contractors are used at all times during the construction process. They will therefore be aware of the risks normally associated with precast installation. This designer's risk assessment highlights hazards that are unusual or non standard.

Identified Hazard:	People at Risk				Mitigation of Risk	Risk Category		Detailed Action
	A	B	C	D		Likelihood	Severity	
1 - Injury during loading and unloading					Only authorised lifting eyes to be used. Design to take account of lifters required per unit weight. Design to also take account of unit sizes with regard to transportability. Lifters to be clearly marked on production dwgs.	LOW	HIGH	**BPC Ltd. & Contractor** - All lifting equipment to be in test. Contractor to have correct lifting equipment on site as per BPC Ltd. production dwgs
2 - Fabrication of precast concrete units. Handling of constituent materials/ mould oils.					Correct use of PPE. Trained and approved Banagher Precast Concrete personnel to carry out work only	LOW	LOW	**BPC Ltd.** - Training and PPE to be available to workers
3 - Errors in fabrication and precasting of the units leading to substandard structure					Precast units to be regularly inspected and surveyed. Final survey of precast elements to be undertaken prior to delivery.	LOW	MED	**BPC Ltd.** - Quality engineer to be asigned to each project. A set of production dwgs to be produced for each precast element manufactured
4 - Transportation					Design to take account of unit sizes with regard to transportability. Units to be properly secured to trailors and checked by transport manager before delivery.	LOW	HIGH	**BPC Ltd. & Contractor** - All securing equipment to be visually inspected by Haulier prior to units leaving the factory. Contractor to report any defective securing gear when offloading
5 - Tripping or falling on rebar					Use of mushroom caps to protect	MED	MED	**BPC Ltd. & Contractor** - All rebar that is projecting from a precast unit that could cause an accident to be identified and protected with mushroom caps if necessary
6 - The placing of Precast Sections in the wrong location					(1) All precast units are clearly marked during precasting. (2) Install to layout drawings. (3) Check markings.	LOW	LOW	**BPC Ltd. & Contractor** - Units to be installed as per the layout dwgs using the info marked on the units themselves
7 - Alterations to Banagher Precast Concrete Limited Products.					No alterations i.e. Cutting, Drilling, Boring, etc to be done without consulting Banagher Precast Concrete Limited Technical Department	MED	MED	**Contractor** - Check with BPC Ltd. before altering any units on site
8								
9								
10								

Key:

A = Banagher Precast Operative
B = General Public
C = Site Personnel
D = Maintenance Workers

Likelihood of occurence

HIGH	- Certain or near certain to occur
MED	- Reasonably likely to occur
LOW	- Very seldom or nevero occurs

Likelihood of severity

HIGH	- Fatality / Serious Injury / Permanent disability or illness
MED	- Injury or illness causing short term disability
LOW	- Other minor injury or illness

Detailed Action

HIGH	- Contractor/BPC to manage risk
MED	- Contractor/BPC to manage risk
LOW	- Risk designed out

PERMANENT WORKS DESIGN CERTIFICATE

BANAGHER PRECAST CONCRETE

Name of Project: R179 Carrickmackross & Kingscourt
Name of Structure: U on U_Large Structure
Specific Element Checked: Precast Culverts Only
Structure Ref No: NA

We hereby certify to the Employer in respect of the design and check of the above detailed element(s) that reasonable professional skill, care and diligence have been taken by us with a view to securing that this divided part of the Design Element: -

(i) Complies with the Contract Requirements;
(ii) Is not detrimental to the whole Design
(iii) Has been accurately translated into Design Data (including but not limited to, calculations, drawings, schedules and specifications) (including lifting requirements) bearing the unique reference numbers listed below:

Calculation No./date =
Drawing No. = NA
Additional Info. = Design calculations attached
Designed in accordance with = Eurocode 1 "Actions on structures – Part 2: Traffic loads on bridges" , Eurocode 2 "Design of concrete structures" and PD6694 "Recommendations for the design for structures subject to traffic loading"

DESIGNER
Signed: Adrian Pilch Firm: Banagher Precast Concrete Ltd

Name: Adrian Pilch Date: 29/11/2019

Qualifications: Structural Engineer
BEc, BSc, MSc, CEng, MIEI

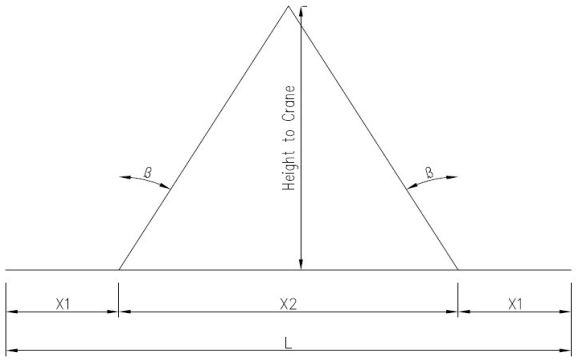
Receipt of this certificate is acknowledged
Signed: Firm: Golder

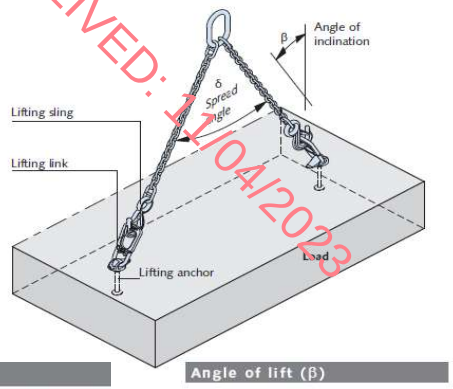
Name: Date

Lifting Calculation

BANAGHER PRECAST CONCRETE

Name of Project: R179 Carrickmackross & Kingscourt
Name of Structure: U on U_Large Structure
Type of PC: Culvert
Designed by: Adrian Pilch
Checked by:





The below is based on " DEHA Lifting Anchor System"

Calculation parameters:		Banagher	On Site	
G, Mass	=	32.5365	32.5365	t
A, Mould Area	=	23.88	23.88	m^2
q, Adhesion to formwork	=	1	1	kN/m^2
n, Number of effective lifters	=	4	2	nr
f, Lifting load coefficent	=	1.3	1.1	
β, Angle of lift	=	25	25	degrees
z, cable angle factor	=	1.10	1.10	
βw, Concrete strength	=	25	50	N/mm^2
L	=		4.80	m
X1	=		1.00	m
X2	=		2.80	m
Height to crane	=		2.54	m

Step 1:
Lifting from the mould(demoulding)
F = (G + q x A)x z / n
96.34 kN **9.63 t**

Step 2:
Transport in the yard
F = G + f x z / n
116.68 kN **11.67 t**

Step 3:
Transport on site - assuming all lifters are equally loaded
F = G x f x z / n
197.45 kN **19.75 t**

Applicable Lifters =	**20 T**
Type of lifter =	**Lifting Pins**

BPC Available Lifters		
	Lifting Sockets	Lifting Pins
Size	Safe Working Load (T)	Safe Working Load (T)
M12	0.50	1.30
M16	1.20	2.50
M20	2.00	5.00
M24	2.50	7.50
M30	4.00	10.00
M36	6.30	15.00
M42	8.00	20.00
M52	12.50	32.00

Adhesion to the mould	
for smooth, oiled moulds	$q = 1\ kN/m^2$
for smooth, non-oiled moulds	$q = 2\ kN/m^2$
for rough moulds	$q = 3\ kN/m^2$

Crane Factors

Lift Equipment	Lifting Speed [m/min.]	Impact Factor ψ
Stationary Crane, Revolving Crane, Rail-mounted Crane	< 90	1.0 - 1,2
Stationary Crane, Revolving Crane, Rail-mounted Crane	≥ 90	1.3 - 1,4
Lifting and transporting with excavator on even ground	-	1.5 - 1,65
Lifting and transporting with excavator on uneven ground	-	≥ 2.0

Angle of lift (β)

If a lifting sling is used in a triangle form, the acting forces on the anchors (sling loads) are increasing compared to simple vertical lifting. As the angle of lift (β) increases, the acting forces on the anchors and slings increase as well. This influence is taken into account by factor ω dependent on angle β.

$z = 1 / \cos \beta$

Information:

For avoiding sloped hanging position of the precast elements, the position of the hook at a spreader beam should be straight above the centre of gravity.

If lifting is executed without spreader beam, the anchors should be positioned symmetrically to the centre of gravity.

Please see production dwgs for detailed lifting diagram, please also see the Banagher Precast Concrete "Bridge Beam Manual" for additional details on lifting, handling, delivery and installation.

PRECAST CONCRETE SPECIALISTS

Job: R179 Carrickmackross Option one - E = 32 MPa

			SS model length			
Foundation Width	8	m	0.8	m	10	divisions
Foundation Length	1	m	1	m		
Area	8					
E	32	MPa				

Spring stiffness calculation guidance to EC Hambley - Chapter 14

Kz	$1.5EA^{0.5}$	Vertical
Kx	$EA^{0.5}$	Horizontal
Km	1.5EA	Rocking stiffness (Moment)

Kz	135764.5	kPa			
Kx	90509.67	kPa			
Kz	13576.45	kPa	per m width per	0.8	m length
Kx	9050.967	kPa	per m width per	0.8	m length
Kz	6788.225	kPa	per m width per	0.4	m length
Kx	4525.483	kPa	per m width per	0.4	m length

Check			
Kz	135764.5	kPa	ok
Kx	90509.67	kPa	ok

Typical values of Young's modulus for granular material (MPa) (based on Obrzud & Truty 2012 complied from Kezdi 1974 and Prat et al. 1995)

USCS	Description	Loose	Medium	Dense
GW, SW	Gravels/Sand well-graded	30-80	80-160	160-320
SP	Sand, uniform	10-30	30-50	50-80
GM , SM	Sand/Gravel silty	7-12	12-20	20-30

Typical values of Young's modulus for cohessive material (MPa) (based on Obrzud & Truty 2012 compiled from Kezdi 1974 and Prat et al. 1995)

USCS	Description	Very soft to soft	Medium	Stiff to very stiff	Hard
ML	Silts with slight plasticity	2.5 - 8	10 - 15	15 -40	40 - 80
ML, CL	Silts with low plasticity	1.5 - 6	6 -10	10 - 30	30 -60
CL	Clays with low-medium plasticity	0.5 - 5	5 -8	8 - 30	30 - 70
CH	Clays with high plasticity	0.35 - 4	4 -7	7 - 20	20 - 32
OL	Organic silts	-	0.5 -5	-	-
OH	Organic clays	-	0.5 -4	-	-

Job: R179 Carrickmackross Option two - E = 117 MPa

			SS model length			
Foundation Width	8	m	0.8	m	10	divisions
Foundation Length	1	m	1	m		
Area	8					
E	117	MPa				

Spring stiffness calculation guidance to EC Hambley - Chapter 14

Kz	$1.5EA^{0.5}$	Vertical
Kx	$EA^{0.5}$	Horizontal
Km	1.5EA	Rocking stiffness (Moment)

Kz	496389	kPa		
Kx	330926	kPa		
Kz	49638.9	kPa	per m width per	0.8 m length
Kx	33092.6	kPa	per m width per	0.8 m length
Kz	24819.45	kPa	per m width per	0.4 m length
Kx	16546.3	kPa	per m width per	0.4 m length

Check			
Kz	496389	kPa	ok
Kx	330926	kPa	ok

Typical values of Young's modulus for granular material (MPa) (based on Obrzud & Truty 2012 complied from Kezdi 1974 and Prat et al. 1995)

USCS	Description	Loose	Medium	Dense
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Typical values of Young's modulus for cohessive material (MPa) (based on Obrzud & Truty 2012 compiled from Kezdi 1974 and Prat et al. 1995)

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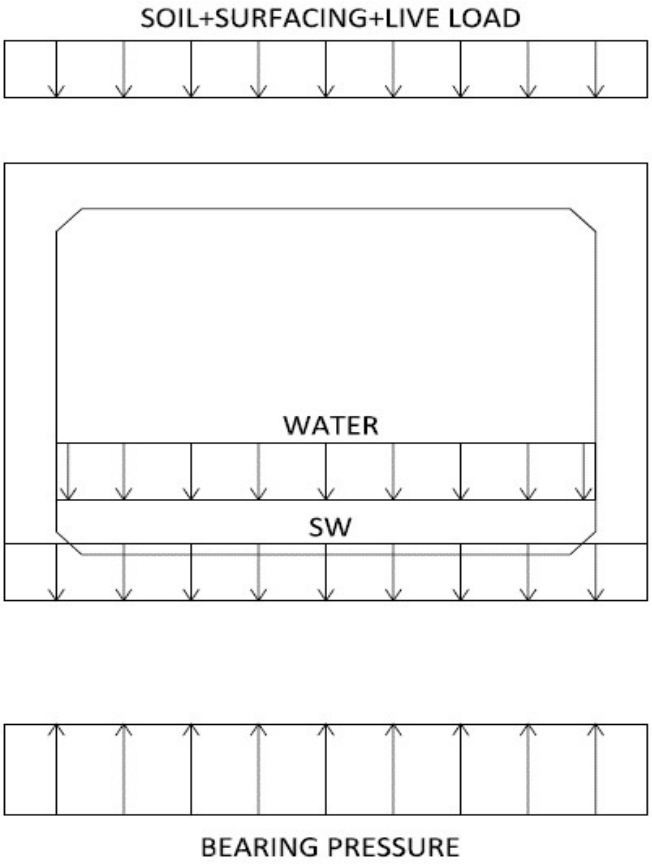
ML	Silts with slight plasticity	2.5 - 8	10 - 15	15 -40	40 - 80
ML, CL	Silts with low plasticity	1.5 - 6	6 -10	10 - 30	30 -60
CL	Clays with low-medium plasticity	0.5 - 5	5 -8	8 - 30	30 - 70
CH	Clays with high plasticity	0.35 - 4	4 -7	7 - 20	20 - 32
OL	Organic silts	-	0.5 -5	-	-
OH	Organic clays	-	0.5 -4	-	-

Bearing pressure at serviceability limit state

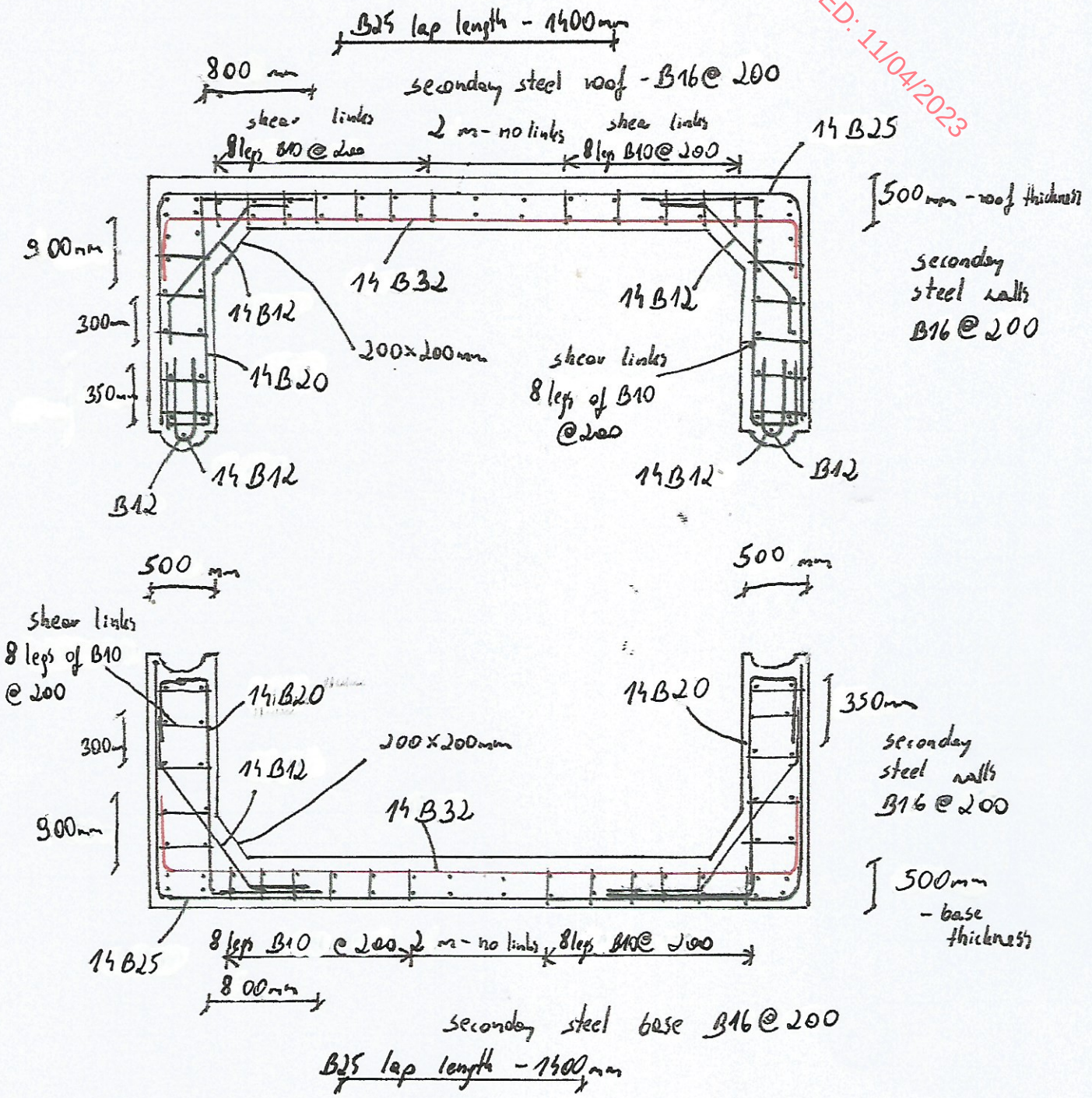
V- Total Vertical Load = 1371.484 kN

p= V/ (beff x L) = 172.00 kN/m^2 **Bearing pressure from unit**



BANAGHER
PRECAST CONCRETE

Date: 28/11/2018
Project: R173
Subject: Large Structure
Job No: 18.852



Banagher Precast Concrete Ltd., Queen Street, Banagher, Birr, Co. Offaly, Ireland.
Tel: +353 (0)57 9151413 Fax: +353 (0)57 9151558 E-mail: info@banagher.com Web: www.banagher.com

BANAGHER PRECAST CONCRETE

UonU CULVERT DESIGN

Job Number:	**19.852**		
Job Title:	**R179 Carrickmackross & Kingscourt**		
Structure =	**U on U_S Structure**		
Culvert Type =	**5 m x 3 m x 400 mm x 1.99 m**		
Total L =	**35.915m**		
Culvert Length =	**1.99 m**		
Number of units required =	**18 Nr**		
Designed to:	**Eurocode 1 "Actions on structures – Part 2: Traffic loads on bridges". Eurocode 2 "Design of concrete structures" and PD6694 "Recommendations for the design for structures subject to traffic loading"**		
Designed by:	**Adrian Pilch**	DATE:	**05/12/2019**
Checked by:		DATE:	

Revision	Description	By	Date
C01	First draft - For approval	A Pilch	05/12/2019

Irl: Banagher, Co. Offaly, Ireland
UK: Mundford Road, Weeting, Norfolk, IP27 0PL
Tel Irl: +353 (0)57 9151417
Tel UK: 0161 300 0513
web: www.bancrete.com

Box Culvert Design Sheet - per m length

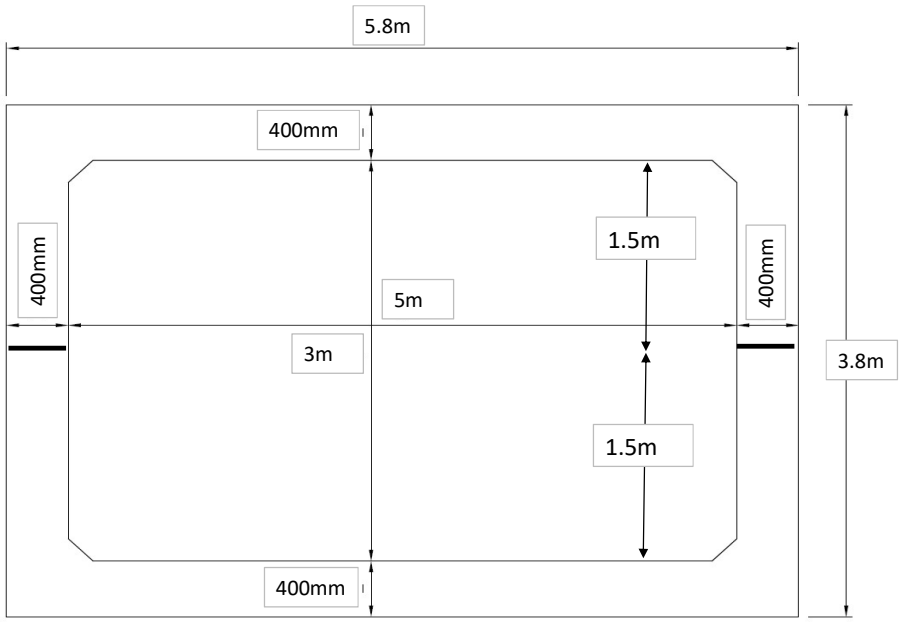
Project Details:

Job Title:	R179 Carrickmackross & Kingscou	Date :	05/12/19	Revision :	C01
Structure:	U on U_S Structure	Job No:	19.852	Status:	For Approval
Client:	Golder	No Required:	18	PO:	GAIRL 001432
Insertion site:	Ireland	Total length:	35.915m		

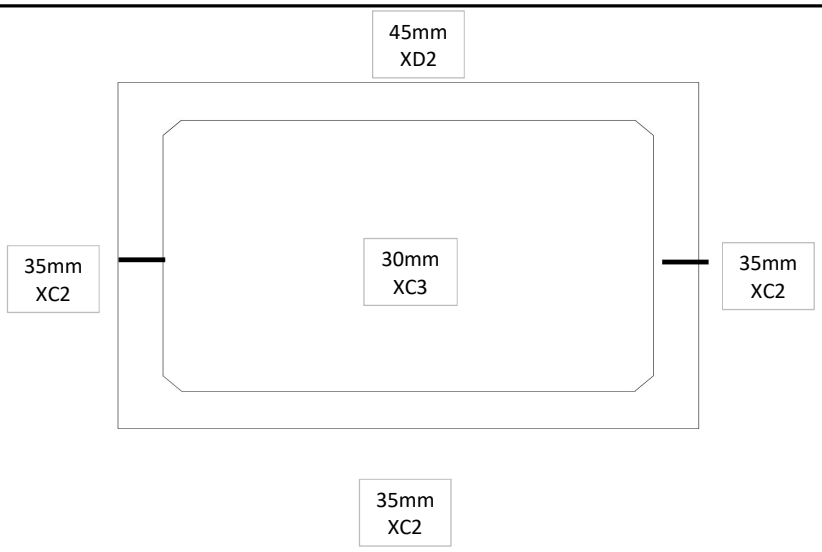
Culvert Dimensions:

Width	5.0	m	Ext Roof Cover	45	mm	Roof Exposure	XD2
Height	3.0	m	Ext Wall Cover	35	mm	Wall Exposure	XC2
Design Length	1.0	m	Internal Cover	30	mm	Internal Exposure	XC3
Unit Length	1.99	m	Ext Base Cover	35	mm	Base Exposure	XC2
Roof/floor thickness	400	mm	Mix Design Constituents for 100yr design life as per BD57/10				
Sidewall thickness	400	mm	Concrete Grade =	C50/60			
Chamfer	200	mm	Cement Type =	CEM I		GGBS Content:	0 %
			Max W/C ratio =	0.4		Min. Cement =	440 kgs

Max fill depth = 5 m (In general)
Min fill depth = 5 m (Between culvert roof and carriageway)



SECTION THROUGH BOX CULVERT SHOWING DIMENSIONS



SECTION THROUGH BOX CULVERT SHOWING EXPOSURE CLASS AND NOMINAL COVER

BANAGHER
PRECAST CONCRETE

Table of contents

Span	Height	Wall Thick.	Roof Thick.	Length	Soil Density	Surfacing Density
5.00	3.00	0.40	0.40	1.99	19	23.00

MAX FILL = 5 m Surfacing = 0.2 m
MIN FILL = 5 m

β = 1.15+0.35(H_c-8)/3 but not less than 1.15
β_{max} = 1.15
β_{min} = 1.15

Loadings

1 Self weight
= Slab Thick x Density of Concrete x unit length
= 10 kN/m

2 Surfacing
= Surfacing Thick x Density of Surfacing x Arching Factor x 40% future addition x unit length
= 7.406 kN/m

3 Soil (max)
= Soil Thick x Density of Soil x Arching Factor x unit length
= 104.88 kN/m

4 Soil (min)
= Soil Thick x Density of Soil x Arching Factor x unit length
= 104.88 kN/m

5 Horz. Earth Pressure (Triangular Load Block)
= Depth of box from centre line of roof/base x Density of Soil x unit length
= 60.8 kN/m

6 Horz. Earth Pressure due to fill over box(max)
= Depth of soil from centre line of roof to road level x Density of Soil/surfacing x unit length
= 97.7 kN/m

7 Horz. Earth Pressure due to fill over box(min)
= Depth of soil from centre line of roof to road level x Density of Soil/surfacing x unit length
= 97.7 kN/m

8 Internal Water Pressure N/A
= Depth of box x Density of water x unit length all divided by 2
= 15 kN/m

9 Horizontal Traffic Surcharge Loading for LM1 Vehicles - UDL
= 20KdR(kN/m2) as per Table 7 of PD6694-1:2011
= 20*Ko*3/Weff
= 10 kN/m2 - for Ko = 0.5 as per SLS Loading Combination
= 15 kN/m2 - for Ko = 0.729 as per EQU Loading Combination
= 14 kN/m2 - for Ko = 0.675 as per STR/GEO1 Loading Combination
= 13 kN/m2 - for Ko = 0.667 as per STR/GEO Loading Combination

10 Horizontal Traffic Surcharge Loading for LM1 Vehicles - Line Load(Min Fill)
= 330KdDf(kN/m) as per Table 7 of PD6694-1:2011

Where;
Df = (1+z/2)/(1+z)
= z = 5
= 0.583
Reduction Factor = (1-Hc/2)^2
= Hc = 5
= 2.250

= 330*Ko*Df*Reduction Factor
= 433.125 Ko **Can Be Ignored as Fill is Greater than 2.0m**

11 Horizontal Traffic Surcharge Loading for LM1 Vehicles - Line Load(Max Fill)
= 330KdDf(kN/m) as per Table 7 of PD6694-1:2011

Where;
Df = (1+z/2)/(1+z)
= z = 5.0
= 0.583
Reduction Factor = (1-Hc/2)^2
= Hc = 5.0
= 2.250

= 330*Ko*Df*Reduction Factor
= 433.125 Ko **Can Be Ignored as Fill is Greater than 2.0m**

12 Horizontal Traffic Surcharge Loading for LM3 Vehicles - UDL
= 30Kd(kN/m2) as per Table 7 of PD6694-1:2011
= 30*Ko
= 15 kN/m2 - for Ko = 0.5 as per SLS Loading Combination
= 22 kN/m2 - for Ko = 0.729 as per EQU Loading Combination
= 20 kN/m2 - for Ko = 0.675 as per STR/GEO1 Loading Combination
= 20 kN/m2 - for Ko = 0.675 as per STR/GEO1 Loading Combination

13 Horizontal Traffic Surcharge Loading for LM3 Vehicles - Line Load(Min Fill)
= 433.125 Ko **Can Be Ignored as Fill is Greater than 2.0m**
14 Horizontal Traffic Surcharge Loading for LM3 Vehicles - Line Load(Max Fill)
= 433.125 Ko **Can Be Ignored as Fill is Greater than 2.0m**

15 Horizontal Braking & Acceleration Loading for LM1 Vehicles - Point Load(min Fill)
= (360+2.7L)/3.0 (kN) as per 10.2.8.2 of PD6694-1:2011 & 4.4.1 of I.S. EN 1991-2:2003
Where;
L = External width of the structure
= 5.80 m

Reduction Factor, n = (LL-Hc)/(LL-0.6)
LL = 5.80 m
Hc = 5.00 m
= 0.153846
= ((360+2.7*Hc)/3.0)*n
= 19.154 kN

16 Horizontal Braking & Acceleration Loading for LM1 Vehicles - Point Load(max Fill)
= (360+2.7L)/3.0 (kN) as per 10.2.8.2 of PD6694-1:2011 & 4.4.1 of I.S. EN 1991-2:2003
Where;
L = External width of the structure
= 5.80 m

Reduction Factor, n = (LL-Hc)/(LL-0.6)
LL = 5.80 m
Hc = 5.00 m
= 0.153846
= ((360+2.7*Hc)/3.0)*n
= 19.154 kN

17 Horizontal Braking & Acceleration Loading for LM3 Vehicles - Point Load
as per 10.2.8.2 of PD6694-1:2011 & NA.2.18.1 of I.S. EN 1991-2:2003
= QLK,S = δw
Where;
δ = Deceleration Factor 0.3
w = The basic axle load of the relevant SV Vehicle x its DAF factor
= DAF x Total Load
= 924.000

QLK,S = (δ*w)/3.0
= 77 kN

Loaded Length =	5.4	m	
No. Axles =	5	nr	
Total Load =	825	kN	
Braking pace =	206.25	kN	
Vehicle Type =	SV196		
DAF =	1.12		

Reduction Factor =
Max fill = 0.083333
Min fill = 0.083333

Therefore the horizontal load is as follows:
Max fill = 6.4 kN/m
Min fill = 6.4 kN/m

or

10% of the Force
= (0.1*w)/3.0
= 30.80 kN

Live Load to EC2

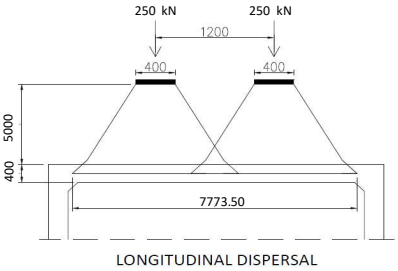
Date:	05/12/2019
Prepared by:	MS
Checked by:	

BANAGHER PRECAST CONCRETE

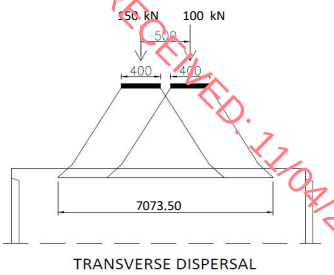
Live Load = LM1 as per Eurocode:

I. Maximum Fill

Max Fill =	5000	mm
Roof thickness =	400	mm
Load =	250	kN
Longitudinal Dispersal =	7773.50	mm
Transverse Dispersal =	7073.50	mm
UDL Load TS=	9.09	kN/m^2
UDL Load =	5.5	kN/m^2
Total UDL =	14.59	kN/m^2



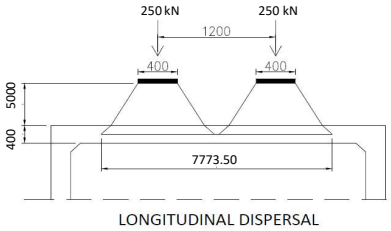
LONGITUDINAL DISPERSAL



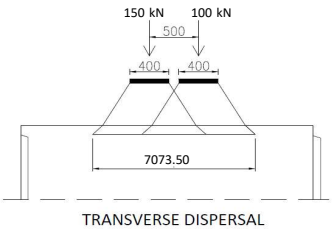
TRANSVERSE DISPERSAL

II. Minimum Fill

Min Fill =	5000	mm
Roof thickness =	400	mm
Load =	250	kN
Longitudinal Dispersal =	7773.50	mm
Transverse Dispersal =	7073.50	mm
UDL Load TS=	9.09	kN/m^2
UDL Load =	5.5	kN/m^2
Total UDL =	14.59	kN/m^2



LONGITUDINAL DISPERSAL

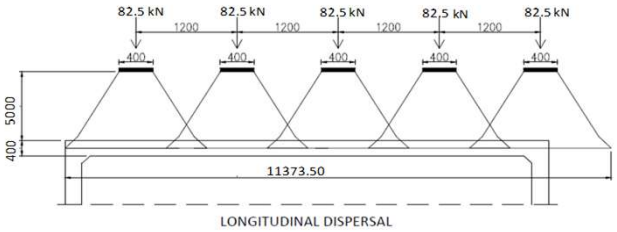


TRANSVERSE DISPERSAL

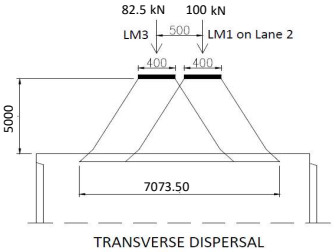
Live Load = LM3 as per Eurocode:

I. Maximum Fill

Max Fill =	5000	mm	Dynamic factor =	1.12
Roof thickness =	400	mm		
External Unit Width =	5800	mm		
Load LM3 =	82.5	kN	No. point loads =	5
Load LM1 =	100	kN	No. point loads =	2
Longitudinal Dispersal =	11373.50	mm		
Transverse Dispersal =	7073.50	mm		
UDL Load =	8.23	kN/m^2		



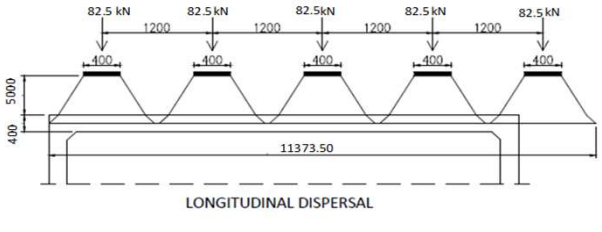
LONGITUDINAL DISPERSAL



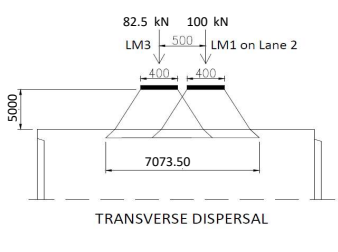
TRANSVERSE DISPERSAL

II. Minimum Fill

Min Fill =	5000	mm	Dynamic factor =	1.12
Roof thickness =	400	mm		
External Unit Width =	5800	mm		
Load LM3 =	82.5	kN	No. point loads =	5
Load LM1 =	100	kN	No. point loads =	2
Longitudinal Dispersal =	11373.50	mm		
Transverse Dispersal =	7073.50	mm		
UDL Load =	8.23	kN/m^2		

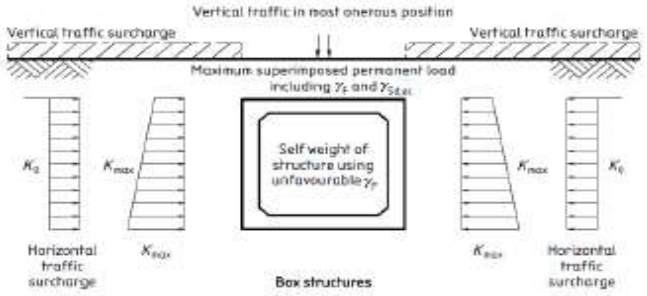


LONGITUDINAL DISPERSAL



TRANSVERSE DISPERSAL

Table B.1 – Maximum vertical load with maximum horizontal load



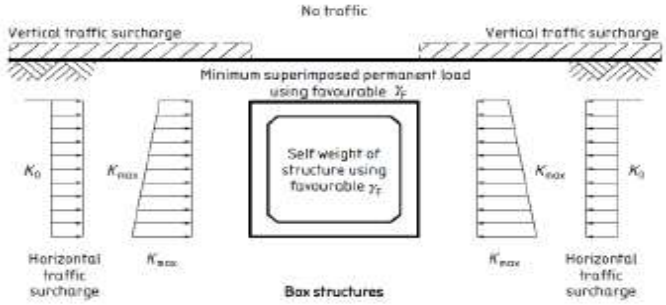
B1 - Max vert + Max Horiz									
	Surcharge	Soil-Horiz	traffic loads						
Limit state	K_0	K_{max}	gr1a(LM1)	gr5(LM3)**	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.5	0.6	1	1	1	1	1	0.6	1
EQU	0.729	0.8085	1.35	1.35	1.05	1.05	1.05	0.93	0
STR/GEO 1	0.675	0.972	1.35	1.35	1.35	1.2	1.35	0.93	1.2
STR/GEO 2	0.667	0.84	1.15	1.15	1	1	1	0.78	1

Note: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,K}$

* Load value to include supplementary model factor for arching action $\gamma_{Sd,inf}$

**LM3 load values multiplied by DAF(SV80=1.16; SV100 & SV196=1.12)

Table B.2 – Minimum vertical load with maximum horizontal load

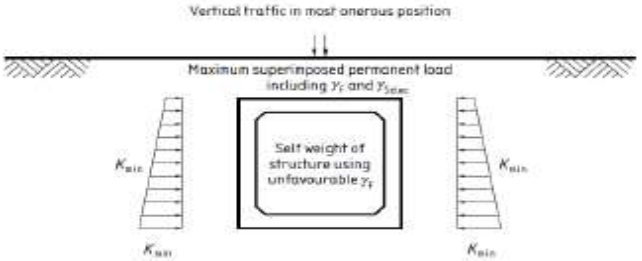


B2 - Min Vert + Max Horiz							
	Surcharge	Soil-Horiz					
Limit state	K_0	K_{max}	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.5	0.6	1	1	1	0.6	1
EQU	0.729	0.8085	0.95	0.95	0.95	0.93	0
STR/GEO 1	0.675	0.972	0.95	0.95	0.95	0.93	1.2
STR/GEO 2	0.667	0.84	1	1	1	0.78	1

Note: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,K}$

* Load value to include supplementary model factor for arching action $\gamma_{Sd,inf}$

Table B.3 – Maximum vertical load with minimum horizontal load



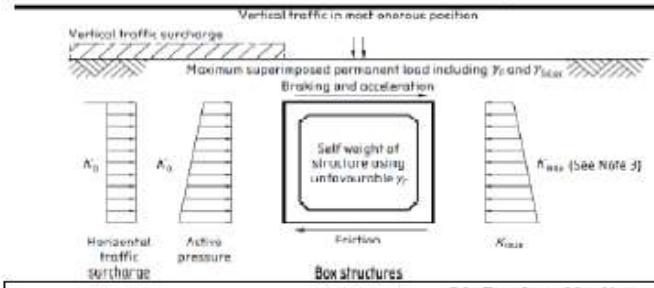
B3 - Max Vert + Min Horiz								
	Soil-Horiz	traffic loads						
Limit state	K_{min}	gr1a(LM1)	gr5(LM3)**	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.2	1	1	1	1	1	0.6	1
EQU	0.171	1.35	1.35	1.05	1.05	1.05	0.93	0
STR/GEO 1	0.19	1.35	1.35	1.35	1.2	1.35	0.93	1.2
STR/GEO 2	0.16	1.15	1.15	1	1	1	0.78	1

Note: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,K}$

* Load value to include supplementary model factor for arching action $\gamma_{Sd,inf}$

**LM3 load values multiplied by DAF(SV80=1.16; SV100 & SV196=1.12)

Table B.4 – Traction with maximum vertical load and active pressure



B4 - Traction + Max Vert + Active pressure											
	Surcharge	Soil-Horiz	Soil-Horiz	traffic loads							
Limit state	K_a	K_a	K_{max}	gr2/6 Horiz	gr2 vert***	gr6 vert**	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.33	0.33	0.6	1	0.75	1	1	1	1	0.6	1
EQU	0.4995	0.462	0.8085	1.35	1.0125	1.35	1.05	1.05	1.05	0.93	0
STR/GEO 1	0.4455	0.54	0.972	1.35	1.0125	1.35	1.35	1.2	1.35	0.93	1.2
STR/GEO 2	0.4715	0.49	0.84	1.15	0.8625	1.15	1	1	1	0.78	1

Note1: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,E}$

Note2: if the strucutre sways towards the active side the loadcase can be ignored

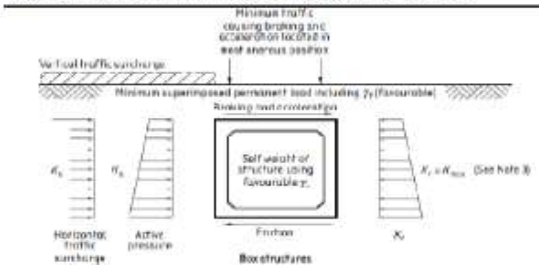
Note3:The earth pressure coefficient for the passive wall may be taken as greater than Kmax for bearing, sliding and overturning provided the associated displacments are acceptable at the relevant limt state

* Load value to include supplementary model factor for arching action $\gamma_{Sd,arc}$

**LM3 load values multiplied by DAF(SV80=1.16; SV100 & SV196=1.12)

*** frequent LM1 values used: ψ=0.75

Table B.5 – Traction with minimum vertical load and active pressures



B5 - Traction + Min Vert + Active pressure											
	Surcharge	Soil-Horiz	Soil-Horiz	Traffic Loads							
Limit state	K_a	K_a	K_{max}	gr2/6 Horiz	gr2 vert***	gr6 vert**	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.33	0.33	0.6	1	0.75	1	1	1	1	0.6	1
EQU	0.4995	0.462	0.8085	1.35	1.0125	1.35	0.95	0.95	0.95	0.93	0
STR/GEO 1	0.4455	0.54	0.972	1.35	1.0125	1.35	0.95	0.95	0.95	0.93	1.2
STR/GEO 2	0.4715	0.49	0.84	1.15	0.8625	1.15	1	1	1	0.78	1

Note1: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,E}$

Note2: if the strucutre sways towards the active side the loadcase can be ignored

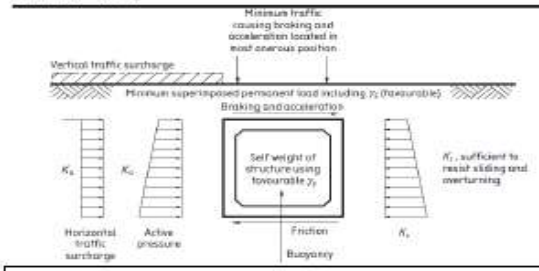
Note3:The earth pressure coefficient for the passive wall may be taken as greater than Kmax for bearing, sliding and overturning provided the associated displacments are acceptable at the relevant limt state

* Load value to include supplementary model factor for arching action $\gamma_{Sd,arc}$

**LM3 load values multiplied by DAF(SV80=1.16; SV100 & SV196=1.12)

*** frequent LM1 values used: ψ=0.75

Table B.6 – Sliding



B6 - Sliding											
	Surcharge	Soil-Horiz	Soil-Horiz	traffic loads							
Limit state	K_a	K_a	K_r	gr2/6 Horiz	gr2 vert***	gr6 vert**	DL	Pavemt*	Soil vert*	Thermal	Settlement
SLS Char	0.33	0.33	K_r	1	0.75	1	1	1	1	0.6	1
EQU	0.4995	0.462	K_r	1.35	1.0125	1.35	0.95	0.95	0.95	0.93	0
STR/GEO 1	0.4455	0.54	K_r	1.35	1.0125	1.35	0.95	0.95	0.95	0.93	1.2
STR/GEO 2	0.4715	0.49	K_r	1.15	0.8625	1.15	1	1	1	0.78	1

Note1: the value of K includes partial factor γ_M and $\gamma G/\gamma Q$ and (for permanent earth pressure at ULS)the model factor $\gamma_{Sd,E}$

* Load value to include supplementary model factor for arching action $\gamma_{Sd,arc}$

**LM3 load values multiplied by DAF(SV80=1.16; SV100 & SV196=1.12)

*** frequent LM1 values used: ψ=0.75

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

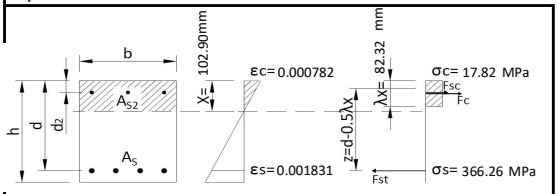
Flexure Design - Roof Sagging Steel

Design Moment		
595.00	1.000	595 kNm

Step 1:-

$K = M/bd^2f_{ck}$ = 0.1006 — no compression steel req

Step 2:-



$z = d - 0.5\lambda x$ = 318.92 mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$ = 4291.0584 mm²

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$ = 733.408 mm² — ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$ = 447.2 mm² — ok

Step 6:- (Max Longitudinal Steel)

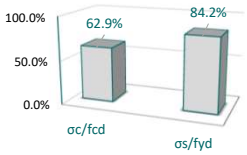
$A_{smax} = 0.04A_c$ = 13760 mm² — ok

Height of Concrete Section, h =	400	mm
Width of Concrete Section, b =	1000	mm
Exposure Class=	XC3	
Cover to Tension Steel =	40	mm
Effective Depth, d =	344	mm
Concrete Grade =	C50/60	
Type of Cement =	R	
Age of the Concrete in Days, t =	28	days
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm²
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm²
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm²
Yield strength,fy =	500	N/mm²
Max stress in steel, f_{yd} =	434.78	MPa
Max Steel Strain, ϵ_{st} =	0.002173913	
Max Concrete Strain, ϵ_{cu2} =	0.0035	
Modulus od Elasticity of Steel, E_s =	200000	N/mm²
λ =	0.8	
η=	1	
α =	0.85	
Yc=	1.5	
Ys=	1.15	
Ø =	0.666666667	
α_{cw} =	1	

Tension Steel

Bar	32	mm
Area	804.25	mm²
No req	5.34	
No used	6.67	
As Prov	5364.33	mm²
M_R	706.32	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	16	mm
Area	201.06	mm²
No req	2.22	
No used	5	
As Prov	1005.31	mm²

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x = 0.419896641 — therefore compression steel has not yielded

If compression reinforcement is required then $x = x_{bal}$ = 0.45d

x = 154.8 mm

If compression reinforcement is required then z = 0.82d

z = 282.08 mm

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$ = 0 mm²

$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$ = 0 mm²

Compression Steel

Bar	20	mm
Area	314.16	mm²
No req	0.00	
No used	6.67	
As Prov	2095.44	mm²
cover to CS =	55	mm
d_2 =	65	mm

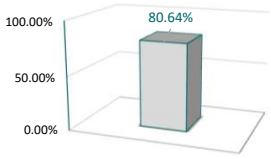
Shear Design - Roof Sagging Steel

V_{Ed} = 422 kN

Shear Width = 1000 mm

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	310.3693464 kN	Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.762492852	**USE THIS VALUE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.015593989	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.57908737 MPa	**IGNORE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	199.2060552 kN	Shear links Req



Capacity with Shear links

Step 7:-

Max Allowable Shear Force -

$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$

1506.470268 kN

$v_1 = 0.6.[1-(fck/250)]$	0.48 MPa	
$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4 MPa	**- Maximum Allowable Shear Stress**
$v = (Vx10^3)/A_{sh}$	1.227 MPa	**- Actual Shear Stress**

θ =	22
cotθ =	2.475086853
θ =	22
tanθ =	0.404026226

Step 8:-

To Calculate Links -

$V_{Rd,s} = (A_{sw}/s).z.f_{ywd}.\cot\theta$

Shear Reinforcement -

$A_{sv}/s = V/(\cot\theta.0.9.d.0.87.f_{yv})$

1.265994441

(i.e. 1 leg B12 -200 c/c's = 0.565)

Use	4	10 mm Links	per meter	
As prov =	314 mm2/m			
C/C's =	200 mm	> Max Spacing = 258mm		per unit length 8
Asv/sv =	1.57 OK	> Min Asv/sv = 1.13		
No. rows req =	20	Max transverse spacing	516 mm	Transverse spacing 248.8 mm

Links Only Req in unit where shear is greater than shear capacity of 310.369346 kN

θ = 22°	cotθ = 2.5
θ = 45°	cotθ = 1.0

Shear Links Curtailment:

1/2 Span =	2.5	m
distance back from midspan	0.5	m
shear force at this location	84.4	kN

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

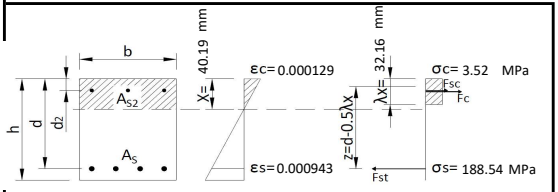
Flexure Design - Roof Hogging Steel

Design Moment		
126.00	1.000	126 kNm

Step 1:-

$K = M/bd^2f_{ck}$	0.0225	no compression steel req

Step 2:-



$z = d - 0.5\lambda x$	=	318.25	mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$	910.60487 mm²	

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$	714.22 mm²	ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$	435.5 mm²	ok

Step 6:- (Max Longitudinal Steel)

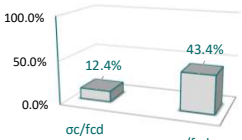
$A_{smax} = 0.04A_c$	13400 mm²	ok

Height of Concrete Section, h =	400	mm
Width of Concrete Section, b =	1000	mm
Exposure Class=	XD2	
Cover to Tension Steel =	55	mm
Effective Depth, d =	335	mm
Concrete Grade =	C50/60	
Type of Cement =	R	
Age of the Concrete in Days, t =	28	days
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm²
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm²
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm²
Yield strength,fy =	500	N/mm²
Max stress in steel, f_{yd} =	434.78	MPa
Max Steel Strain, ϵ_{st} =	0.002173913	
Max Concrete Strain, ϵ_{cu2} =	0.0035	
Modulus od Elasticity of Steel, E_s =	200000	N/mm²
λ =	0.8	
η=	1	
α =	0.85	
Yc=	1.5	
Ys=	1.15	
Ø =	0.666666667	
α_{cw} =	1	

Tension Steel

Bar	20	mm
Area	314.16	mm²
No req	2.90	
No used	6.67	
As Prov	2095.44	mm²
M_R	290.56	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	12	mm
Area	113.10	mm²
No req	3.85	
No used	5	
As Prov	565.49	mm²

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x =	0		therefore compression steel has yielded
x =	150.75	mm	
z =	274.7	mm	

If compression reinforcement is required then $x = x_{bal} = 0.45d$

If compression reinforcement is required then $z = 0.82d$

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$	0	mm²
$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$	0	mm²

Compression Steel

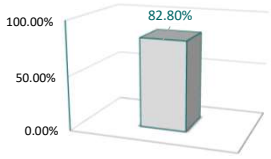
Bar	32	mm
Area	804.25	mm²
No req	0.00	
No used	6.67	
As Prov	0.00	mm²
cover to CS =	40	mm
d_2 =	0	mm

Shear Design - Roof Hogging Steel

V_{Ed} =	422	kN	
Shear Width =	1000	mm	

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	224.2617539 kN	Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.772667409	**USE THIS VALUE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.006255052	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.584109052 MPa	**IGNORE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	195.6765325 kN	Shear links Req



Capacity with Shear links

Step 7:-

Max Allowable Shear Force -	$v_1 = 0.6.[1-(fck/250)]$	0.48 MPa	
$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$	$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4 MPa	**- Maximum Allowable Shear Stress**
1503.31018 kN	$v = (Vx10^3)/A_{sh}$	1.260 MPa	**- Actual Shear Stress**

θ =	22
cotθ =	2.475086853

Step 8:-

To Calculate Links -	Use	4	10 mm Links	per meter	
$V_{Rd,s} = (A_{sw}/s)\,z\,f_{ywd}.\cot\theta$	As prov =	314 mm2/m			
Shear Reinforcement -	C/C's =	200 mm	> Max Spacing = 251.25mm		
$A_{sw}/s = V/(\cot\theta.0.9.d.0.87.f_{yv})$	Asv/sv =	1.57 OK	> Min Asv/sv = 1.13		
1.300006232	No. rows req =	20			
(i.e. 1 leg B12 -200 c/c's = 0.565)	Links Only Req in unit where shear is greater than shear capacity of			224.26175 kN	

θ =	22
tanθ =	0.404026226
θ = 22°	cotθ = 2.5
θ = 45°	cotθ = 1.0

Step 9:-

Additional Longitudinal Reinforcement -		
$\Delta F_{td} = 0.5V_{Ed}\cot\theta$		
522.2433261 kN		
1200.55937 mm²	not ok,add more main steel	Ok - sag B16 @150 extended

Shear Links Curtailment:		
1/2 Span =	2.5	m
distance back from midspan	0.5	m
shear force at this location	84.4	kN

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

Flexure Design - Base Sagging Steel

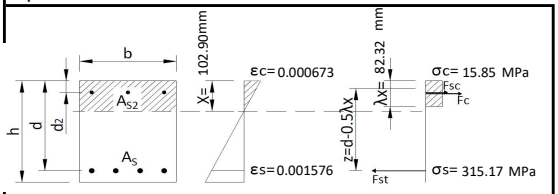
Design Moment

512.00	1.000	512 kNm

Step 1:-

$K = M/bd^2f_{ck}$	0.0865	no compression steel req

Step 2:-



$z = d - 0.5\lambda x$ = 302.84 mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$	3888.5035 mm²	

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$	733.408 mm²	ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$	447.2 mm²	ok

Step 6:- (Max Longitudinal Steel)

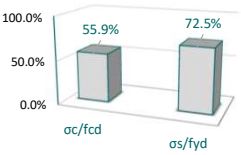
$A_{smax} = 0.04A_c$	13760 mm²	ok

Height of Concrete Section, h =	400	mm
Width of Concrete Section, b =	1000	mm
Exposure Class=	XC3	
Cover to Tension Steel =	40	mm
Effective Depth, d =	344	mm
Concrete Grade =	C50/60	
Type of Cement =	R	
Age of the Concrete in Days, t =	28	days
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm²
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm²
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm²
Yield strength,fy =	500	N/mm²
Max stress in steel, f_{yd} =	434.78	MPa
Max Steel Strain, ϵ_{st} =	0.002173913	
Max Concrete Strain, ϵ_{cu2} =	0.0035	
Modulus od Elasticity of Steel, E_s =	200000	N/mm²
λ =	0.8	
η=	1	
α =	0.85	
Yc=	1.5	
Ys=	1.15	
Ø =	0.666666667	
α_{cw} =	1	

Tension Steel

Bar	32	mm
Area	804.25	mm²
No req	4.83	
No used	6.67	
As Prov	5364.33	mm²
M_R	706.32	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	16	mm
Area	201.06	mm²
No req	2.22	
No used	5	
As Prov	1005.31	mm²

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x = 0 therefore compression steel has yielded

If compression reinforcement is required then $x = x_{bal} = 0.45d$

x = 154.8 mm

If compression reinforcement is required then z = 0.82d

z = 282.08 mm

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$	0 mm²	
$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$	0 mm²	

Compression Steel

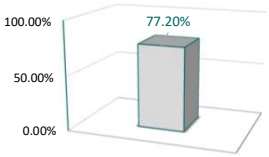
Bar	20	mm
Area	314.16	mm²
No req	0.00	
No used	6.67	
As Prov	0.00	mm²
cover to CS =	45	mm
d_2 =	0	mm

Shear Design - Base Sagging Steel

V_{Ed} =	404 kN	Shear Width =	1000 mm

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	310.3693464 kN	Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.762492852	**USE THIS VALUE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.015593989	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.57908737 MPa	**IGNORE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	199.2060552 kN	Shear links Req



Capacity with Shear links

Step 7:-

Max Allowable Shear Force -	$v_1 = 0.6.[1-(fck/250)]$	0.48 MPa	
$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$	$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4 MPa	**- Maximum Allowable Shear Stress**
1430.525121 kN	$v = (Vx10^3)/A_{sh}$	1.174 MPa	**- Actual Shear Stress**

θ =	22
cotθ =	2.475086853
θ =	22
tanθ =	0.404026226

Step 8:-

To Calculate Links -	Use	4	10 mm Links	per meter	θ = 22° cotθ = 2.5
$V_{Rd,s} = (A_{sw}/s)\,z\,f_{ywd}.\cot\theta$	As prov =	314 mm2/m			θ = 45° cotθ = 1.0
Shear Reinforcement -	C/C's =	200 mm	> Max Spacing = 258mm		
$A_{sv}/s = V/(\cot\theta 0.9.d.0.87.f_{yv})$	Asv/sv =	1.57 OK	> Min Asv/sv = 1.13		
1.211994678	No. rows req =	20			
(i.e. 1 leg B12 -200 c/c's = 0.565)	Links Only Req in unit where shear is greater than shear capacity of				310.36935 kN

Step 9:-

Additional Longitudinal Reinforcement -			Shear Links Curtailment:
$\Delta F_{td} = 0.5V_{Ed}\cot\theta$			1/2 Span = 2.5 m
499.9675444 kN			distance back from midspan 0.5 m
1149.350677 mm²	ok, steel adequate	Don't Ignore	shear force at this location 80.8 kN

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

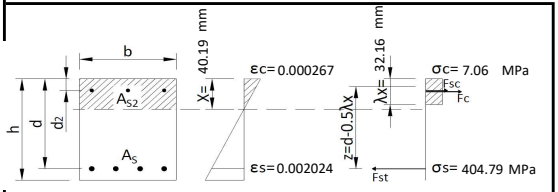
Flexure Design - Base Hogging Steel

Design Moment		
279.00	1.000	279 kNm

Step 1:-

$K = M/bd^2f_{ck}$ = 0.0469 — no compression steel req

Step 2:-



$z = d - 0.5\lambda x$ = 327.75 mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$ = 1957.8947 mm²

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$ = 735.54 mm² — ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$ = 448.5 mm² — ok

Step 6:- (Max Longitudinal Steel)

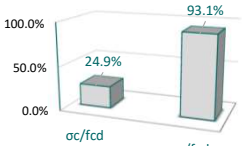
$A_{smax} = 0.04A_c$ = 13800 mm² — ok

Height of Concrete Section, h =	400	mm
Width of Concrete Section, b =	1000	mm
Exposure Class=	XC2	
Cover to Tension Steel =	45	mm
Effective Depth, d =	345	mm
Concrete Grade =	C50/60	
Type of Cement =	R	
Age of the Concrete in Days, t =	28	days
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm²
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm²
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm²
Yield strength,fy =	500	N/mm²
Max stress in steel, f_{yd} =	434.78	MPa
Max Steel Strain, ϵ_{st} =	0.002173913	
Max Concrete Strain, ϵ_{cu2} =	0.0035	
Modulus od Elasticity of Steel, E_s =	200000	N/mm²
λ =	0.8	
η=	1	
α =	0.85	
Yc=	1.5	
Ys=	1.15	
Ø =	0.666666667	
α_{cw} =	1	

Tension Steel

Bar	20	mm
Area	314.16	mm²
No req	6.23	
No used	6.67	
As Prov	2095.44	mm²
M_R	299.67	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	12	mm
Area	113.10	mm²
No req	3.97	
No used	5	
As Prov	565.49	mm²

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x = 0 — therefore compression steel has yielded

If compression reinforcement is required then $x = x_{bal}$ = 0.45d → x = 155.25 mm

If compression reinforcement is required then z = 0.82d → z = 282.9 mm

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$ = 0 mm²

$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$ = 0 mm²

Compression Steel

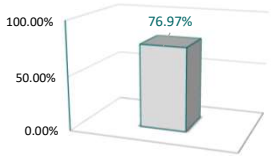
Bar	32	mm
Area	804.25	mm²
No req	0.00	
No used	6.67	
As Prov	0.00	mm²
cover to CS =	40	mm
d_2 =	0	mm

Shear Design - Base Hogging Steel

V_{Ed} = 404 kN — Shear Width = 1000 mm

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	227.2496316 kN	Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.761386988	**USE THIS VALUE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.006073746	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.578542439 MPa	**IGNORE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	199.5971414 kN	Shear links Req



Capacity with Shear links

Step 7:-

Max Allowable Shear Force -

$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$

1548.18511 kN

$v_1 = 0.6.[1-(fck/250)]$	0.48	MPa	
$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4	MPa	**- Maximum Allowable Shear Stress**
$v = (Vx10^3)/A_{sh}$	1.171	MPa	**- Actual Shear Stress**

θ =	22
cotθ =	2.475086853
θ =	22
tanθ =	0.404026226
θ = 22°	cotθ = 2.5
θ = 45°	cotθ = 1.0

Step 8:-

To Calculate Links -

$V_{Rd,s} = (A_{sw}/s)\,z\,f_{ywd}\cot\theta$

Shear Reinforcement -

$A_{sv}/s = V/(\cot\theta 0.9.d.0.87.f_{yv})$

1.20848165

(i.e. 1 leg B12 -200 c/c's = 0.565)

Use	4	10 mm Links	per meter	
As prov =	314	mm2/m		
C/C's =	200	mm	> Max Spacing = 258.75mm	
Asv/sv =	1.57	OK	> Min Asv/sv = 1.13	
No. rows req =	20			

Links Only Req in unit where shear is greater than shear capacity of 227.24963 kN

Step 9:-

Additional Longitudinal Reinforcement -

$\Delta F_{td} = 0.5V_{Ed}\cot\theta$

499.9675444 kN

1149.350677 mm² — not ok,add more main steel

Ok - sag B16 @150 extended

Shear Links Curtailment:

1/2 Span =	2.5	m
distance back from midspan	0.5	m
shear force at this location	80.8	kN

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

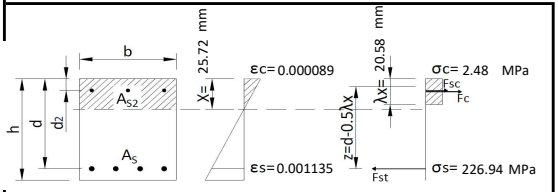
Flexure Design - Wall Sagging Steel

Design Moment: 104.00 × 1.000 = 104 kNm

Step 1:-

$K = M/bd^2f_{ck}$ = 0.0168 — no compression steel req

Step 2:-



$z = d - 0.5\lambda x$ = 334.40 mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$ = 715.311 mm²

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$ = 750.464 mm² — ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$ = 457.6 mm² — ok

Step 6:- (Max Longitudinal Steel)

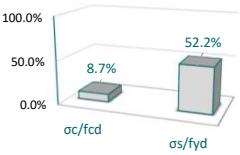
$A_{smax} = 0.04A_c$ = 14080 mm² — ok

Height of Concrete Section, h =	400	mm
Width of Concrete Section, b =	1000	mm
Exposure Class=	XC3	
Cover to Tension Steel =	40	mm
Effective Depth, d =	352	mm
Concrete Grade =	C50/60	
Type of Cement =	R	
Age of the Concrete in Days, t =	28	days
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm²
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm²
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm²
Yield strength,fy =	500	N/mm²
Max stress in steel, f_{yd} =	434.78	MPa
Max Steel Strain, ϵ_{st} =	0.002173913	
Max Concrete Strain, ϵ_{cu2} =	0.0035	
Modulus od Elasticity of Steel, E_s =	200000	N/mm²
λ =	0.8	
η=	1	
α =	0.85	
Yc=	1.5	
Ys=	1.15	
Ø =	0.666666667	
α_{cw} =	1	

Tension Steel

Bar	16	mm
Area	201.06	mm²
No req	3.73	
No used	6.67	
As Prov	1341.08	mm²
M_R	199.14	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	12	mm
Area	113.10	mm²
No req	4.05	
No used	5	
As Prov	565.49	mm²

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x = 0 — therefore compression steel has yielded

If compression reinforcement is required then $x = x_{bal} = 0.45d$: x = 158.4 mm

If compression reinforcement is required then z = 0.82d : z = 288.64 mm

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$ = 0 mm²

$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$ = 0 mm²

Compression Steel

Bar	20	mm
Area	314.16	mm²
No req	0.00	
No used	6.67	
As Prov	0.00	mm²
cover to CS =	45	mm
d_2 =	0	mm

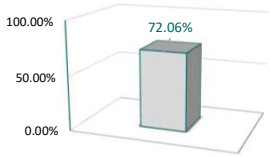
Shear Design - Wall Sagging Steel

V_{Ed} = 217 kN

Shear Width = 1000 mm

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	197.6512945 kN	Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.753778361	**IGNORE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.003809895	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.574797814 MPa	**USE THIS VALUE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	202.3288304 kN	Shear links Req



Capacity with Shear links

Step 7:-

Max Allowable Shear Force -

$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$

1579.597562 kN

$v_1 = 0.6.[1-(fck/250)]$	0.48 MPa	
$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4 MPa	**- Maximum Allowable Shear Stress**
$v = (Vx10^3)/A_{sh}$	0.616 MPa	**- Actual Shear Stress**

θ =	22
cotθ =	2.475086853
θ =	22
tanθ =	0.404026226

Step 8:-

To Calculate Links -

$V_{Rd,s} = (A_{sw}/s)\,z\,f_{ywd}.\cot\theta$

Shear Reinforcement -

$A_{sv}/s = V/(\cot\theta 0.9.d.0.87.f_{yv})$

0.636201752

(i.e. 1 leg B12 -200 c/c's = 0.565)

Use	4	10 mm Links	per meter	
As prov =	314	mm2/m		
C/C's =	200	mm	> Max Spacing = 264mm	
Asv/sv =	1.57	OK	> Min Asv/sv = 1.13	
No. rows req =	16			

θ = 22°	cotθ = 2.5
θ = 45°	cotθ = 1.0

Links Only Req in unit where shear is greater than shear capacity of 202.32883 kN

Step 9:-

Additional Longitudinal Reinforcement -

$\Delta F_{td} = 0.5V_{Ed}\cot\theta$

268.5469236 kN

617.3492496 mm² — ok, steel adequate

Shear Links Curtailment:

1/2 Span =	1.5	m
distance back from midspan	0	m
shear force at this location	#DIV/0!	kN

BANAGHER PRECAST CONCRETE

Section Design to EC2 - Rectangular

Job Title:	179 Carrickmackross & Kingscou	Calcs by:	Adrian Pilch
Date:	05/12/2019	Checked by:	0

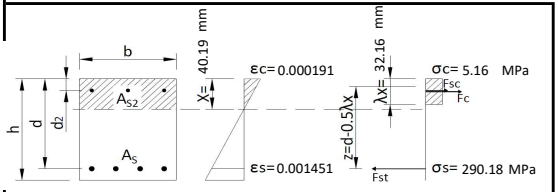
Flexure Design - Wall Hogging Steel

Design Moment: 200.00 | 1.000 | 200 kNm

Step 1:-

$K = M/bd^2f_{ck}$ = 0.0336 — no compression steel req

Step 2:-



$z = d - 0.5\lambda x$ = 327.75 mm

Step 3:- (Area of Tension Steel Req.)

$A_s = M/0.87f_{yk}z$ = 1403.5088 mm²

Step 4:- (Min Longitudinal Steel)

$A_{smin} = 0.26f_{ctm}b_wd/f_y$ = 735.54 mm² — ok

Step 5:- (Min Distribution Steel)

$A_{smin} = 0.0013bd$ = 448.5 mm² — ok

Step 6:- (Max Longitudinal Steel)

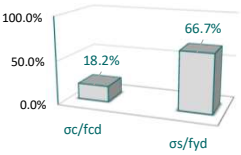
$A_{smax} = 0.04A_c$ = 13800 mm² — ok

Height of Concrete Section, h =	400	mm
Width of Concrete Section, b =	1000	mm
Exposure Class=	XC2	
Cover to Tension Steel =	45	mm
Effective Depth, d =	345	mm
Concrete Grade =	C50/60	
Type of Cement =	R	
Age of the Concrete in Days, t =	28	days
Concrete Compressive Stength at t, $f_{ck(t)}$ =	50.00	N/mm²
Design Value of fck at age t, $f_{cd(t)}$ =	28.33	N/mm²
Concrete Tensile Strength at t, $f_{ctm(t)}$ =	4.10	MPa
Concrete Tensile Strength at t=28, f_{ctm} =	4.10	MPa
Modulus of Elasticity of Concrete,Ecm (t)=	37.00	kN/mm²
Yield strength,fy =	500	N/mm²
Max stress in steel, f_{yd} =	434.78	MPa
Max Steel Strain, ϵ_{st} =	0.002173913	
Max Concrete Strain, ϵ_{cu2} =	0.0035	
Modulus od Elasticity of Steel, E_s =	200000	N/mm²
λ =	0.8	
η=	1	
α =	0.85	
Yc=	1.5	
Ys=	1.15	
Ø =	0.666666667	
α_{cw} =	1	

Tension Steel

Bar	20	mm
Area	314.16	mm²
No req	4.47	
No used	6.67	
As Prov	2095.44	mm²
M_R	299.67	kNm
$M_R \geq M$	ok	
Bars will be at approx...	150	mm centres
No. of bars =	14	

Use of steel and concrete -ULS stresses



Distribution Steel

Bar	12	mm
Area	113.10	mm²
No req	3.97	
No used	5	
As Prov	565.49	mm²

Rectangular Sections with tension & compression reinforcement:

If $d_2/x \leq 0.38$ the compression steel has yielded and $f_{sc} = 0.87f_{yk}$

If $d_2/x \geq 0.38$ then the strain ϵ_{sc} in the compressive steel must be calculated from the proportions of the strain diagram and $f_{sc} = E_s\epsilon_{sc} = 200x10^3\epsilon_{sc}$

d_2/x = 0 — therefore compression steel has yielded

If compression reinforcement is required then $x = x_{bal} = 0.45d$: x = 155.25 mm

If compression reinforcement is required then z = 0.82d : z = 282.9 mm

Step 5:- If Compression Steel is Required

$A_s = (K_{bal})f_{ck}bd^2/f_{yd}z + A_{s2}$ = 0 mm²

$A_{s2} = (K-K_{bal})f_{ck}bd^2/f_y(d-d')$ = 0 mm²

Compression Steel

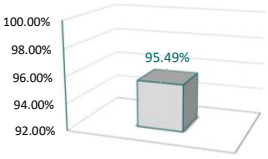
Bar	16	mm
Area	201.06	mm²
No req	0.00	
No used	6.67	
As Prov	0.00	mm²
cover to CS =	40	mm
d_2 =	0	mm

Shear Design - Wall Hogging Steel

V_{Ed} = 217 kN — Shear Width = 1000 mm

Step 6:-

$V_{Rd,c} = [C_{Rd,c}.k(100\rho_l f_{ck})^{1/3}]b_wd$	227.2496316 kN	No Shear links Req
$k = 1 + (200/d)^{1/2} \leq 2.0$, with d in mm	1.761386988	**USE THIS VALUE**
$\rho_l = (A_{sl}/b_wd) \leq 0.02$	0.006073746	
$\sigma_{cp} = 0.1333fck$	6.665	
Minimum Shear Capacity - (The shear that can be used as a minimum because the empirical formula for unreinforced concrete fails)		
$v_{min} = 0.035k^{1.5}.f_{ck}^{0.5}$ - (Exp 6.3N)	0.578542439 MPa	**IGNORE**
$V_{co} = v_c.A_{sh}.1x10^{-3}$ - (Exp 6.2b)	199.5971414 kN	Shear links Req



Capacity without Shear links

Step 7:-

Max Allowable Shear Force -

$V_{Rd,max} = \alpha_{cw}.b_w.z.v_1.f_{cd}/(\cot\theta + \tan\theta)$

1548.18511 kN

$v_1 = 0.6.[1-(fck/250)]$	0.48	MPa	
$v_{cu} = 0.4.v_1.Ø.f_{ck}$	6.4	MPa	**- Maximum Allowable Shear Stress**
$v = (Vx10^3)/A_{sh}$	0.629	MPa	**- Actual Shear Stress**

θ =	22
cotθ =	2.475086853
θ =	22
tanθ =	0.404026226
θ = 22°	cotθ = 2.5
θ = 45°	cotθ = 1.0

Step 8:-

To Calculate Links -

$V_{Rd,s} = (A_{sw}/s)\,z\,f_{ywd}.\cot\theta$

Shear Reinforcement -

$A_{sv}/s = V/(\cot\theta.0.9.d.0.87.f_{yv})$

0.649110193

(i.e. 1 leg B12 -200 c/c's = 0.565)

Use	4	10 mm Links	per meter	
As prov =	314	mm2/m		
C/C's =	200	mm	> Max Spacing = 258.75mm	
Asv/sv =	1.57	OK	> Min Asv/sv = 1.13	
No. rows req =	16			

Links Only Req in unit where shear is greater than shear capacity of 227.24963 kN

Step 9:-

Additional Longitudinal Reinforcement -

$\Delta F_{td} = 0.5V_{Ed}\cot\theta$

268.5469236 kN

617.3492496 mm² — ok, steel adequate

Shear Links Curtailment:

1/2 Span =	1.5	m
distance back from midspan	0	m
shear force at this location	#DIV/0!	kN

Crack Width Calculation to EC2	**Date:**	**05/12/2019**
Rectangular Cross - Section	**Prepared by:**	**Adrian Pilch**
Roof Sagging	**Checked by:**	**0**

BANAGHER PRECAST CONCRETE

Design Data:

Insertion site: Ireland

Concrete Grade =	C50/60	
Actual Concrete Cover to Tension Reinforcement: C_{nom} =	40	mm
Width of Concrete Section Being Considered: b =	1000	mm
Height of Concrete Section Being Considered: h=	400	mm
Effective Depth, d =	344	mm
Depth to Compression Steel, d_2=	65	mm
Quasi Permanent Moment, M =	384	kNm/m width
Exposure Class =	XC3	
Allowable Crack Width, w_{cr} =	0.25	mm
Modulus of Elasticity of Reinforcement, E_s =	200	kN/mm^2
Age of Concrete in Days, t=	28	days
Mean Value of the Concrete Tensile Strength at an Age t, fctm (t) =	4.10	Mpa
Modulus of Elasticity of Concrete at Age t, E_{cm} =	37.00	kN/mm^2
Final Value of Creep Coefficient, φ =	1	
Efective Modulus of Elasticity of Concrete, Eceff(t) = Ecm(t)/(1+φ)=	18.500	kN/mm^2
Modular Ratio with Eceff, αeff=Es/Eceff(t), αeff =	10.811	
Tension steel — A_s provided =	5364.33	mm^2
Consisting of =	6.67	nr
	32	mm
Compression steel — A_{s2} provided =	2095.44	mm^2
Center of Gravity - Uncraked Section , x_1=	211.01	mm
Section Modulus about the Tension Side, Wts =	36459659.58	mm^4
Cracking Moment Mcr= Wts * fctm (t) =	149.48	kNm
Cracking Moment is lower than Quasi Permanent Moment - Crack Width should be calculate		

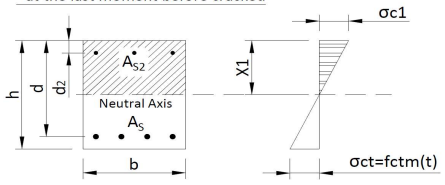
NA to I.S.EN 1992-2:2005 Table NA.2

Exposure Class	W_{max}
X0,XC1	0.25
XC2,XC3,XC4	0.25
XD1,XD2,XD3,XS1,XS2,XS3	0.1

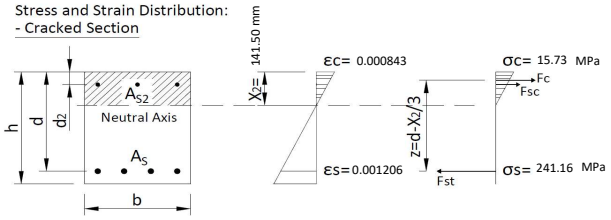
B.S.EN 1992-2:2005 Table 7.101N

Exposure Class	W_{max}
X0,XC1	0.3
XC2,XC3,XC4	0.3
XD1,XD2,XD3,XS1,XS2,XS3	0.3

Stress Distribution:
- at the last moment before cracked



Stress and Strain Distribution:
- Cracked Section



Equation of Total of Static Moments about the Neutral Axis After Cracked:

$b*x_2*0.5x_2 + \alpha eff*A_{s2}(x2 - d_2) = \alpha eff*A_s(d-x_2)$ $\quad x_2$= 141.50 mm

Tensile Stress in Steel, σ_s = M/(d-x_2/3)A_s
241.158 N/mm2

Calculated Crack Width, $W_k = S_{r\,max}(\epsilon_{sm} - \epsilon_{cm})$
= 0.230 mm OK

The strain difference (ε_{sm}-ε_{cm}) may be calculated from the expression:

$$(\varepsilon_{sm}-\varepsilon_{cm}) = \frac{\sigma_s}{E_s} - k_t\frac{\sigma_{sr}}{E_s} = \frac{\sigma_s - k_t\frac{f_{ctm}}{\rho_{p,eff}}(1+\alpha\rho_{p,eff})}{E_s} \geq 0.6\frac{\sigma_s}{E_s} \quad (1.31)$$

$\epsilon_{sm} - \epsilon_{cm}$ = 0.001029749

where

σ_s — stress in the tension reinforcement assuming a cracked section. σ_s = 241.16 N/mm2; σ_c = 15.73 N/mm2

ε_{sr} — $\varepsilon_{sr} = \frac{\sigma_{sr}}{E_s} \approx \frac{\frac{f_{ctm}}{\rho_{p,eff}}(1+\alpha\rho_{p,eff})}{E_s}$. This is a simplification which is exact for pure tension but not for bending. However, this simplification makes it easier to apply the model in practical cases and does not imply any significant loss of accuracy as is shown below. ϵ_s = 0.001206; therefore:, ϵ_c = 0.000843

α_e — ratio E_s/E_c $\quad \alpha_e$ = 5.405

$\rho_{p,eff} = \frac{A_s}{A_{c,eff}}$ $\quad \rho_{P,\,eff}$ = 0.062254686

$A_{c,eff}$ — effective tension area. $A_{c,eff}$ is the area of concrete surrounding the tension reinforcement of depth, $h_{c,ef}$, where $h_{c,ef}$ is the lesser of 2,5(h-d), (h-x)/3 or h/2 (see figure). $A_{c,eff}$ = 86167.52601 mm^2; $h_{c,ef}$ = 86.16752601 mm

k_t — factor dependent on the duration of the load
k_t = 0,6 for short term loading
k_t = 0,4 for long term loading $\quad k_t$ = 0.4

In situations, where bonded reinforcement is fixed at reasonably close spacing within the tension zone (spacing ≤ 5(c+ϕ/2), the maximum final crack spacing can be calculated from the expression:

5(c+Ø/2)= 280 mm; spacing= 31.25 mm; spacing ≤ 5(c+Ø/2) hence, Formula (1.32) is using

$$s_{r\,max} = 3.4c + 0.425k_1k_2\frac{\phi}{\rho_{p,eff}} \quad (1.32)$$

$S_{r\,max}$ = 223.38 mm

where

ϕ — bar diameter. Ø = 32 mm

c — cover to the reinforcement c = 40 mm

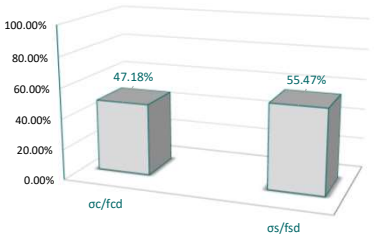
k_1 — coefficient which takes account of the bond properties of the bonded reinforcement;
= 0.8 for high bond bars
= 1.6 for bars with an effectively plain surface $\quad k_1$ = 0.8 for ribbed bars

k_2 — coefficient which takes account of the distribution of strain;
k_2 = 0.5 for bending
= 1.0 for pure tension
For cases of eccentric tension or for local areas, intermediate values of k_2 should be used which can be calculated from the relation:
$k_2 = \frac{(\varepsilon_1+\varepsilon_2)}{2\varepsilon_1}$
Where ε_1 is the greater and ε_2 is the lesser tensile strain at the boundaries of the section considered, assessed on the basis of a cracked section. $\quad k_2$ = 0.5 for flexure

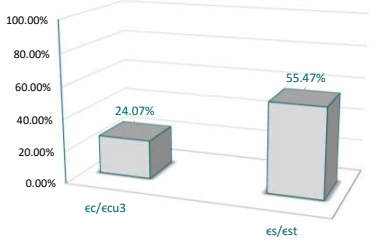
Where the spacing of the bonded reinforcement exceeds 5(c+ϕ/2) (see Figure 7.2) or where there is no bonded reinforcement within the tension zone, an upper bound to the crack width may be found by assuming a maximum crack spacing:

$s_{r,max}$ = 1,3 (h - x) (7.14)

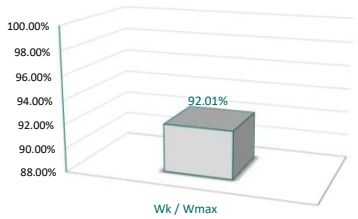
Percent of allowable stresses
-post crack



Percent of allowable strains
-post crack



Relation of W_k to W_{max}



Crack Width Calculation to EC2	Date:	05/12/2019
Rectangular Cross - Section	Prepared by:	Adrian Pilch
Roof Hogging	Checked by:	0

BANAGHER PRECAST CONCRETE

Design Data:

Insertion site: Ireland

NA to I.S.EN 1992-2:2005 Table NA.2	
Exposure Class	W_{max}
X0,XC1	0.25
XC2,XC3,XC4	0.25
XD1,XD2,XD3,XS1,XS2,XS3	0.1

B.S.EN 1992-2:2005 Table 7.101N	
Exposure Class	W_{max}
X0,XC1	0.3
XC2,XC3,XC4	0.3
XD1,XD2,XD3,XS1,XS2,XS3	0.3

Concrete Grade =		C50/60	
Actual Concrete Cover to Tension Reinforcement: C_{nom} =		55	mm
Width of Concrete Section Being Considered: b =		1000	mm
Height of Concrete Section Being Considered: h=		400	mm
Effective Depth, d =		335	mm
Depth to Compression Steel, d_2=		0	mm
Quasi Permanent Moment, M =		34	kNm/m width
Exposure Class =		XD2	
Allowable Crack Width, w_{cr} =		0.1	mm
Modulus of Elasticity of Reinforcement, E_s =		200	kN/mm^2
Age of Concrete in Days, t=		28	days
Mean Value of the Concrete Tensile Strength at an Age t, fctm (t) =		4.10	Mpa
Modulus of Elasticity of Concrete at Age t, E_{cm} =		37.00	kN/mm^2
Final Value of Creep Coefficient, φ =		1	
Efective Modulus of Elasticity of Concrete, Eceff(t) = Ecm(t)/(1+φ)=		18.500	kN/mm^2
Modular Ratio with Eceff, αeff=Es/Eceff(t), αeff =		10.811	
Tension steel	A_s provided =	2095.44	mm^2
	Consisting of =	6.67	nr
		20	mm
Compression steel	A_{s2} provided =	0.00	mm^2
Center of Gravity - Uncraked Section , x_1=		207.24	mm
Section Modulus about the Tension Side, Wts =		29694632.39	mm^4
Cracking Moment Mcr= Wts * fctm (t) =		121.75	kNm
Cracking Moment is bigger than Quasi Permanent Moment - Cross section does not crack			

Equation of Total of Static Moments about the Neutral Axis After Cracked:

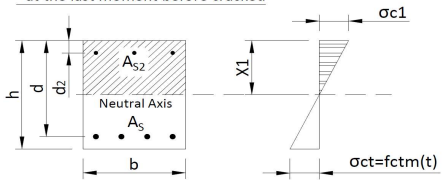
$b*x_2*0.5x_2 + \alpha eff*A_{s2}(x2 - d_2) = \alpha eff*A_s(d-x_2)$ $\quad x_2$= mm

Tensile Stress in Steel, σ_s = $M/(d-x_2/3)A_s$ N/mm2

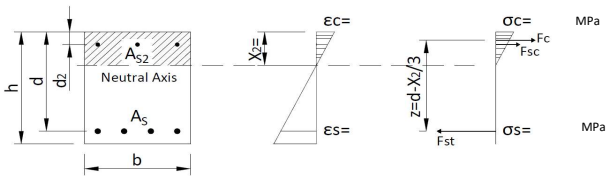
Calculated Crack Width, $W_k = S_{r\,max}(\epsilon_{sm} - \epsilon_{cm})$

= mm

Stress Distribution:
- at the last moment before cracked



Stress and Strain Distribution:
- Cracked Section



The strain difference $(\varepsilon_{sm}-\varepsilon_{cm})$ may be calculated from the expression:

$$(\varepsilon_{sm}-\varepsilon_{cm}) = \frac{\sigma_s}{E_s} - k_t\cdot\varepsilon_{sr} = \frac{\sigma_s - k_t\frac{f_{cm}}{\rho_{eff}}(1+\alpha\rho_{eff})}{E_s} \geq 0.6\frac{\sigma_s}{E_s} \qquad (1.31)$$

$\epsilon_{sm} - \epsilon_{cm}$ =

where

σ_s	stress in the tension reinforcement assuming a cracked section.	σ_s =	N/mm2
		σ_c =	N/mm2
ε_{sr}	$\varepsilon_{sr} = \frac{\sigma_{sr}}{E_s} \approx \frac{\frac{f_{ctm}}{\rho_{eff}}(1+\alpha\rho_{eff})}{E_s}$. This is a simplification which is exact for pure tension but not for bending. However, this simplification makes it easier to apply the model in practical cases and does not imply any significant loss of accuracy as is shown below.	ϵ_s =	
		therefore:, ϵ_c =	
α_e	ratio E_s/E_c	α_e =	
$\rho_{p,eff}$	$= \frac{A_s}{A_{c,eff}}$	ρ_P, eff =	
$A_{c,eff}$	effective tension area. $A_{c,eff}$ is the area of concrete surrounding the tension reinforcement of depth, $h_{c,ef}$, where $h_{c,ef}$ is the lesser of 2,5(h-d), (h-x)/3 or h/2 (see figure).	$A_{c,eff}$ =	mm^2
		$h_{c,ef}$ =	mm
k_t	factor dependent on the duration of the load k_t = 0,6 for short term loading k_t = 0,4 for long term loading	k_t =	0.4

In situations, where bonded reinforcement is fixed at reasonably close spacing within the tension zone (spacing ≤ 5(c+ϕ/2), the maximum final crack spacing can be calculated from the expression:

5(c+Ø/2)= mm

spacing= mm

spacing

$$s_{r\,max} = 3.4c + 0.425k_1k_2\frac{\phi}{\rho_{p,eff}} \qquad (1.32)$$

$S_{r\,max}$ = mm

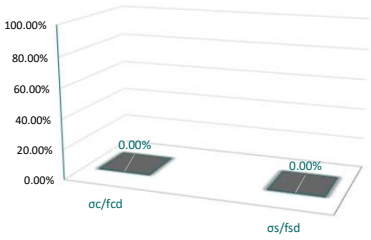
where

ϕ	bar diameter.	Ø =	20 mm
c	cover to the reinforcement	c =	55 mm
k_1	coefficient which takes account of the bond properties of the bonded reinforcement; = 0.8 for high bond bars = 1.6 for bars with an effectively plain surface	k_1 =	0.8 for ribbed bars
k_2	coefficient which takes account of the distribution of strain; k_2 = 0.5 for bending = 1.0 for pure tension For cases of eccentric tension or for local areas, intermediate values of k_2 should be used which can be calculated from the relation: $k_2 = \frac{(\varepsilon_1+\varepsilon_2)}{2\varepsilon_1}$ Where ε_1 is the greater and ε_2 is the lesser tensile strain at the boundaries of the section considered, assessed on the basis of a cracked section.	k_2 =	0.5 for flexure

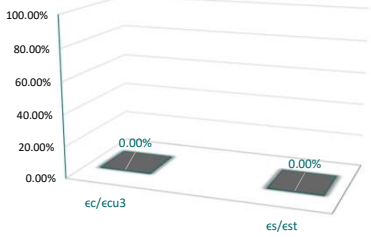
Where the spacing of the bonded reinforcement exceeds 5(c+ϕ/2) (see Figure 7.2) or where there is no bonded reinforcement within the tension zone, an upper bound to the crack width may be found by assuming a maximum crack spacing:

$s_{r,max} = 1,3\ (h - x)$ (7.14)

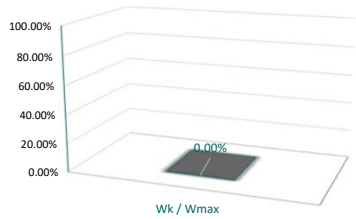
Percent of allowable stresses
-post crack



Percent of allowable strains
-post crack



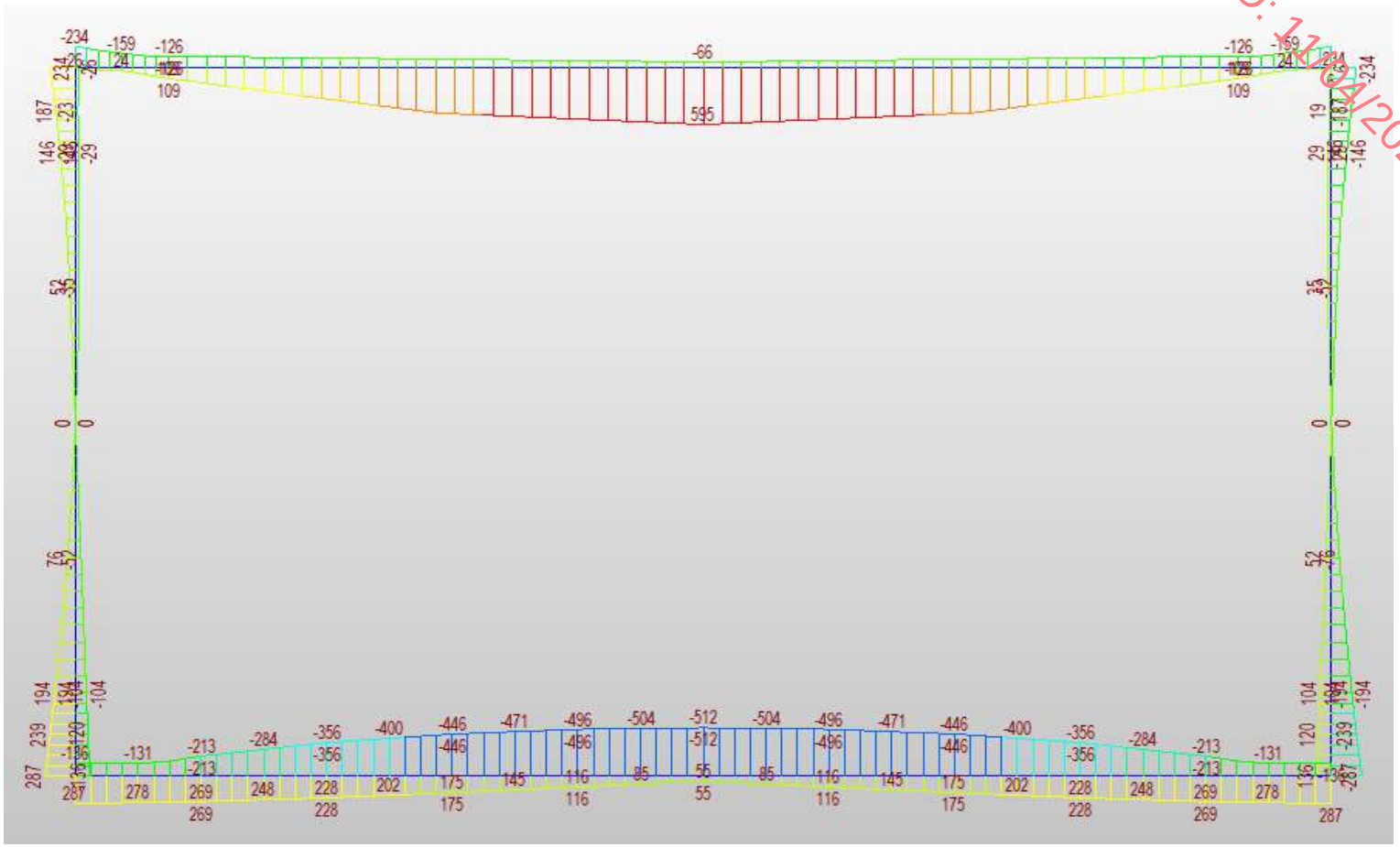
Relation of W_k to W_{max}



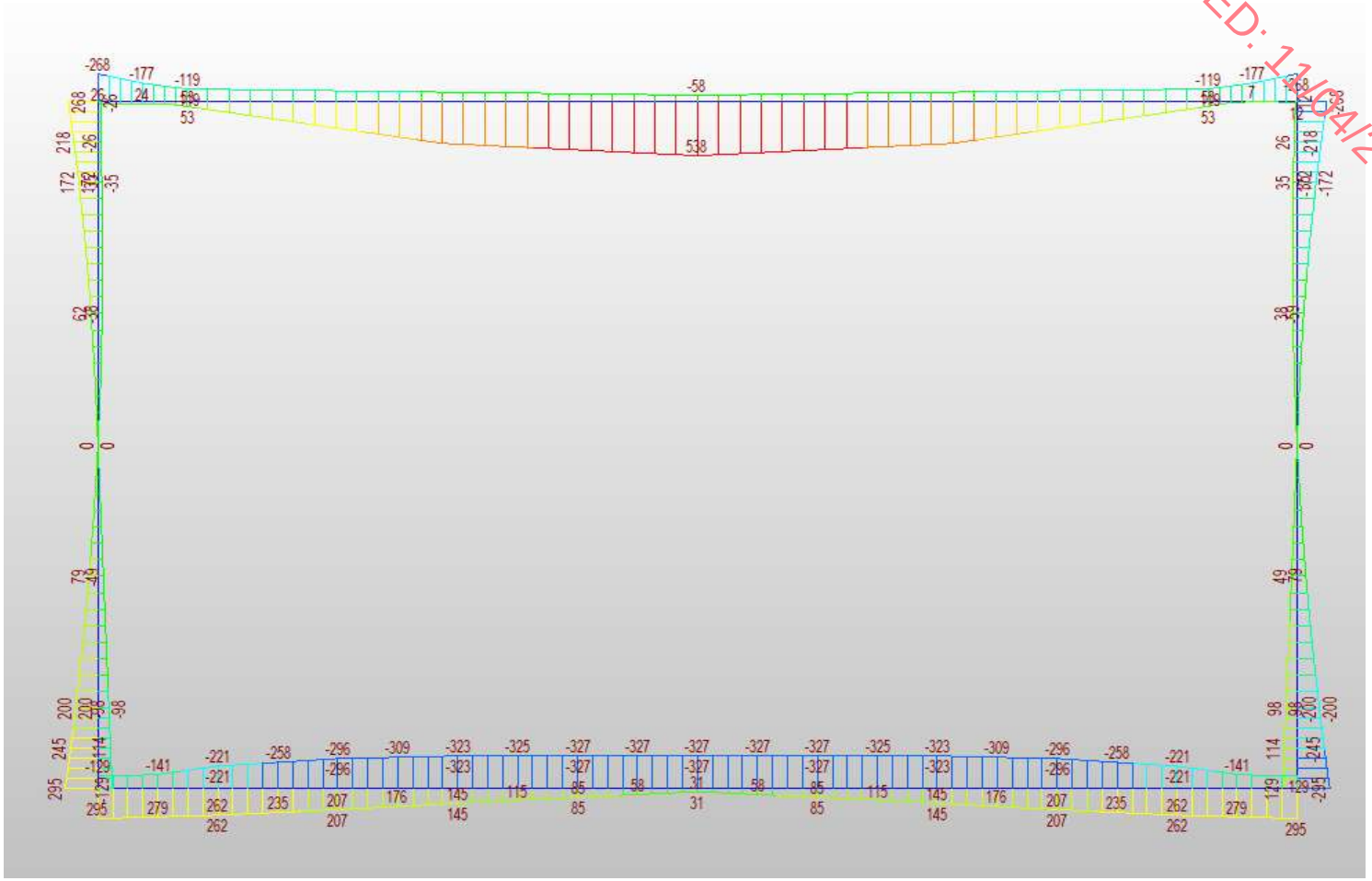
BANAGHER PRECAST CONCRETE

APPENDIX

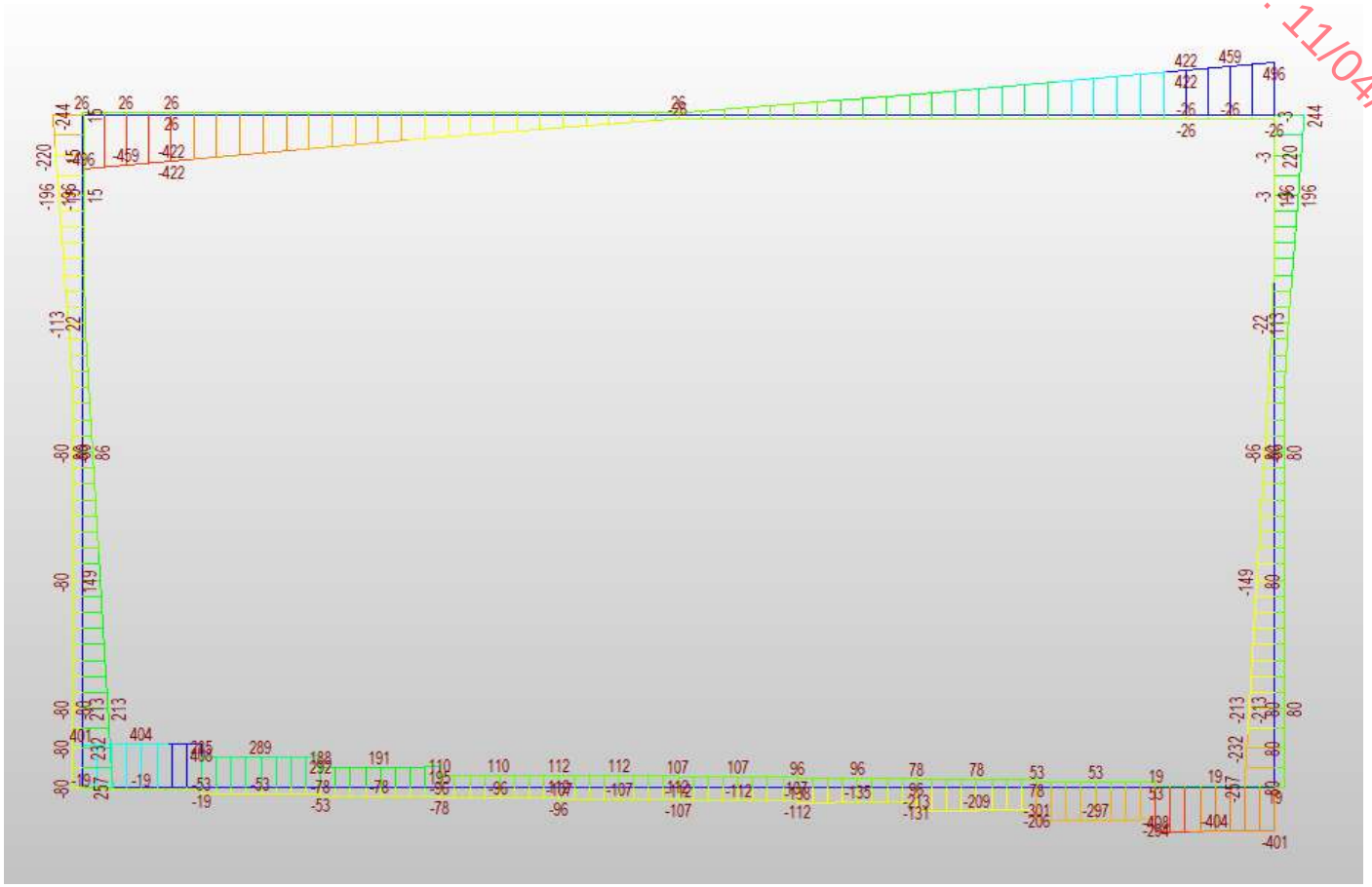
Bending Moment & Shear Force Diagrams
Design Risk Assessment
Permanent Works Design Cert
Lifting Calculations
Spring Stiffness Calculation
Bearing Pressure Calculation
Rebar Sketch



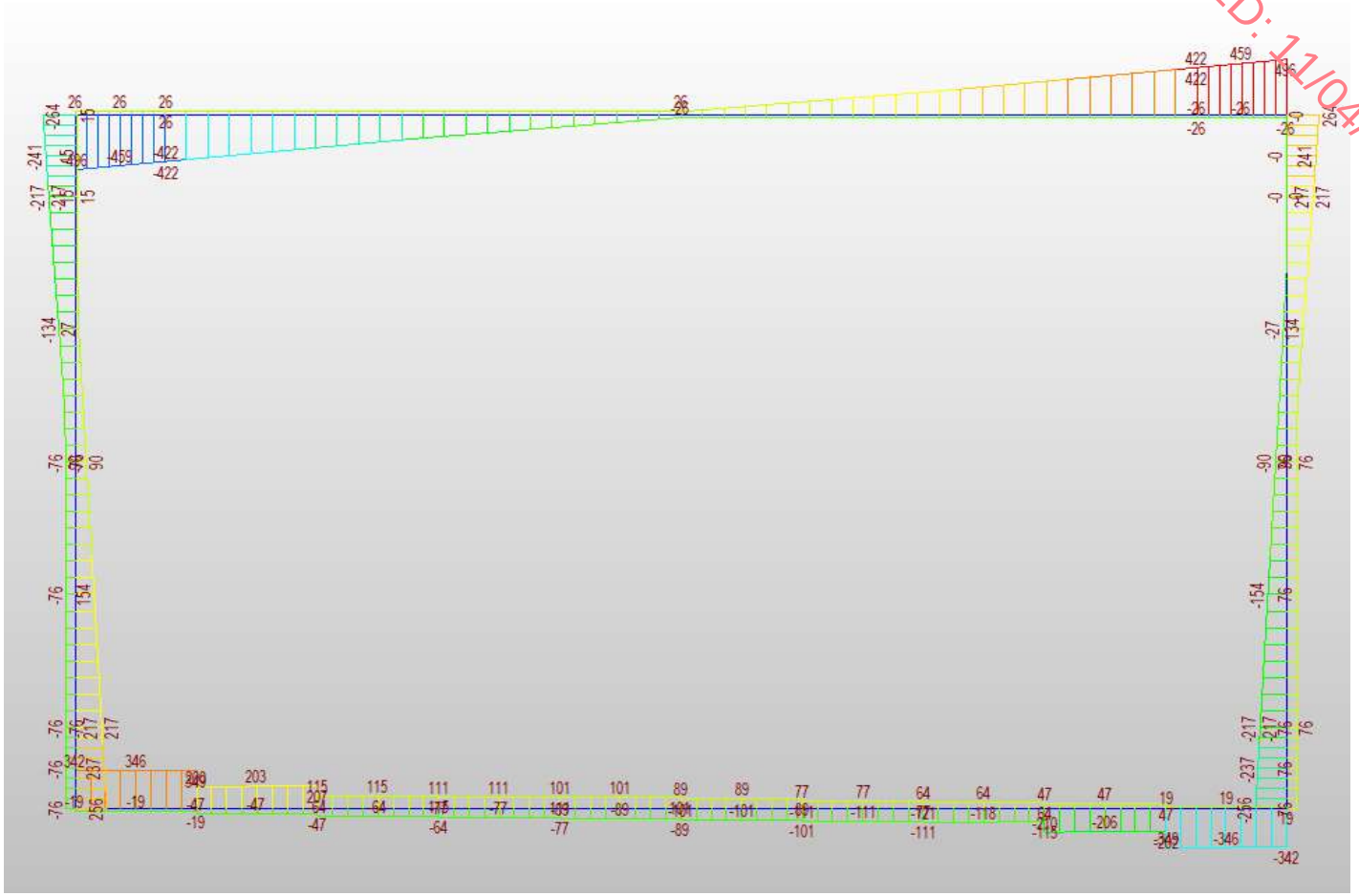
BENDING MOMENT DIAGRAM , E=32 MPa



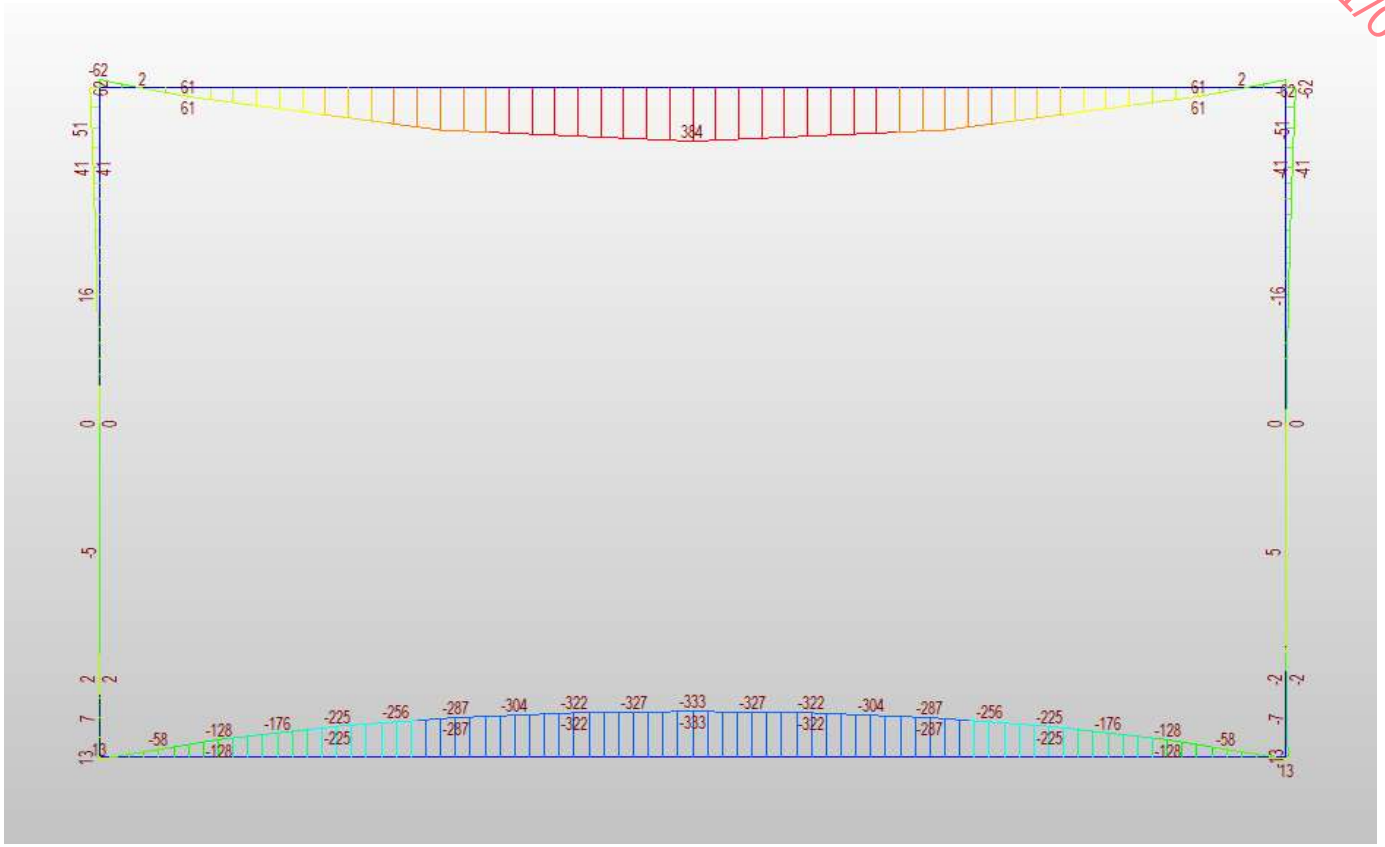
BENDING MOMENT DIAGRAM , E=117 MPa



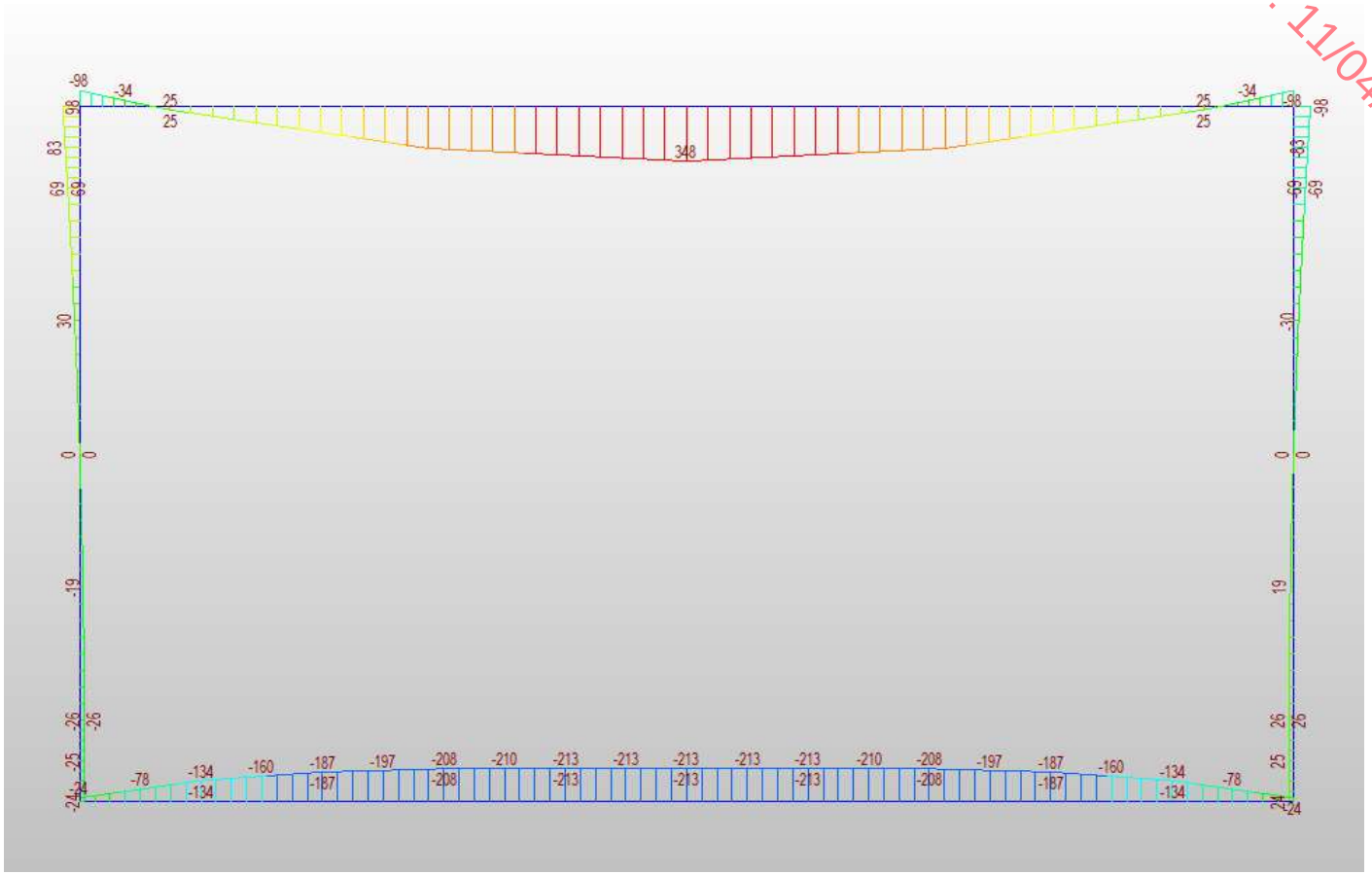
SHEAR FORCE DIAGRAM , E=32 MPa



SHEAR FORCE DIAGRAM , E=117 MPa



QUASI PERMANENT BENDING MOMENT DIAGRAM , E=32 MPa



QUASI PERMANENT BENDING MOMENT DIAGRAM , E=117 MPa

BANAGHER PRECAST CONCRETE

Design Risk Assessment

Job Title:	R179 Carrickmackross & Kingscourt	Prepared by:	AP
Date:	05/12/2019	Checked by:	

This DRA assumes that competent contractors are used at all times during the construction process. They will therefore be aware of the risks normally associated with precast installation. This design risk assessment highlights hazards that are unusual or non standard.

Identified Hazard:	People at Risk				Mitigation of Risk	Risk Category		Detailed Action
	A	B	C	D		Likelihood	Severity	
1 - Injury during loading and unloading					Only authorised lifting eyes to be used. Design to take account of lifters required per unit weight. Design to also take account of unit sizes with regard to transportability. Lifters to be clearly marked on production dwgs.	LOW	HIGH	**BPC Ltd. & Contractor** - All lifting equipment to be in test. Contractor to have correct lifting equipment on site as per BPC Ltd. production dwgs
2 - Fabrication of precast concrete units. Handling of constituent materials/ mould oils.					Correct use of PPE. Trained and approved Banagher Precast Concrete personnel to carry out work only	LOW	LOW	**BPC Ltd.** - Training and PPE to be available to workers
3 - Errors in fabrication and precasting of the units leading to substandard structure					Precast units to be regularly inspected and surveyed. Final survey of precast elements to be undertaken prior to delivery.	LOW	MED	**BPC Ltd.** - Quality engineer to be asigned to each project. A set of production dwgs to be produced for each precast element manufactured
4 - Transportation					Design to take account of unit sizes with regard to transportability. Units to be properly secured to trailors and checked by transport manager before delivery.	LOW	HIGH	**BPC Ltd. & Contractor** - All securing equipment to be visually inspected by Haulier prior to units leaving the factory. Contractor to report any defective securing gear when offloading
5 - Tripping or falling on rebar					Use of mushroom caps to protect	MED	MED	**BPC Ltd. & Contractor** - All rebar that is projecting from a precast unit that could cause an accident to be identified and protected with mushroom caps if necessary
6 - The placing of Precast Sections in the wrong location					(1) All precast units are clearly marked during precasting. (2) Install to layout drawings. (3) Check markings.	LOW	LOW	**BPC Ltd. & Contractor** - Units to be installed as per the layout dwgs using the info marked on the units themselves
7 - Alterations to Banagher Precast Concrete Limited Products.					No alterations i.e. Cutting, Drilling, Boring, etc to be done without consulting Banagher Precast Concrete Limited Technical Department	MED	MED	**Contractor** - Check with BPC Ltd. before altering any units on site
8								
9								
10								

Key:

A = Banagher Precast Operative
B = General Public
C = Site Personnel
D = Maintenance Workers

Likelihood of occurence

HIGH	- Certain or near certain to occur
MED	- Reasonably likely to occur
LOW	- Very seldom or nevero occurs

Likelihood of severity

HIGH	- Fatality / Serious Injury / Permanent disability or illness
MED	- Injury or illness causing short term disability
LOW	- Other minor injury or illness

Detailed Action

HIGH	- Contractor/BPC to manage risk
MED	- Contractor/BPC to manage risk
LOW	- Risk designed out

PERMANENT WORKS DESIGN CERTIFICATE

BANAGHER PRECAST CONCRETE

Name of Project: R179 Carrickmackross & Kingscourt
Name of Structure: U on U_S Structure
Specific Element Checked: Precast Culverts Only
Structure Ref No: NA

We hereby certify to the Employer in respect of the design and check of the above detailed element(s) that reasonable professional skill, care and diligence have been taken by us with a view to securing that this divided part of the Design Element: -

(i) Complies with the Contract Requirements;
(ii) Is not detrimental to the whole Design
(iii) Has been accurately translated into Design Data (including but not limited to, calculations, drawings, schedules and specifications) (including lifting requirements) bearing the unique reference numbers listed below:

Calculation No./date =
Drawing No. = NA
Additional Info. = Design calculations attached
Designed in accordance with = Eurocode 1 "Actions on structures – Part 2: Traffic loads on bridges" , Eurocode 2 "Design of concrete structures" and PD6694 "Recommendations for the design for structures subject to traffic loading"

DESIGNER
Signed: Adrian Pilch Firm: Banagher Precast Concrete Ltd

Name: Adrian Pilch Date: 05/12/2019

Qualifications: Structural Engineer
BEc, BSc, MSc, CEng, MIEI

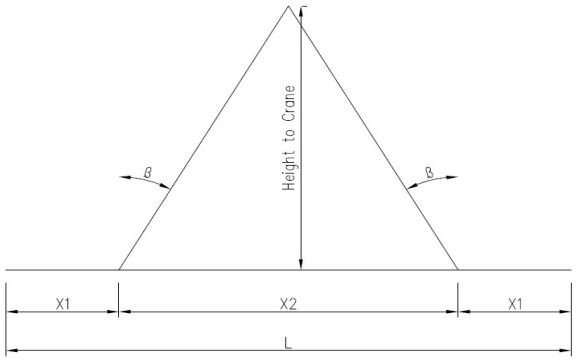
Receipt of this certificate is acknowledged
Signed: Firm: Golder

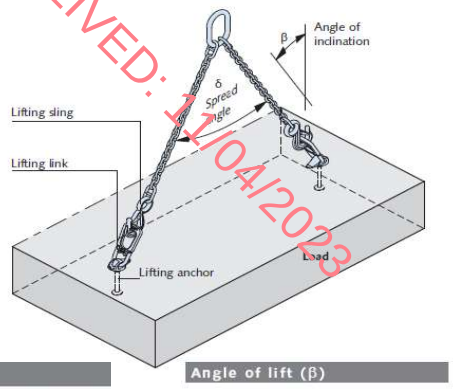
Name: Date

Lifting Calculation

BANAGHER PRECAST CONCRETE

Name of Project: R179 Carrickmackross & Kingscourt
Name of Structure: U on U_S Structure
Type of PC: Culvert
Designed by: Adrian Pilch
Checked by:





The below is based on " DEHA Lifting Anchor System"

Calculation parameters:		Banagher	On Site	
G, Mass	=	17.711	17.711	t
A, Mould Area	=	15.92	15.92	m^2
q, Adhesion to formwork	=	1	1	kN/m^2
n, Number of effective lifters	=	4	2	nr
f, Lifting load coefficent	=	1.3	1.1	
β, Angle of lift	=	25	25	degrees
z, cable angle factor	=	1.10	1.10	
βw, Concrete strength	=	25	50	N/mm^2
L	=		4.80	m
X1	=		1.00	m
X2	=		2.80	m
Height to crane	=		2.54	m

Step 1:
Lifting from the mould(demoulding)
F = (G + q x A)x z / n
53.25 kN **5.32 t**

Step 2:
Transport in the yard
F = G + f x z / n
63.51 kN **6.35 t**

Step 3:
Transport on site - assuming all lifters are equally loaded
F = G x f x z / n
107.48 kN **10.75 t**

Applicable Lifters =	**15 T**
Type of lifter =	**Lifting Pins**

BPC Available Lifters		
	Lifting Sockets	Lifting Pins
Size	Safe Working Load (T)	Safe Working Load (T)
M12	0.50	1.30
M16	1.20	2.50
M20	2.00	5.00
M24	2.50	7.50
M30	4.00	10.00
M36	6.30	15.00
M42	8.00	20.00
M52	12.50	32.00

Adhesion to the mould	
for smooth, oiled moulds	q = 1 kN/m^2
for smooth, non-oiled moulds	q = 2 kN/m^2
for rough moulds	q = 3 kN/m^2

Crane Factors

Lift Equipment	Lifting Speed [m/min.]	Impact Factor ψ
Stationary Crane, Revolving Crane, Rail-mounted Crane	< 90	1.0 - 1,2
Stationary Crane, Revolving Crane, Rail-mounted Crane	≥ 90	1.3 - 1,4
Lifting and transporting with excavator on even ground	-	1.5 - 1,65
Lifting and transporting with excavator on uneven ground	-	≥ 2.0

Angle of lift (β)

If a lifting sling is used in a triangle form, the acting forces on the anchors (sling loads) are increasing compared to simple vertical lifting. As the angle of lift (β) increases, the acting forces on the anchors and slings increase as well. This influence is taken into account by factor ω dependent on angle β.

$z = 1 / \cos \beta$

Information:

For avoiding sloped hanging position of the precast elements, the position of the hook at a spreader beam should be straight above the centre of gravity.

If lifting is executed without spreader beam, the anchors should be positioned symmetrically to the centre of gravity.

Please see production dwgs for detailed lifting diagram, please also see the Banagher Precast Concrete "Bridge Beam Manual" for additional details on lifting, handling, delivery and installation.

PRECAST CONCRETE SPECIALISTS

Job: R179 Carrickmackross Option one - E = 32 MPa

			SS model length			
Foundation Width	5.8	m	0.58	m	10	divisions
Foundation Length	1	m	1	m		
Area	5.8					
E	32	MPa				

Spring stiffness calculation guidance to EC Hambley - Chapter 14

Kz	$1.5EA^{0.5}$	Vertical
Kx	$EA^{0.5}$	Horizontal
Km	1.5EA	Rocking stiffness (Moment)

Kz	115599.3	kPa		
Kx	77066.21	kPa		
Kz	11559.93	kPa	per m width per	0.58 m length
Kx	7706.621	kPa	per m width per	0.58 m length
Kz	5779.965	kPa	per m width per	0.29 m length
Kx	3853.31	kPa	per m width per	0.29 m length

Check			
Kz	115599.3	kPa	ok
Kx	77066.21	kPa	ok

Typical values of Young's modulus for granular material (MPa) (based on Obrzud & Truty 2012 complied from Kezdi 1974 and Prat et al. 1995)

USCS	Description	Loose	Medium	Dense
GW, SW	Gravels/Sand well-graded	30-80	80-160	160-320
SP	Sand, uniform	10-30	30-50	50-80
GM , SM	Sand/Gravel silty	7-12	12-20	20-30

Typical values of Young's modulus for cohessive material (MPa) (based on Obrzud & Truty 2012 compiled from Kezdi 1974 and Prat et al. 1995)

USCS	Description	Very soft to soft	Medium	Stiff to very stiff	Hard
ML	Silts with slight plasticity	2.5 - 8	10 - 15	15 -40	40 - 80
ML, CL	Silts with low plasticity	1.5 - 6	6 -10	10 - 30	30 -60
CL	Clays with low-medium plasticity	0.5 - 5	5 -8	8 - 30	30 - 70
CH	Clays with high plasticity	0.35 - 4	4 -7	7 - 20	20 - 32
OL	Organic silts	-	0.5 -5	-	-
OH	Organic clays	-	0.5 -4	-	-

Job: R179 Carrickmackross Option two - E = 117 MPa

			SS model length			
Foundation Width	5.8	m	0.58	m	10	divisions
Foundation Length	1	m	1	m		
Area	5.8					
E	117	MPa				

Spring stiffness calculation guidance to EC Hambley - Chapter 14

Kz	$1.5EA^{0.5}$	Vertical
Kx	$EA^{0.5}$	Horizontal
Km	1.5EA	Rocking stiffness (Moment)

Kz	422660	kPa		
Kx	281773.3	kPa		
Kz	42266	kPa	per m width per	0.58 m length
Kx	28177.33	kPa	per m width per	0.58 m length
Kz	21133	kPa	per m width per	0.29 m length
Kx	14088.67	kPa	per m width per	0.29 m length

Check			
Kz	422660	kPa	ok
Kx	281773.3	kPa	ok

Typical values of Young's modulus for granular material (MPa) (based on Obrzud & Truty 2012 complied from Kezdi 1974 and Prat et al. 1995)

USCS	Description	Loose	Medium	Dense
GW, SW	Gravels/Sand well-graded	30-80	80-160	160-320
SP	Sand, uniform	10-30	30-50	50-80
GM , SM	Sand/Gravel silty	7-12	12-20	20-30

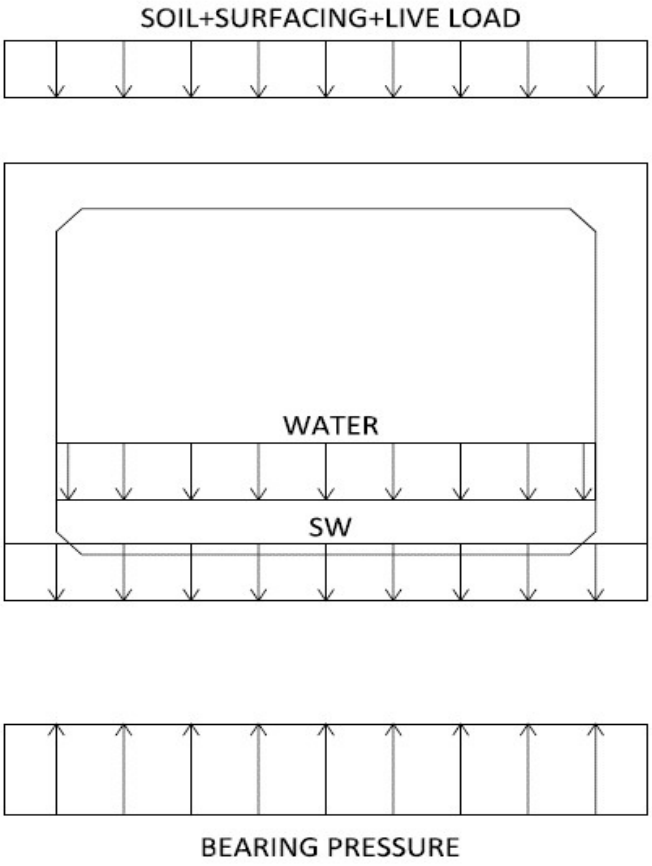
Typical values of Young's modulus for cohessive material (MPa) (based on Obrzud & Truty 2012 compiled from Kezdi 1974 and Prat et al. 1995)

USCS	Description	Very soft to soft	Medium	Stiff to very stiff	Hard
ML	Silts with slight plasticity	2.5 - 8	10 - 15	15 -40	40 - 80
ML, CL	Silts with low plasticity	1.5 - 6	6 -10	10 - 30	30 -60
CL	Clays with low-medium plasticity	0.5 - 5	5 -8	8 - 30	30 - 70
CH	Clays with high plasticity	0.35 - 4	4 -7	7 - 20	20 - 32
OL	Organic silts	-	0.5 -5	-	-
OH	Organic clays	-	0.5 -4	-	-

Bearing pressure at serviceability limit state

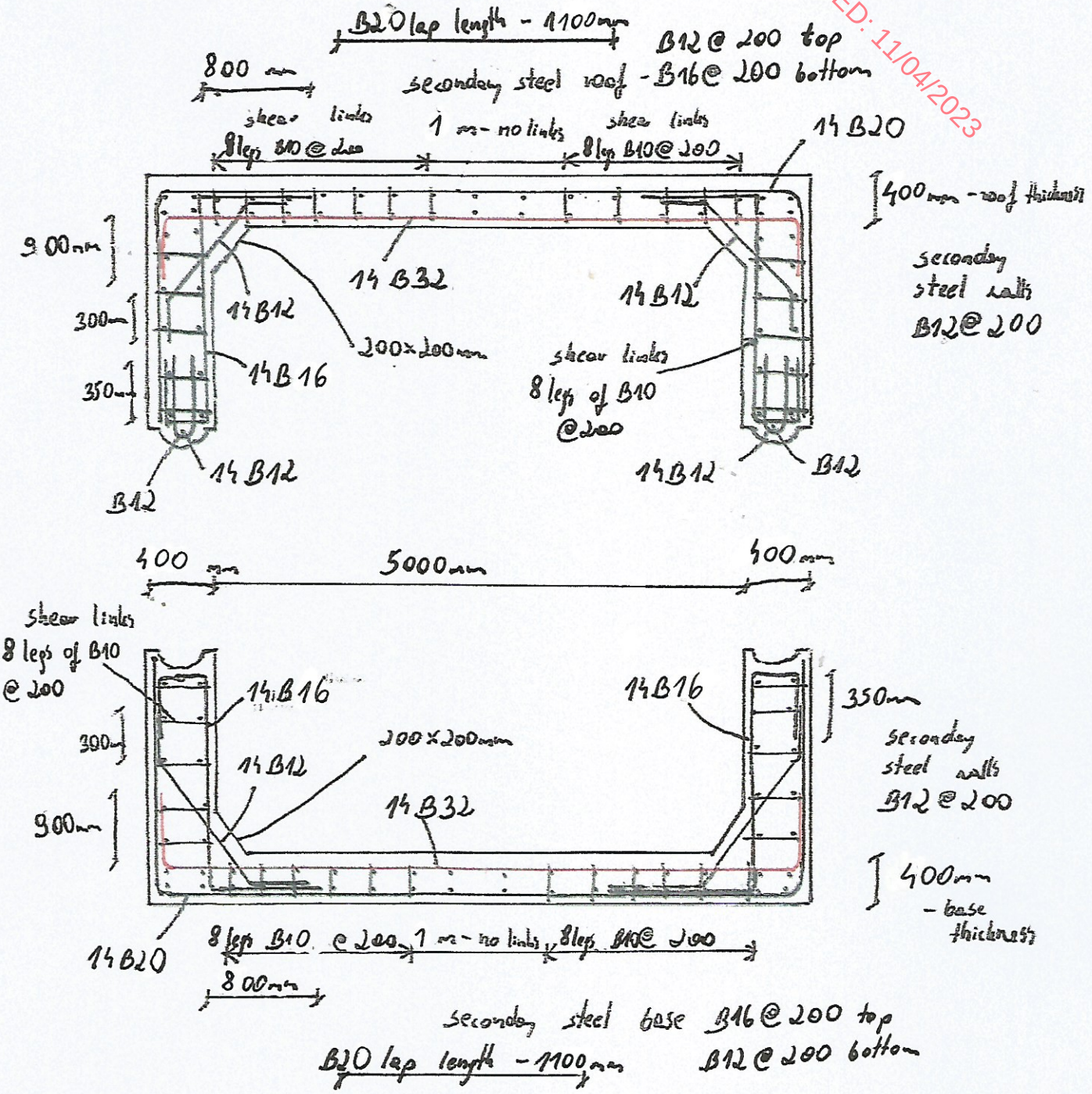
V- Total Vertical Load = 1030 kN

p= V/ (beff x L) = 178.00 kN/m^2 **Bearing pressure from unit**

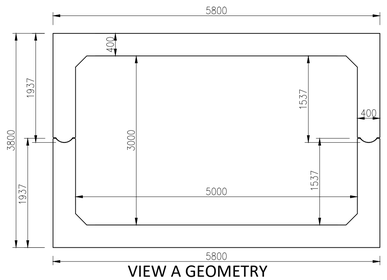


BANAGHER
PRECAST CONCRETE

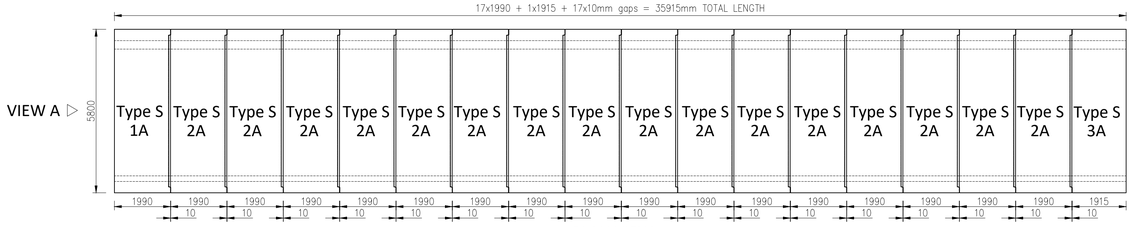
Date: 05/12/2019
Project: R173
Subject: Small Structure
Job No: 19. 852



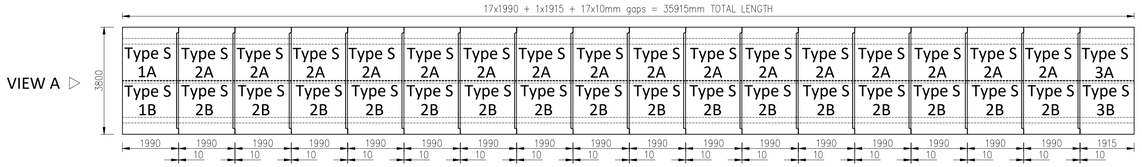
Banagher Precast Concrete Ltd., Queen Street, Banagher, Birr, Co. Offaly. Ireland.



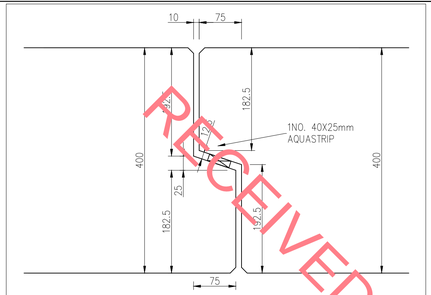
VIEW A GEOMETRY
STRUCTURE S (1:50)



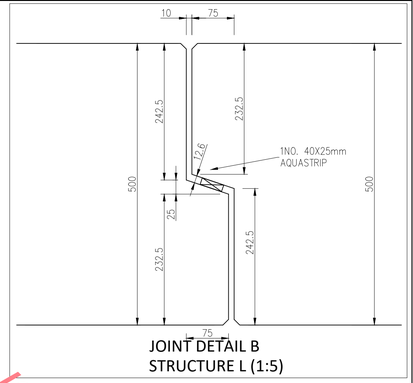
PLAN VIEW
STRUCTURE S (1:100)



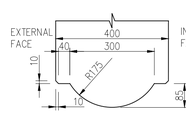
ELEVATION
STRUCTURE S (1:100)



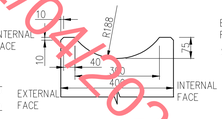
JOINT DETAIL A
STRUCTURE S (1:5)



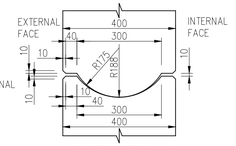
JOINT DETAIL B
STRUCTURE L (1:5)



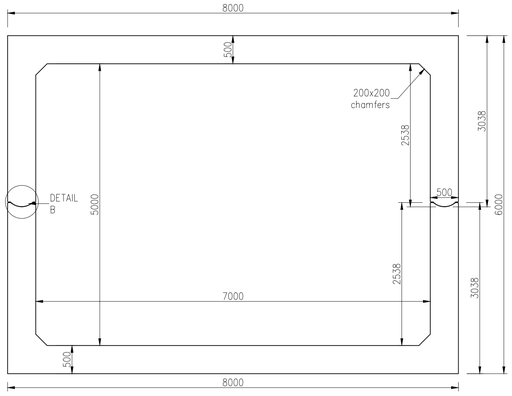
DETAIL A (S) (1:10)
Top



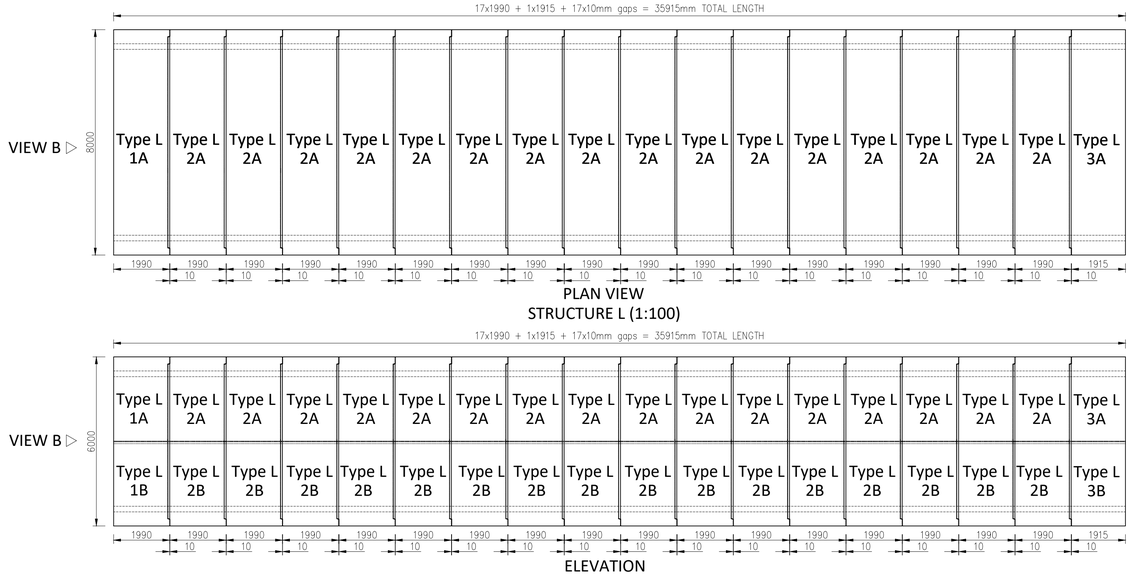
DETAIL B (S) (1:10)
Bottom



JOINT DETAIL (S)
TOP & BOTTOM UNIT (1:10)

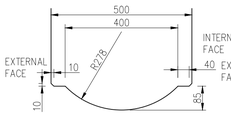


VIEW B GEOMETRY
STRUCTURE L (1:50)

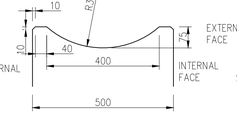


PLAN VIEW
STRUCTURE L (1:100)

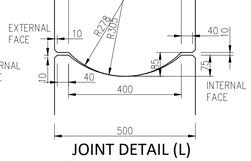
ELEVATION
STRUCTURE L (1:100)



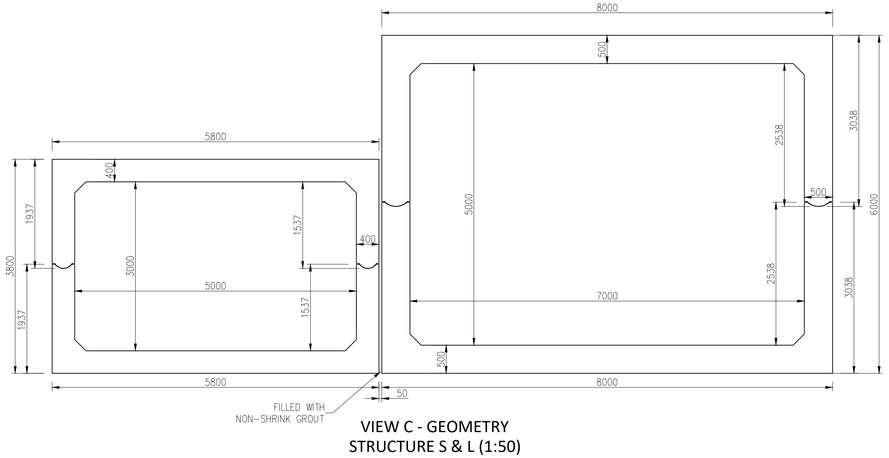
DETAIL A (L) (1:10)
Top



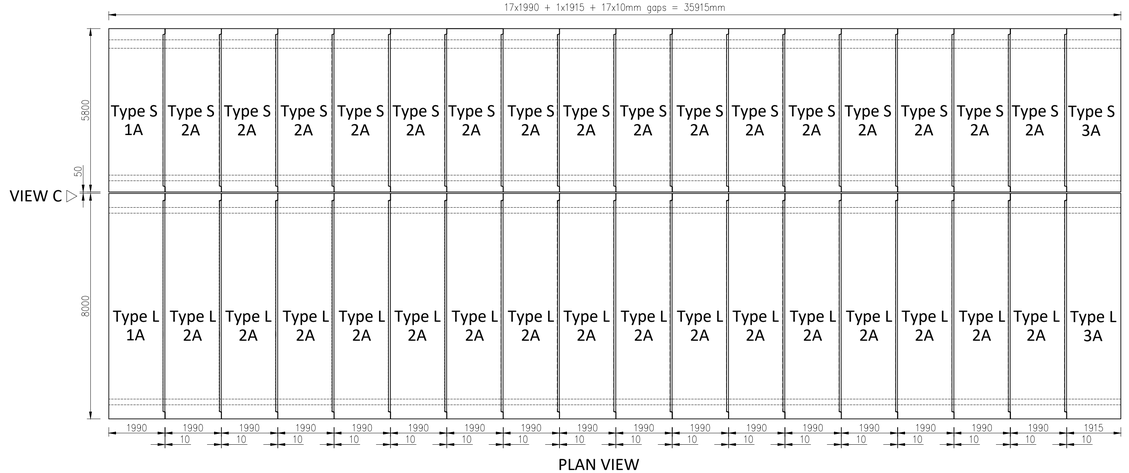
DETAIL B (L) (1:10)
Bottom



JOINT DETAIL (L)
TOP & BOTTOM UNIT (1:10)



VIEW C - GEOMETRY
STRUCTURE S & L (1:50)



PLAN VIEW
BOTH STRUCTURES (1:100)

03/12/2019 P01: Issued For Comment

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Project:
R179 Carrickmacross & Kingscourt

Title:
General Arranagement
Structure S & L

Scales:	Issued by:	Date:
As Shown		03/12/2019

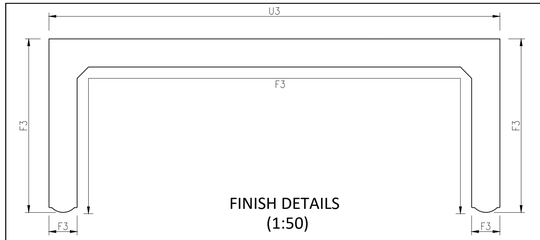
Contractor:	Designer:
Golder	BPC Ltd.
Client:	Project manager:
Golder	Brian Grogan

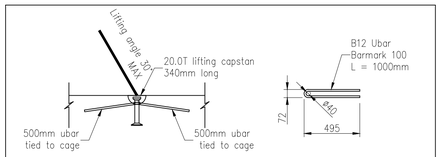
Drawn by:	Checked by:	Approved by:	Project No.:
A Troy	MM	AP	19.852

Drawing No.:	Rev.:
CMC-BPC-00-XX-DR-X-0001	P01

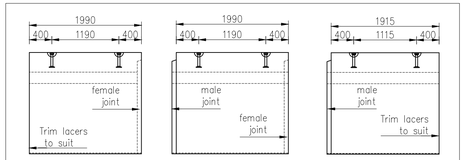
Designer Approval:	Contractor Appr.:	P.O. No.:

Preformed Ducts or Pockets are to be protected from water ingress where there is a risk of frost damage occurring.Susceptible Ducts should be checked regularly for the presence of water & or ice, whether in storage or on site.Water or ice within the Ducts should be removed immediately. Once units are delivered to site it is the responsibility of the contractor to protect & monitor the Ducts.





Anchorage steel detail for
20.0T lifting capstans (1:25)

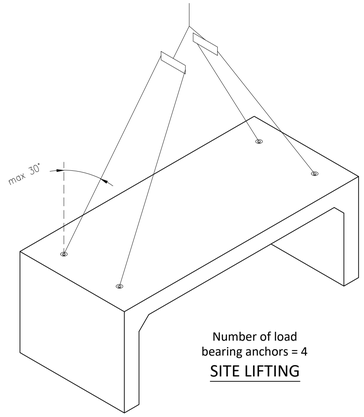


PORTAL TOP UNIT
TYPE 1A (1:50)
1NR. REQUIRED

PORTAL TOP UNIT
TYPE 2A (1:50)
16 NR. REQUIRED

PORTAL TOP UNIT
TYPE 3A (1:50)
1NR. REQUIRED

KEY ELEVATION VIEW



Number of load
bearing anchors = 4

SITE LIFTING

BANAGHER PRECAST CONCRETE LTD																			
R179 Carrickmackross & Kingscourt TYPE A's Structure L							Bar Schedule ref:		CMC-BPC-00-XX-BS-X-0002					Revision		P01			
							Date Prepared		06/12/2019					Date Revised					
							Prepared By:		AT					Checked BY:		MM			
Member	Bar Mark	Type and Size		Radius	No. of Members	No. of bars in each	Total No.	Length of each bar mm	Shape Code	A* mm	B* mm	C* mm	D* mm	E/R* mm	F* mm	Bar Weight Per m	Total Weight (kgs)	Total Volume (m^3)
	01	B	25	87	18	28	504	7415	11	4655	2855					3.85	14461.29	1.842
	02	B	32	112	18	14	252	9535	21	900	7910	900				6.31	15169.00	1.932
	03	B	20	70	18	28	504	4248	22	350	410	2850	800			2.47	5275.96	0.672
	04	B	12	24	18	28	504	1815	21	300	300	210	210	1295		0.89	848.11	0.108
	05	B	12	24	18	28	504	983	21	350	330	350				0.89	440.84	0.056
	06	B	12	24	18	2	36	1920	00	1920						0.89	61.38	0.008
	07a	B	10	20	18	192	3456	705	31	130	80	425	130			0.62	1500.87	0.191
	07b	B	10	20	18	176	3168	715	31	130	80	435	130			0.62	1395.31	0.178
	08a	B	16	32	18	49	882	4530	41	192	340	1845	340	210		1.58	6308.83	0.803
	08b	B	16	32	18	16	288	4580	41	1920	35	1845	365	210		1.58	2082.76	0.265
	08c	B	16	32	18	4	72	4560	41	1920	35	1845	355	210		1.58	518.42	0.066
	100	B	12	24	18	8	144	1015	21	495	72	45				0.89	129.79	0.017
Steel Vol. (m^3) = 0.34		Concrete vol. (m^3) = 12.74			Steel Wgt (T) = 2.68			Concrete Wgt (T) = 31.21				Unit Wgt (T) =			33.89	48192.56	6.139
THIS SCHEDULE COMPLIES WITH THE REQUIREMENTS OF BS 8666:2005																Total kgs	Total m^3	
*SPECIFIED IN MULTIPLES OF 5mm.																Ave. Density	204.69	
**SPECIFIED IN MULTIPLES OF 25mm.																2.59	kgs/m^3	

STRENGTH 28 DAYS	C50/60
GGBS CONTENT	0%
COVER	As Shown
ESTIMATED WEIGHT	33.89T
ESTIMATED VOLUME	13.08m³

General Notes:
[1] CONCRETE:
- Cement type CEM I
- Min. cement content = 440kg/m³
- Max water/cement ratio = 0.40

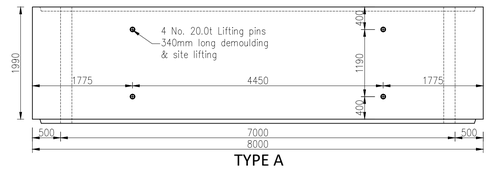
[2] Steel reinforcements to B.S. 4449-05 (Grade B500B)
[4] Max. fill to portal to be 3000mm.
[6] Nominal concrete cover to be as shown.
[9] Surface finishes to be as shown.
[11] Size of the joint between the units will vary depending on the type of sealent product being used.
[12] All precast tolerances to en 14844:- precast concrete products-box culverts.
[13] Estimated steel weight = 2.66T
Estimated concrete weight = 31.21T
Estimated unit weight = 33.89T
Unit Weights will vary. This must be borne in mind when planning lifting on site.
Volume of concrete per unit = 12.74m³

CAST-IN ITEM SCHEDULE

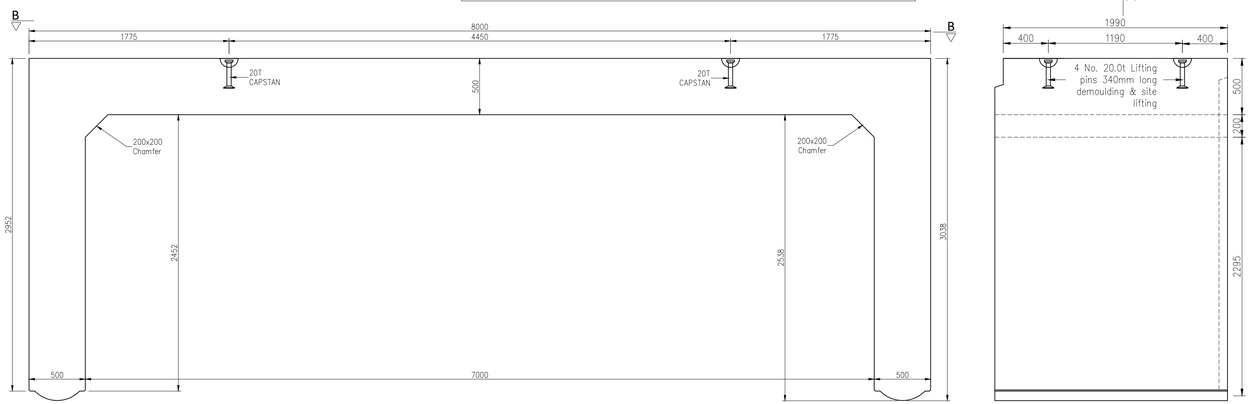
Item	Per unit	Total
20t CAPSTAN 340mm long	4	72

FINISH DETAILS

Formed Finish	
FP	Patterned finish - see drawing
F3	Good mould finish
FEA	Formed exposed aggregate (paint on retarder)
Unformed Finish	
U3	Good steel float finish
U4	Lightly textured timber float finish
UBF	Brush finish
UEA	Exposed aggregate (spray on retarder)
URAC	Rough as cast

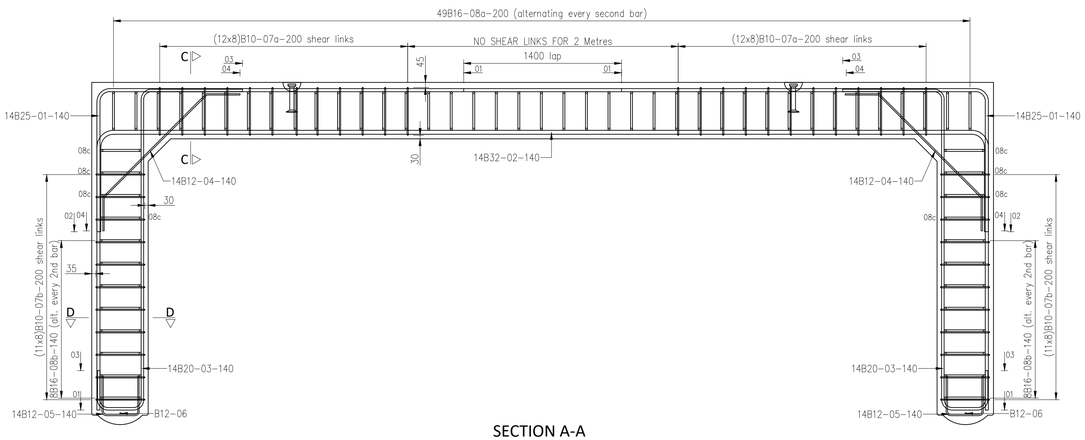


TYPE A
PLAN VIEW B-B (1:50)

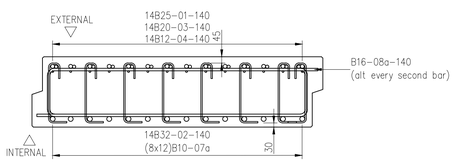


SECTION A-A
SHOWING GEOMETRY (1:25)

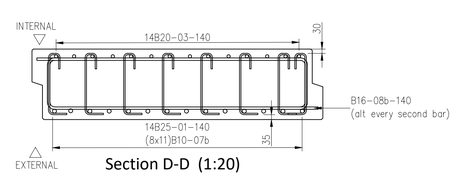
VIEW A (1:25)



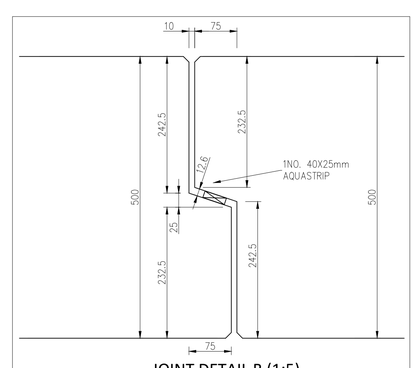
SECTION A-A
SHOWING REINFORCEMENT (1:25)



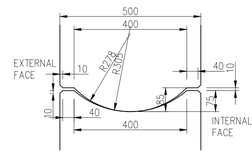
Section C-C (1:20)



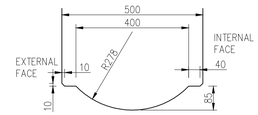
Section D-D (1:20)



JOINT DETAIL B (1:5)



JOINT DETAIL (L)
TOP & BOTTOM UNIT (1:10)



JOINT DETAIL (L) (1:10)
Top Unit

04/12/2019 P01: Issued For Comment

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Project:
R179 Carrickmacross & Kingscourt

Title:
TYPE A's
Strcture L
1 TYPE 1A, 16 TYPE 2A & 1 TYPE 3A

Scales:	Issued by:	Date:
As Shown		04/12/2019

Contractor:	Designer:
Golder	BPC Ltd.
Client:	Project manager:
Golder	Brian Grogan

Drawn by:	Checked by:	Approved by:	Project No.:
A Troy	MM	AP	19.852

Drawing No.:	Rev.:
CMC-BPC-00-XX-DR-X-0002	P01

Designer Approval:	Contractor Appr.:	P.O. No.:

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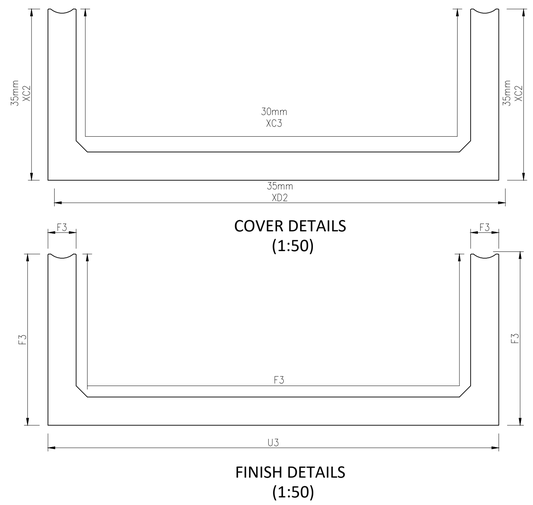
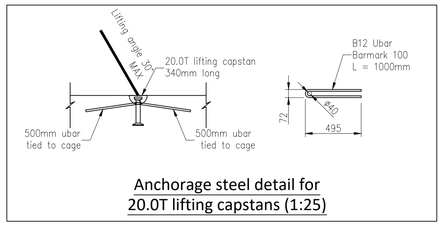
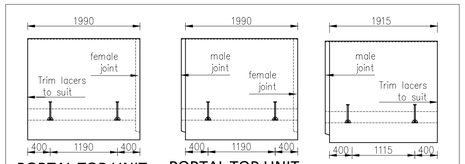


COVER DETAILS
(1:50)

FINISH DETAILS
(1:50)



Anchorage steel detail for
20.0T lifting capstans (1:25)

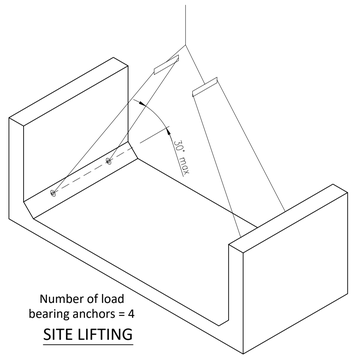


PORTAL TOP UNIT
TYPE 1B (1:50)
1NR. REQUIRED

PORTAL TOP UNIT
TYPE 2B (1:50)
16 NR. REQUIRED

PORTAL TOP UNIT
TYPE 3B (1:50)
1NR. REQUIRED

KEY ELEVATION VIEW



Number of load
bearing anchors = 4

SITE LIFTING

BANAGHER PRECAST CONCRETE LTD

R179 Carrickmackross & Kingscourt TYPE B's Structure L

Bar Schedule ref: CMC-BPC-00-XX-BS-X-0003 | Revision P01
Date Prepared 09/12/2019 | Date Revised
Prepared By: AT | Checked BY: MM

Member	Bar Mark	Type and Size	Radius	No. of Members	No. of bars in each	Total No.	Length of each bar mm	Shape Code	A* mm	B* mm	C* mm	D* mm	E/R* mm	F* mm	Bar Weight Per m	Total Weight (kgs)	Total Volume (m^3)
	01	B 25	87	18	28	504	745	11	4655	2865					3.85	14480.71	1.844
	02	B 32	112	18	14	252	6235	21	900	7910	900				6.31	15169.00	1.932
	03	B 20	70	18	28	504	4255	32	350	410	2860	800			2.47	5288.39	0.674
	04	B 12	24	18	28	504	1905	25	300	300	210	210	1305		0.89	852.59	0.109
	05	B 10	20	18	368	6624	715	31	130	80	435	130			0.62	2917.47	0.372
	06a	B 16	32	18	49	882	4540	41	1920	540	1845	350	210		1.58	6322.76	0.805
	06b	B 16	32	18	16	288	4580	41	1920	375	1845	365	210		1.58	2082.76	0.265
	06c	B 16	32	18	4	72	4560	41	1920	355	1845	355	210		1.58	518.42	0.066
	100	B 12	24	18	8	144	1015	21	495	72	435				0.89	129.79	0.017
Steel Vol. (m^3) = 0.34		Concrete vol. (m^3) = 12.74		Steel Wgt (T) = 2.65			Concrete Wgt (T) = 31.2				Unit Wgt (T) =		33.87	47761.89	6.084
THIS SCHEDULE COMPLIES WITH THE REQUIREMENTS OF BS 8666:2005																Total kgs	Total m^3
*SPECIFIED IN MULTIPLES OF 5mm.																Ave. Density	202.86
**SPECIFIED IN MULTIPLES OF 25mm.																2.59	kgs/m^3

STRENGTH 28 DAYS	C50/60
GGBS CONTENT	0%
COVER	As Shown
ESTIMATED WEIGHT	33.87T
ESTIMATED VOLUME	13.08m³

General Notes:
[1] CONCRETE:
- Cement type CEM I
- Min. cement content = 440kg/m³
- Max water/cement ratio = 0.40

[2] Steel reinforcements to B.S. 4449-05 (Grade B500B)
[4] Max. fill to portal to be 3000mm.
[6] Nominal concrete cover to be as shown.
[9] Surface finishes to be as shown.
[11] Size of the joint between the units will vary depending on the type of sealent product being used.
[12] All precast tolerances to en 14844:- precast concrete products-box culverts.
[13] Estimated steel weight = 2.65T
Estimated concrete weight = 31.22T
Estimated unit weight = 33.87T
Unit Weights will vary. This must be borne in mind when planning lifting on site.
Volume of concrete per unit = 12.74m³

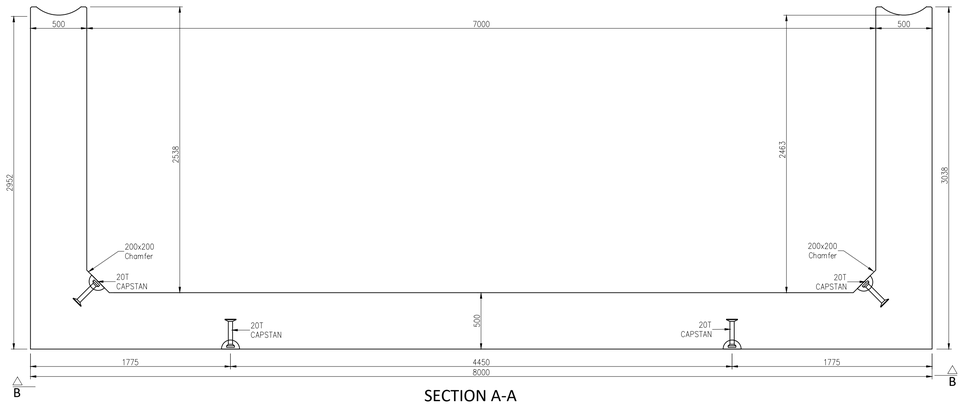
CAST-IN ITEM SCHEDULE

Item	Per unit	Total
20t CAPSTAN 340mm long	8	144

FINISH DETAILS

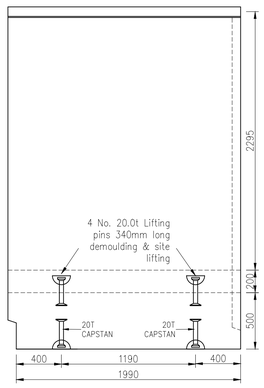
Formed Finish	
FP	Patterned finish - see drawing
F3	Good mould finish
FEA	Formed exposed aggregate (paint on retarder)
Unformed Finish	
U3	Good steel float finish
U4	Lightly textured timber float finish
UBF	Brush finish
UEA	Exposed aggregate (spray on retarder)
URAC	Rough as cast

VIEW A ▷

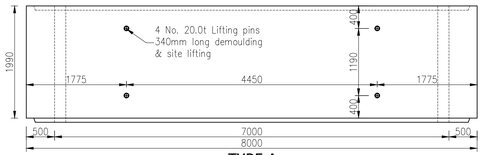


SECTION A-A
SHOWING GEOMETRY (1:25)

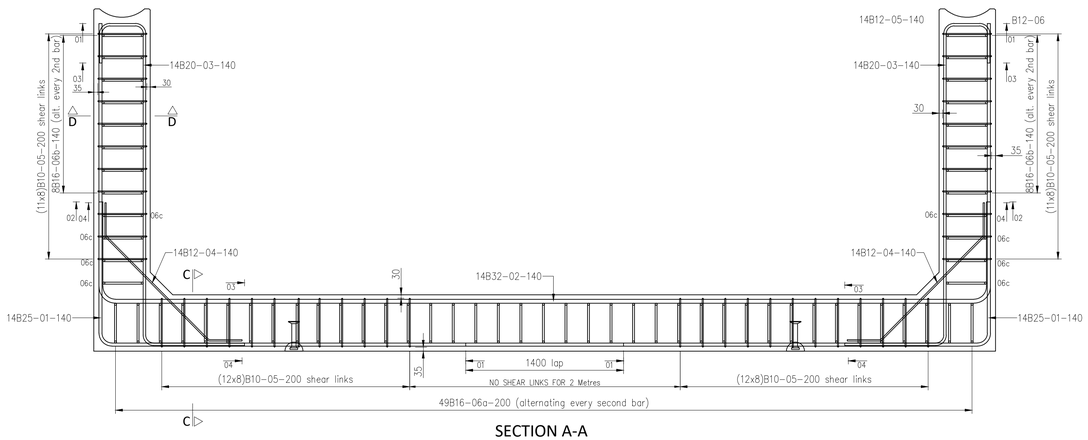
◁A



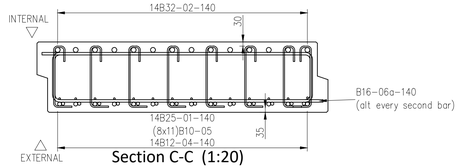
◁A
VIEW A (1:25)



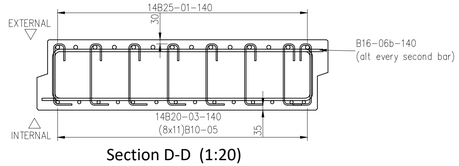
TYPE A
PLAN VIEW B-B (1:50)



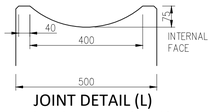
SECTION A-A
SHOWING REINFORCEMENT (1:25)



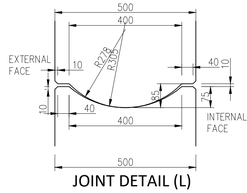
Section C-C (1:20)



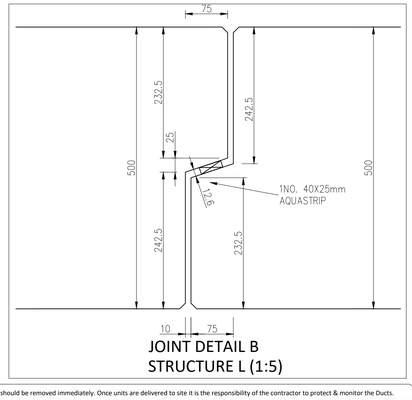
Section D-D (1:20)



JOINT DETAIL (L)
BOTTOM UNIT (1:10)



JOINT DETAIL (L)
TOP & BOTTOM UNIT (1:10)



JOINT DETAIL B
STRUCTURE L (1:5)

05/12/2019 P01: Issued For Comment

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PRECAST CONCRETE

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W: www.bancrete.com

Project:
R179 Carrickmacross & Kingscourt

Title:
TYPE B's
Strcture L
1 TYPE 1B, 16 TYPE 2B & 1 TYPE 3B

Scales:	Issued by:	Date:
As Shown		05/12/2019

Contractor:	Designer:
Golder	BPC Ltd.
Client:	Project manager:
Golder	Brian Grogan

Drawn by:	Checked by:	Approved by:	Project No.:
A Troy	MM	AP	19.852

Drawing No.: CMC-BPC-00-XX-DR-X-0003 | Rev.: P01
Designer Approval: | Contractor Appr.: | P.O. No.:

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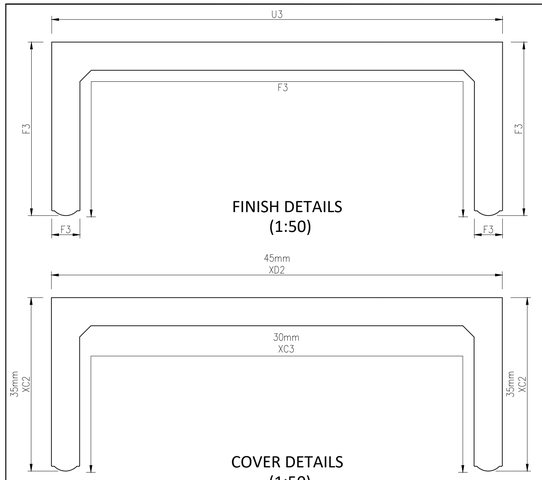
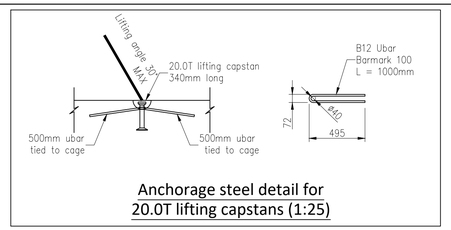
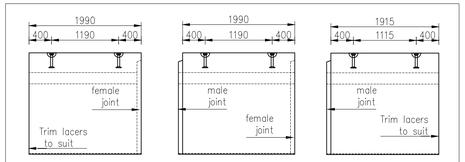




Anchorage steel detail for
20.0T lifting capstans (1:25)

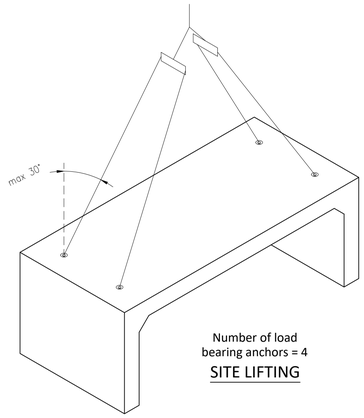


PORTAL TOP UNIT
TYPE 1A (1:50)
1NR. REQUIRED

PORTAL TOP UNIT
TYPE 2A (1:50)
16 NR. REQUIRED

PORTAL TOP UNIT
TYPE 3A (1:50)
1NR. REQUIRED

KEY ELEVATION VIEW



Number of load
bearing anchors = 4

SITE LIFTING

BANAGHER PRECAST CONCRETE LTD																			
R179 Carrickmackross & Kingscourt TYPE A's Structure S							Bar Schedule ref:		CMC-BPC-00-XX-BS-X-0004					Revision	P01			
							Date Prepared		09/12/2019				Date Revised					
							Prepared By:		AT				Checked BY:		AT			
Member	Bar Mark	Type and Size		Radius	No. of Members	No. of bars in each	Total No.	Length of each bar mm	Shape Code	A* mm	B* mm	C* mm	D* mm	E/R* mm	F* mm	Bar Weight Per m	Total Weight (kgs)	Total Volume (m^3)
	01	B	20	70	2	28	504	5130	11	3405	1780					2.47	6375.89	0.812
	02	B	32	112	18	14	252	7335	21	900	5710	900				6.31	11669.08	1.487
	03	B	16	32	18	28	504	3115	32	350	310	1750	800			1.58	2478.97	0.316
	04	B	12	24	18	28	504	2350	25	300	300	210	210	1050		0.89	738.46	0.094
	05	B	12	24	18	28	504	900	21	350	250	350				0.89	405.03	0.052
	06	B	12	24	18	2	36	1920	00	1920						0.89	61.38	0.008
	07a	B	10	20	18	144	2592	595	32	130	80	325	130			0.62	965.99	0.123
	07b	B	10	20	18	112	2016	675	31	130	80	335	130			0.62	763.74	0.097
	08a	B	12	24	18	6	108	4430	41	1920	275	1845	275	210		0.89	424.85	0.054
	08b	B	12	24	18	8	144	4410	41	1920	265	1845	265	210		0.89	563.92	0.072
	09	B	12	24	18	14	252	2280	21	1920	265	160				0.89	510.21	0.065
	10	B	16	32	18	14	252	2320	21	1920	250	210				1.58	923.15	0.118
	100	B	12	24	18	8	144	1015	21	495	49					0.89	129.79	0.017
Steel Vol. (m^3) = 0.18		Concrete vol. (m^3) = 6.88			Steel Wgt (T) = 1.45			Concrete Wgt (T) = 16.85				Unit Wgt (T) =		18.29	26010.45	3.313	
THIS SCHEDULE COMPLIES WITH THE REQUIREMENTS OF BS 8666:2005															Total kgs	Total m^3		
*SPECIFIED IN MULTIPLES OF 5mm.															Ave. Density	204.68		
**SPECIFIED IN MULTIPLES OF 25mm.															2.59	kgs/m^3		

STRENGTH 28 DAYS	**C50/60**
GGBS CONTENT	**0%**
COVER	**As Shown**
ESTIMATED WEIGHT	**18.29T**
ESTIMATED VOLUME	**7.06m³**

General Notes:
[1] CONCRETE:
- Cement type CEM I
- Min. cement content = 440kg/m³
- Max water/cement ratio = 0.40

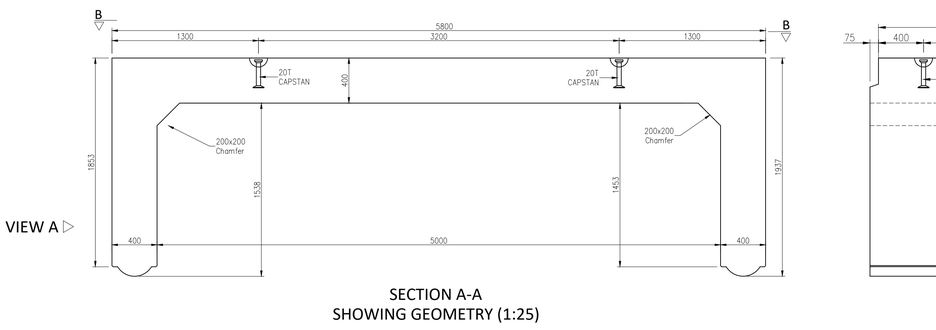
[2] Steel reinforcements to B.S. 4449-05 (Grade B500B)
[4] Max. fill to portal to be 3000mm.
[6] Nominal concrete cover to be as shown.
[9] Surface finishes to be as shown.
[11] Size of the joint between the units will vary depending on the type of sealent product being used.
[12] All precast tolerances to en 14844:-
precast concrete products-box culverts.
[13] Estimated steel weight = 1.45T
Estimated concrete weight = 16.85T
Estimated unit weight = 18.29T
Unit Weights will vary. This must be borne in mind when planning lifting on site.
Volume of concrete per unit = 6.88m³

CAST-IN ITEM SCHEDULE

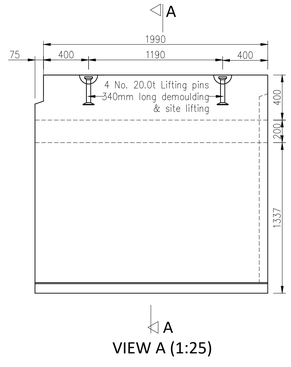
Item	Per unit	Total
20t CAPSTAN 340mm long	4	72

FINISH DETAILS

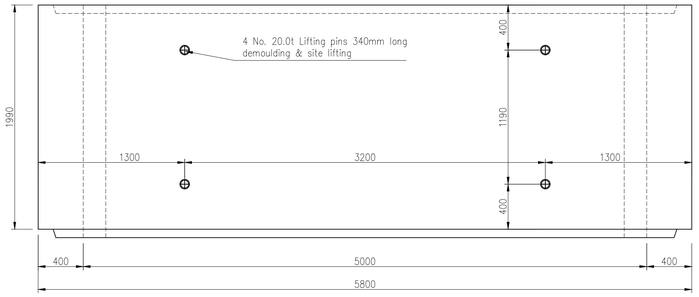
Formed Finish	
FP	Patterned finish - see drawing
F3	Good mould finish
FEA	Formed exposed aggregate (paint on retarder)
Unformed Finish	
U3	Good steel float finish
U4	Lightly textured timber float finish
UBF	Brush finish
UEA	Exposed aggregate (spray on retarder)
URAC	Rough as cast



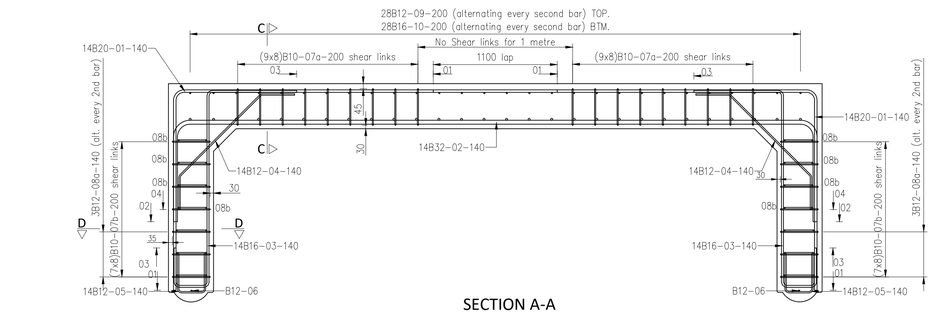
SECTION A-A
SHOWING GEOMETRY (1:25)



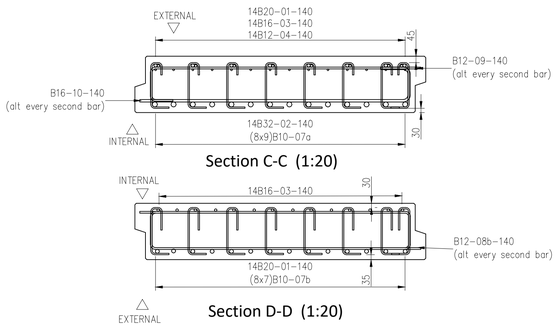
VIEW A (1:25)

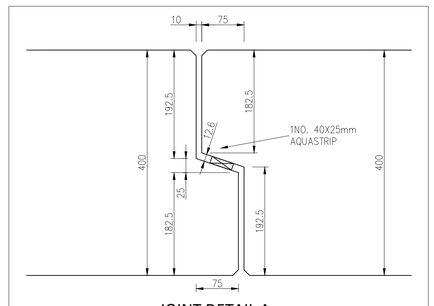


TYPE A
PLAN VIEW B-B (1:25)

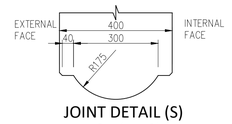


SECTION A-A
SHOWING REINFORCEMENT (1:25)

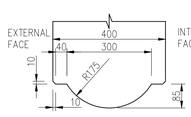




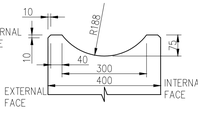
JOINT DETAIL A
STRUCTURE S (1:5)



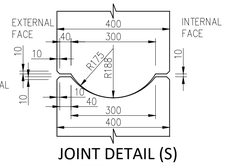
JOINT DETAIL (S)
TOP (1:10)



DETAIL A (S) (1:10)
Top



DETAIL B (S) (1:10)
Bottom



JOINT DETAIL (S)
TOP & BOTTOM UNIT (1:10)

09/12/2019 P01: Issued For Comment

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Ireland
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F: +353 (0)57 9151558
E: info@bancrete.com
W: www.bancrete.com

Project:
R179 Carrickmacross & Kingscourt

Title:
TYPE A's
Structure S
1 TYPE 1A, 16 TYPE 2A & 1 TYPE 3A

Scales:	Issued by:	Date:
As Shown		09/12/2019

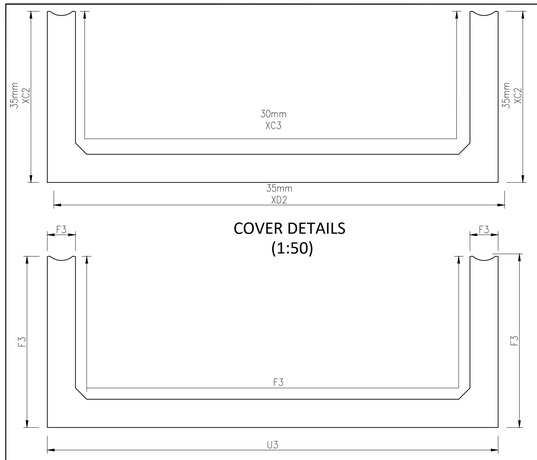
Contractor:	Designer:
Golder	BPC Ltd.
Client:	Project manager:
Golder	Brian Grogan

Drawn by:	Checked by:	Approved by:	Project No.:
A Troy	A Troy	AP	19.852

Drawing No.:	Rev.:
CMC-BPC-00-XX-DR-X-0004	P01

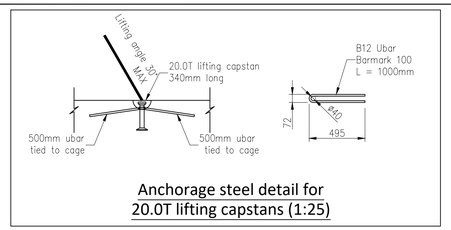
Designer Approval:	Contractor Appr.:	P.O. No.:

Preformed Ducts or Pockets are to be protected from water ingress where there is a risk of frost damage occurring.Susceptible Ducts should be checked regularly for the presence of water & or ice, whether in storage or on site.Water or ice within the Ducts should be removed immediately. Once units are delivered to site it is the responsibility of the contractor to protect & monitor the Ducts.

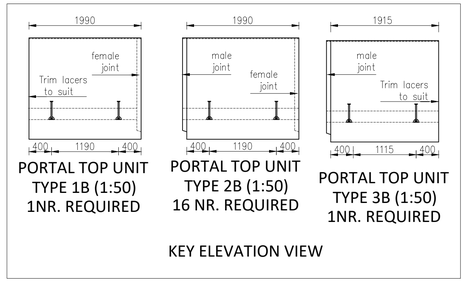


COVER DETAILS
(1:50)

FINISH DETAILS
(1:50)



Anchorage steel detail for
20.0T lifting capstans (1:25)

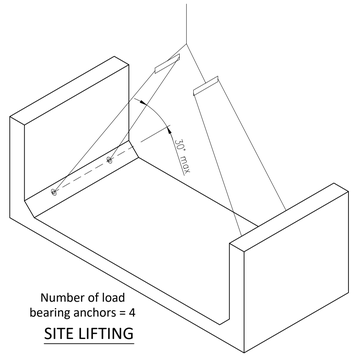


PORTAL TOP UNIT
TYPE 1B (1:50)
1NR. REQUIRED

PORTAL TOP UNIT
TYPE 2B (1:50)
16 NR. REQUIRED

PORTAL TOP UNIT
TYPE 3B (1:50)
1NR. REQUIRED

KEY ELEVATION VIEW



Number of load
bearing anchors = 4

SITE LIFTING

BANAGHER PRECAST CONCRETE LTD																				
R179 Carrickmackross & Kingscourt TYPE B's Structure S								Bar Schedule ref:		CMC-BPC-00-XX-BS-X-0005						Revision		P01	
								Date Prepared		12/12/2019				Date Revised					
								Prepared By:		AT				Checked BY:		AT			
Member	Bar Mark	Type and Size			Radius	No. of Members	No. of bars in each	Total No.	Length of each bar mm	Shape Code	A* mm	B* mm	C* mm	D* mm	E/R* mm	F* mm	Bar Weight Per m	Total Weight (kgs)	Total Volume (m^3)
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	03	B	16		32	18	28	504	3525	32	350	310	1760	1200			1.58	2805.25	0.357
	04	B	12		24	18	28	504	1650	25	350	300	210	210	1050		0.89	738.46	0.094
	05	B	12		24	18	14	252	2290	21	1920	255	160				0.89	512.45	0.065
	06	B	16		32	18	14	252	2330	21	1920	260	210				1.58	927.13	0.118
	07	B	10		20	18	256	4608	615	31	130	85	335	130			0.62	1745.69	0.223
	08a	B	12		24	18	6	108	4430	41	1920	75	1845	275	210		0.89	424.85	0.054
	08b	B	12		24	18	8	144	4410	41	1920	265	845	265	210		0.89	563.92	0.072
	100	B	12		24	18	8	144	1015	21	495	72	495				0.89	129.79	0.017
Steel Vol. (m^3) = 0.18		**Concrete vol. (m^3) = 6.88**				**Steel Wgt (T) = 1.44**			**Concrete Wgt (T) = 16.85**					**Unit Wgt (T) =**		**18.29**	**25904.94**	**3.300**
																		Total kgs	**Total m^3**
THIS SCHEDULE COMPLIES WITH THE REQUIREMENTS OF BS 8666:2005																		**Ave. Density**	**203.85**
*SPECIFIED IN MULTIPLES OF 5mm.																		**2.59**	**kgs/m^3**
**SPECIFIED IN MULTIPLES OF 25mm.																			

STRENGTH 28 DAYS	**C50/60**
GGBS CONTENT	**0%**
COVER	**As Shown**
ESTIMATED WEIGHT	**18.29T**
ESTIMATED VOLUME	**7.06m³**

General Notes:
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- Cement type CEM I
- Min. cement content = 440kg/m³
- Max water/cement ratio = 0.40

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Volume of concrete per unit = 6.88m³

CAST-IN ITEM SCHEDULE

Item	Per unit	Total
20t CAPSTAN 340mm long	4	72

FINISH DETAILS

Formed Finish	
FP	Patterned finish - see drawing
F3	Good mould finish
FEA	Formed exposed aggregate (paint on retarder)
Unformed Finish	
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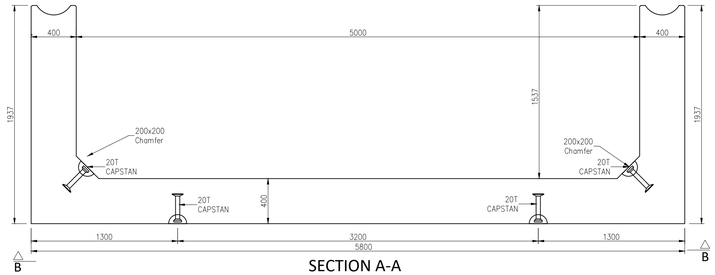
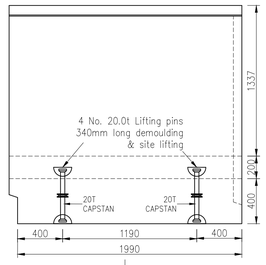
U4	Lightly textured timber float finish
UBF	Brush finish
UEA	Exposed aggregate (spray on retarder)
URAC	Rough as cast

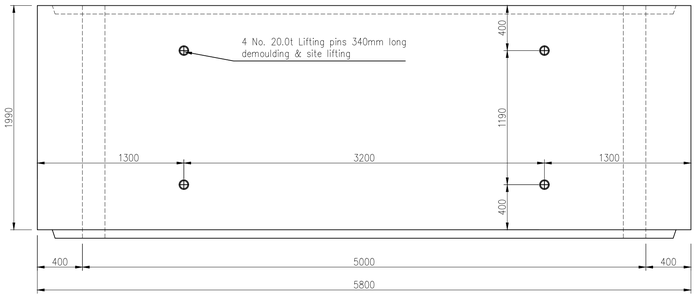
VIEW A ▷



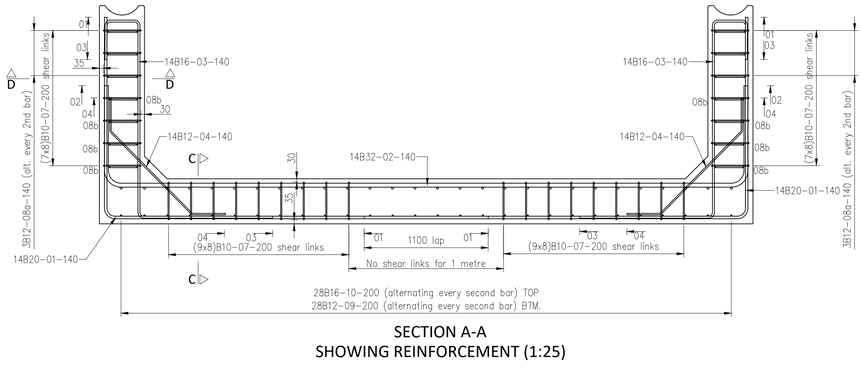
SECTION A-A
SHOWING GEOMETRY (1:25)



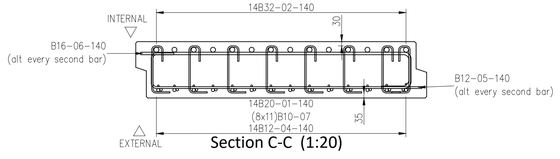
A
VIEW A (1:25)



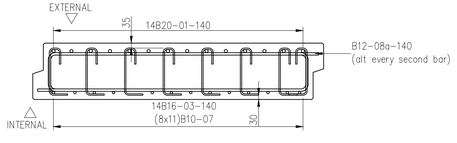
TYPE A
PLAN VIEW B-B (1:25)



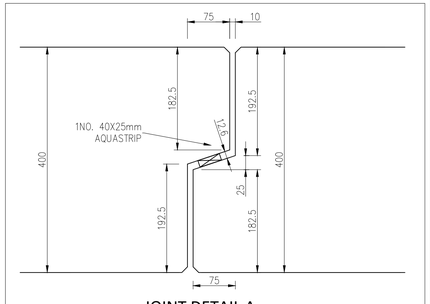
SECTION A-A
SHOWING REINFORCEMENT (1:25)



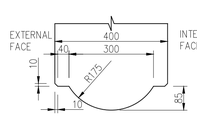
Section C-C (1:20)



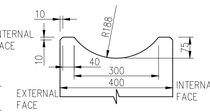
Section D-D (1:20)



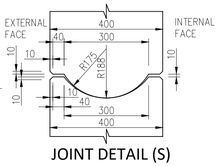
JOINT DETAIL A
STRUCTURE S (1:5)



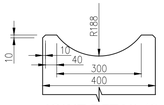
DETAIL A (S) (1:10)
Top



DETAIL B (S) (1:10)
Bottom



JOINT DETAIL (S)
TOP & BOTTOM UNIT (1:10)



JOINT DETAIL (S)
BOTTOM (1:10)

09/12/2019 P01: Issued For Comment

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E: info@bancrete.com
W: www.bancrete.com

Project:
R179 Carrickmacross & Kingscourt

Title:
TYPE B's
Structure S
1 TYPE 1B, 16 TYPE 2B & 1 TYPE 3B

Scales:	Issued by:	Date:
As Shown		09/12/2019

Contractor:	Designer:
Golder	BPC Ltd.
Client:	Project manager:
Golder	Brian Grogan

Drawn by:	Checked by:	Approved by:	Project No.:
A Troy	A Troy	AP	19.852

Drawing No.:	Rev.:
CMC-BPC-00-XX-DR-X-0005	P01

Designer Approval:	Contractor Appr.:	P.O. No.:

Preformed Ducts or Pockets are to be protected from water ingress where there is a risk of frost damage occurring.Susceptible Ducts should be checked regularly for the presence of water & or ice, whether in storage or on site.Water or ice within the Ducts should be removed immediately. Once units are delivered to site it is the responsibility of the contractor to protect & monitor the Ducts.

APPENDIX D

Road Safety Audits

Title: **STAGE 1 ROAD SAFETY AUDIT**

For;

Proposed Knocknacran West Open Cast Mine.

Client: **PMCE**

Date: **October 2022**

Report reference: **1642R01**

VERSION: **FINAL (19-10-2022)**

Prepared By:

Bruton Consulting Engineers Ltd

Glaspistol
Clogherhead
Drogheda
Co. Louth.

Tel: 041 9881456
Mob: 086 8067075
E: admin@brutonceng.ie
W: www.brutonceng.ie

CONTENTS SHEET

Contents

1.0 Introduction

This report was prepared in response to a request from Mr. Peter Monahan, PMCE Ltd, for a Stage 1 Road Safety Audit of a proposed temporary and permanent works associated with the Knocknacran Open Cast Mine.

The Road Safety Audit Team comprised of;

Team Leader: **Norman Bruton**, BE CEng FIEI, Cert Comp RSA.

TII Auditor Approval no. NB 168446

Team Member: **Owen O'Reilly**, B.SC. Eng Dip Struct. Eng NCEA Civil Dip Civil. Eng CEng MIEI

TII Auditor Approval no. OO 1291756

The Road Safety Audit comprised an examination of the drawings and a site visit by the Audit Team, on the 15th of October 2022.

The weather at the time of the daytime site visit was dry and the road surface was also dry.

This Stage 1 Road Safety Audit has been carried out in accordance with the requirements of TII Publication Number GE-STY-01024, dated December 2017.

The scheme has been examined and this report compiled in respect of the consideration of those matters that have an adverse effect on road safety. It has not been examined or verified for compliance with any other standards or criteria.

The problems identified in this report are considered to require action in order to improve the safety of the scheme for road users.

If any of the recommendations within this safety audit report are not accepted, a written response is required, stating reasons for non-acceptance. Comments made within the report under the heading of Observation are intended to be for information only. Written responses to Observations are not required.

A list of the documents provided to the Audit Team is contained in **Appendix A.**

A Problem Location Map is contained in **Appendix B.**

A Feedback Form is contained in **Appendix C.**

There were two Designers involved in the scheme and both have signed the Feedback Form.

2.0 Background

It is proposed to provide a temporary diversion on the R179 to facilitate the construction of a tunnel under the existing R179 for the proposed Knocknacran West Open cast mine.

The scope of this Road Safety Audit included;

1. The proposed temporary diversion of the R179;
2. The permanent reinstatement of the R179;
3. The proposed new mine access on the L4816; and
4. The visibility to the Stop sign for mine traffic on the L4816 approaching the R179/L4816 Junction.

It is proposed to have a 60km/hr speed limit on the temporary diversion. The R179 has a permanent speed limit of 80km/hr.

The site location is shown in the map below.

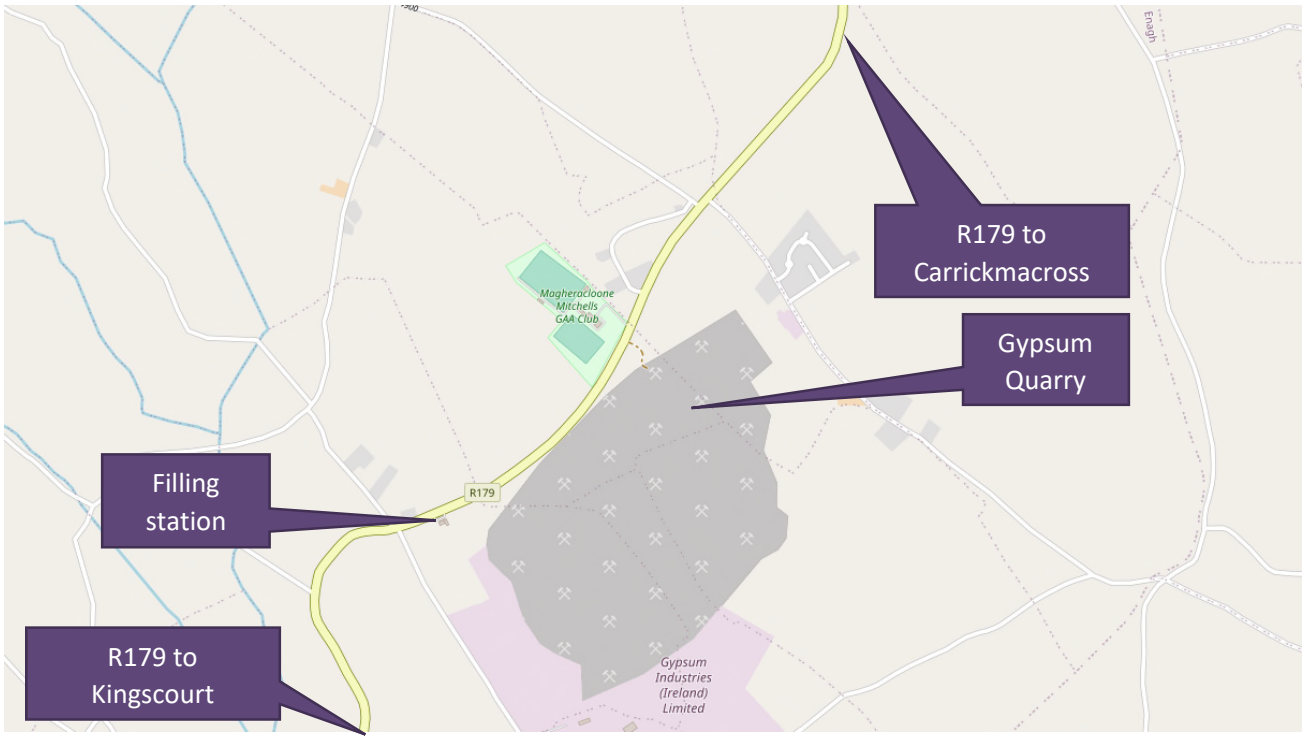
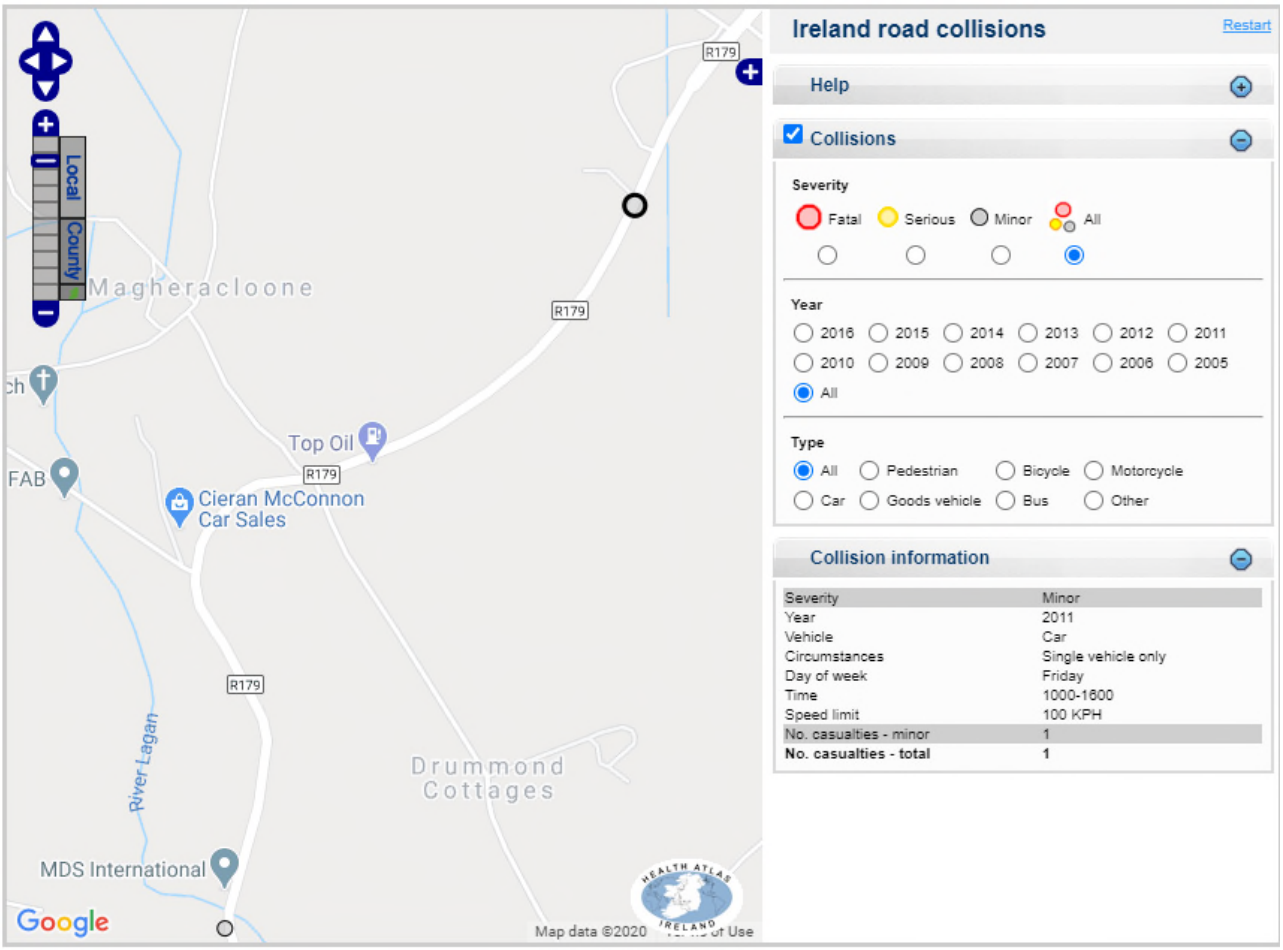


Image courtesy of Openstreetmap.org.

The Road Safety Authority's website shows that there were no recorded injury collisions adjacent to the proposed junction between the years 2005 and 2016. There was one recorded minor injury collision North of the site on the R179 in 2011. That was a single vehicle collision involving a car.



3.0 Issues Identified in This Road Safety Audit.

3.1 Proposed Temporary Diversion of the R179

3.1.1 Problem

LOCATION

Drawing KNCH-WSP-HAW-SW-GN-Z-CH-00001, Temporary diversion alignment.

PROBLEM

The temporary diversion's alignment appears to be broadly based on a design speed of 60km/hr. The construction and finish of the temporary alignment will appear like a permanent realignment and as a result drivers may actually maintain or increase speed. High speeds on this alignment could result in loss of control collisions.

RECOMMENDATION

It is recommended that additional measures be provided to indicate to drivers the temporary nature of the diversion and the need to slow. This may include narrow lane widths.

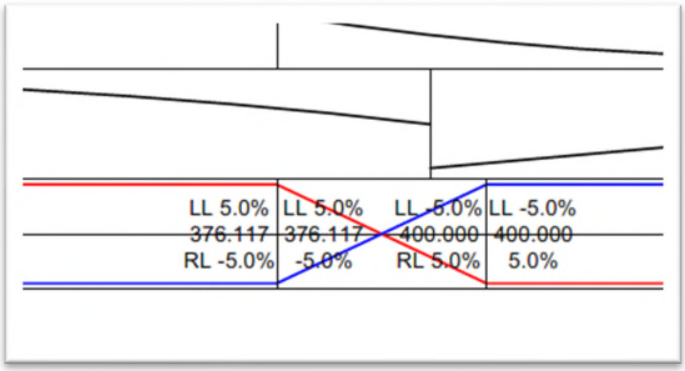
3.1.2 Problem

LOCATION

Drawing KNCH-WSP-HAW-SW-GN-Z-CH-00005, Superelevation

PROBLEM

The change in cross fall at the superelevated sections of the temporary alignment appear to occur over relatively short distances. There is a risk that vehicles will be travelling faster than the posted speed and this may lead to overturning of high sided vehicles.



RECOMMENDATION

It is recommended that rate of change of crossfall be suitable for the anticipated operating speed of the temporary diversion.

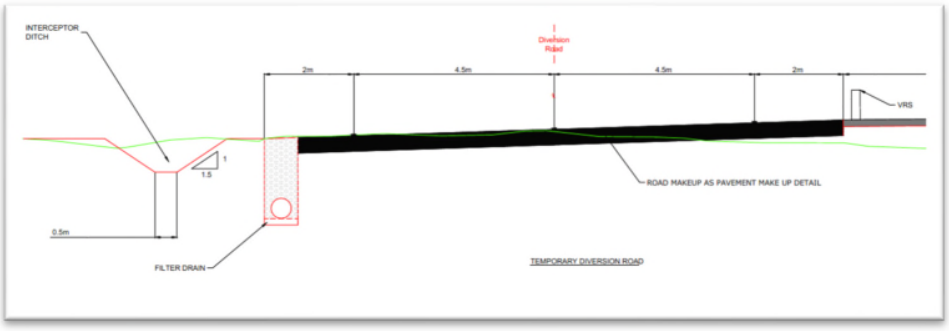
3.1.3 Problem

LOCATION

Drawing KNCH-WSP-HAW-SW-GN-Z-CH-00009, Typical Cross Section – Temporary Diversion.

PROBLEM

The typical cross section shows the VRS on the high side of the carriageway. It is assumed that this is a draughting error. It is unclear how far the VRS will be from the interceptor ditch/cut for the tunnel and if the proposed working width of W4 will be accommodated. A lack of space could lead to errant vehicles not being contained by the VRS resulting in secondary collisions.



RECOMMENDATION

It is recommended that sufficient space be provided to the hazards to allow the proposed VRS to function as intended.

3.2 Proposed Permanent Reinstatement of the R179.

No safety issues Identified.

3.3 Proposed New Mine Access

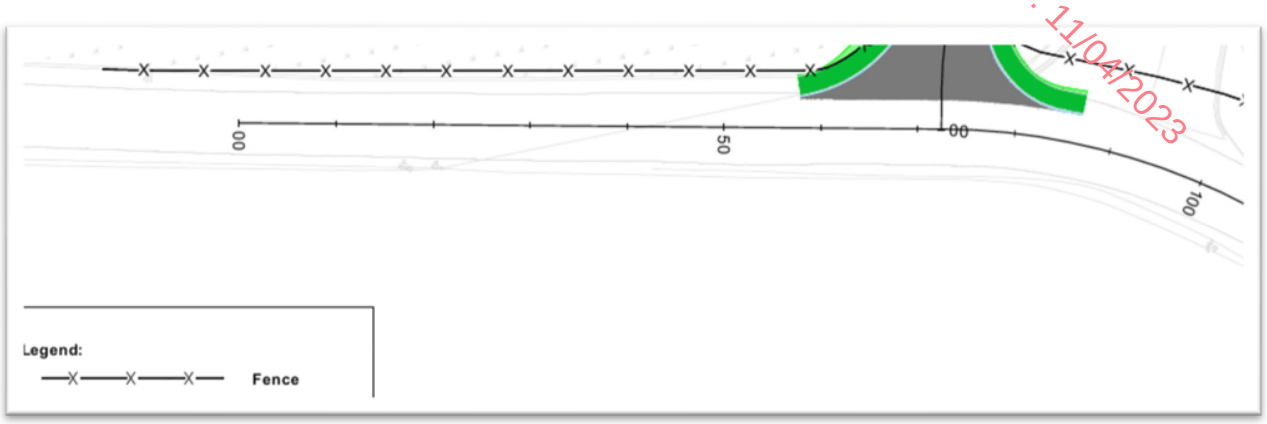
3.3.1 Problem

LOCATION

Drawing P21-110-PSW1-P-DG-FE-001 S0 1.0 Fencing.

PROBLEM

The type of proposed fencing at the realigned access has not been provided. There is a risk that fencing with rails could lead to injuries for vehicle occupants if the rails enters the vehicle.



RECOMMENDATION

It is recommended that rail-less fencing with passively safe posts be provided.

3.4 Existing L4816/R179 Stop Sign

No safety issues Identified.

4.0 Audit Statement

We certify that we have examined the material provided and the site. The examination has been carried out with the sole purpose of identifying any aspects of the design which could be added, removed or modified in order to improve the safety of the scheme.

The problems identified have been noted in this report together with associated safety improvement suggestions which we would recommend should be studied for implementation. The audit has been carried out by the persons named below who have not been involved in any design work on this scheme as a member of the Design Team.

Norman Bruton **Signed:** Norman Bruton

(Audit Team Leader) **Dated: 19-10-2022**

Owen O'Reilly. **Signed:** Owen O'Reilly.

(Audit Team Member) **Dated: 19-10-2022**

Appendix A

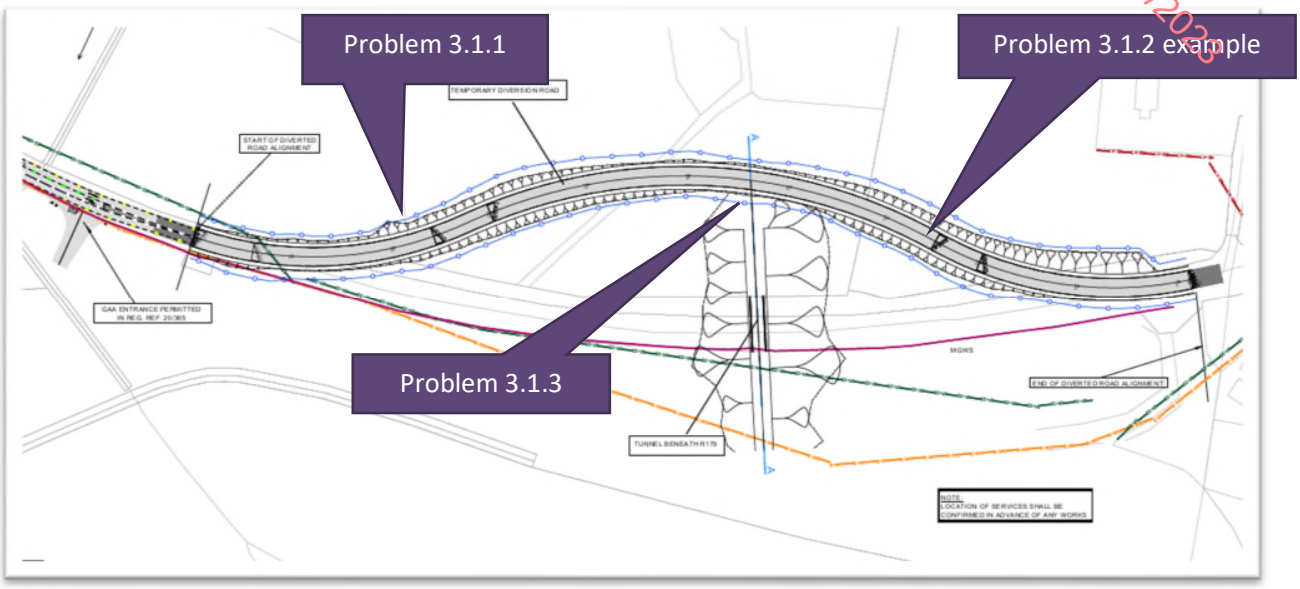
Information Supplied to the Audit Team

- Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00001__General Arrangement
- Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00002__Site Clearance
- Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00003__VRS Drawing
- Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00004__Drainage Plan
- Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00005__Plan & Profile
- Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00006__Cross Sections
- Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00007__Road Markings and Signage
- Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00008__Construction Details - 1 of 2
- Drawing KNCN-WSP-HAW-SW-GN-Z-CH-00009__Construction Details - 2 of 2
- Drawing P21-110-PSW1-P-DG-GE-001
- Drawing P21-110-PSW1-P-DG-SP-001
- Drawing P21-110-PSW1-P-DG-SP-002
- Drawing P21-110-PSW1-P-DG-SP-003
- Drawing P21-110-PSW1-P-DG-VE-001
- Drawing P21-110-PSW1-P-DG-FE-001

Background Information Supplied to the Audit Team

- Draft Traffic &Transport Assessment, PMCE September 2022.
- Audit Brief.

Appendix B - Problem Location Map



Appendix C

Feedback Form

SAFETY AUDIT FORM – FEEDBACK ON AUDIT REPORT

Scheme: Knocknacran Mine
Stage: 1 Road Safety Audit
Date Audit (Site Visit) Completed: 15-10-2022

Paragraph No. in Safety Audit Report	Problem accepted (yes/no)	Recommended measure accepted (yes/no)	Alternative measures (describe)	Alternative measures accepted by Auditors (Yes/No)
3.1.1	Yes	Yes	In addition to the already proposed reduced speed limit of 60pkh, additional signage to be added for example Temporary Diversion Road Ahead.	
3.1.2	Yes	Yes		
3.1.3	Yes	Yes		
3.3.1	Yes	Yes		

Signed.....
Design Team Leader (Mine Access)

Date.....18th October 2022

Signed.....
Design Team Leader (R179 Diversion & Reinstatement)

Date.....18th October 2022

Signed.....
Audit Team Leader

Date.....19-10-2022.....

Signed.....
Employer/Developer

Date.....19-10-2022.....

Title: **STAGE 2 ROAD SAFETY AUDIT**

For;

Proposed Knocknacran West Open Cast Mine.

Client: **PMCE**

Date: **October 2022**

Report reference: **1642R02**

VERSION: **FINAL (19-10-2022)**

Prepared By:

Bruton Consulting Engineers Ltd

Glaspistol
Clogherhead
Drogheda
Co. Louth.

Tel: 041 9881456
Mob: 086 8067075
E: admin@brutonceng.ie
W: www.brutonceng.ie

CONTENTS SHEET

Contents

1.0 Introduction

This report was prepared in response to a request from Mr. Peter Monahan, PMCE Ltd, for a Stage 2 Road Safety Audit of a proposed temporary and permanent works associated with the Knocknacran Open Cast Mine.

The Road Safety Audit Team comprised of;

Team Leader: **Norman Bruton**, BE CEng FIEI, Cert Comp RSA.

TII Auditor Approval no. NB 168446

Team Member: **Owen O'Reilly**, B.SC. Eng Dip Struct. Eng NCEA Civil Dip Civil. Eng CEng MIEI

TII Auditor Approval no. OO 1291756

The Road Safety Audit comprised an examination of the drawings and a site visit by the Audit Team, on the 15th of October 2022.

The weather at the time of the daytime site visit was dry and the road surface was also dry.

This Stage 2 Road Safety Audit has been carried out in accordance with the requirements of TII Publication Number GE-STY-01024, dated December 2017.

The scheme has been examined and this report compiled in respect of the consideration of those matters that have an adverse effect on road safety. It has not been examined or verified for compliance with any other standards or criteria.

The problems identified in this report are considered to require action in order to improve the safety of the scheme for road users.

If any of the recommendations within this safety audit report are not accepted, a written response is required, stating reasons for non-acceptance. Comments made within the report under the heading of Observation are intended to be for information only. Written responses to Observations are not required.

A list of the documents provided to the Audit Team is contained in **Appendix A.**

A Problem Location Map is contained in **Appendix B.**

A feedback Form is contained in **Appendix C.**

There were two Designers on the scheme and both have signed the Feedback Form.

2.0 Background

It is proposed to provide a temporary diversion on the R179 to facilitate the construction of a tunnel under the existing R179 for the proposed Knocknacran West Open cast mine.

The scope of this Road Safety Audit included;

1. The proposed temporary diversion of the R179;
2. The permanent reinstatement of the R179;
3. The proposed new mine access on the L4816; and
4. The visibility to the Stop sign for mine traffic on the L4816 approaching the R179/L4816 Junction.

It is proposed to have a 60km/hr speed limit on the temporary diversion. The R179 has a permanent speed limit of 80km/hr.

The site location is shown in the map below.

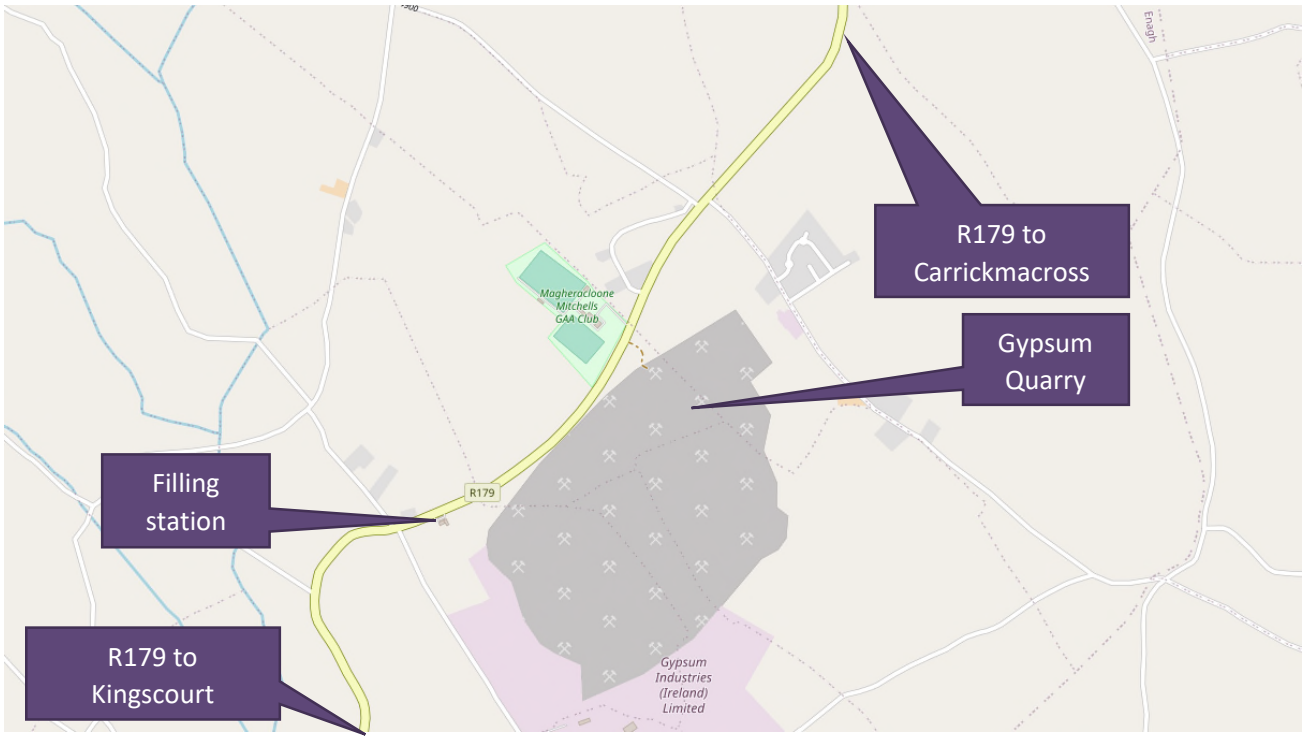
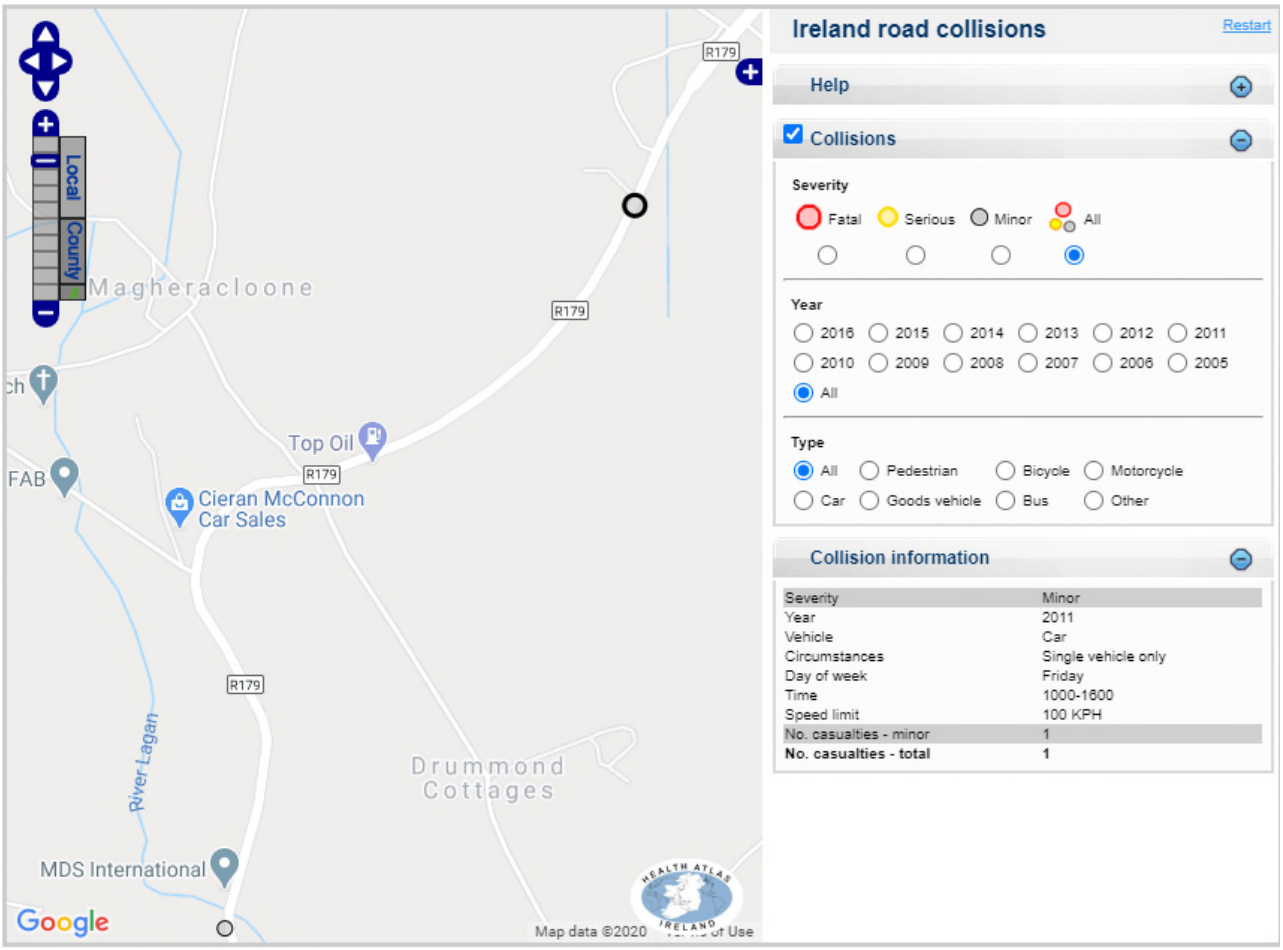


Image courtesy of Openstreetmap.org.

The Road Safety Authority's website shows that there were no recorded injury collisions adjacent to the proposed junction between the years 2005 and 2016. There was one recorded minor injury collision North of the site on the R179 in 2011. That was a single vehicle collision involving a car.



3.0 Issues Identified in This Road Safety Audit.

3.1 Proposed Temporary Diversion of the R179

3.1.1 Problem

LOCATION

Drawing KNCH-WSP-HAW-SW-GN-Z-CH-00007, Temporary diversion alignment

PROBLEM

The horizontal curves on the temporary alignment are relatively tight. Drivers, particularly during the hours of darkness may not be fully aware of the geometry ahead and may slow sufficiently and lose control.

RECOMMENDATION

It is recommended that sharp bend and chevron signs be provided.

3.2 Proposed Permanent Reinstatement of the R179.

No safety issues Identified.

3.3 Proposed New Mine Access

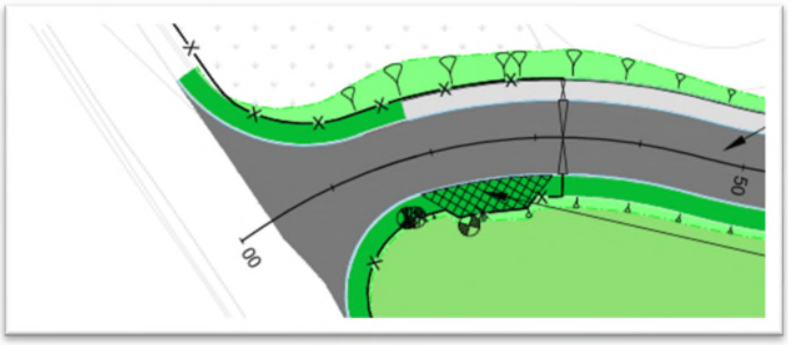
3.3.1 Problem

LOCATION

Drawing P21-110-PSW1-P-DG-GE-001 S4 2.0

PROBLEM

There are no road markings or signage shown on the drawings for the relocated mine access. This may lead to overshoot of the stopping area and side-impact collisions.



RECOMMENDATION

It is recommended that stop road markings and signage be provided at the new access.

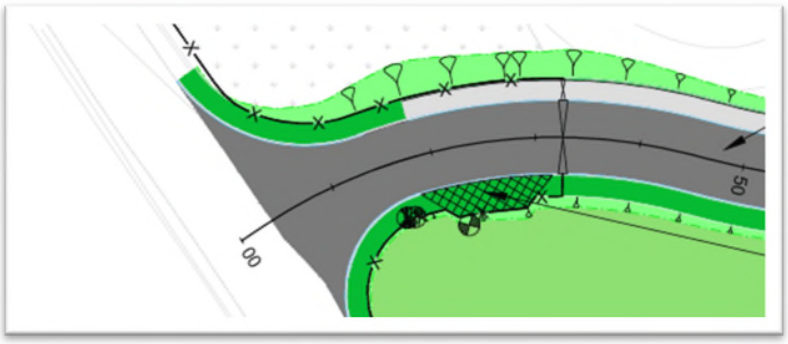
3.3.2 Problem

LOCATION

Drawing P21-110-PSW1-P-DG-GE-001 S4 2.0

PROBLEM

There is no access point provide to the footpath along the access road. This could lead to inaccessibility for the mobility impaired or trips and falls.



RECOMMENDATION

It is recommended that a section of dropped kerb be provided.

3.4 Existing L4816/R179 Stop Sign

No safety issues Identified.

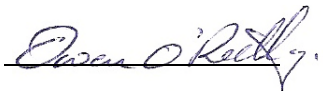
4.0 Audit Statement

We certify that we have examined the material provided and the site. The examination has been carried out with the sole purpose of identifying any aspects of the design which could be added, removed or modified in order to improve the safety of the scheme.

The problems identified have been noted in this report together with associated safety improvement suggestions which we would recommend should be studied for implementation. The audit has been carried out by the persons named below who have not been involved in any design work on this scheme as a member of the Design Team.

Norman Bruton **Signed:** 

(Audit Team Leader) **Dated: 19-10-2022**

Owen O'Reilly. **Signed:** 

(Audit Team Member) **Dated: 19-10-2022**

Appendix A

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- Drawing P21-110-PSW1-P-DG-SP-002
- Drawing P21-110-PSW1-P-DG-SP-003
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- Drawing P21-110-PSW1-P-DG-FE-001

Background Information Supplied to the Audit Team

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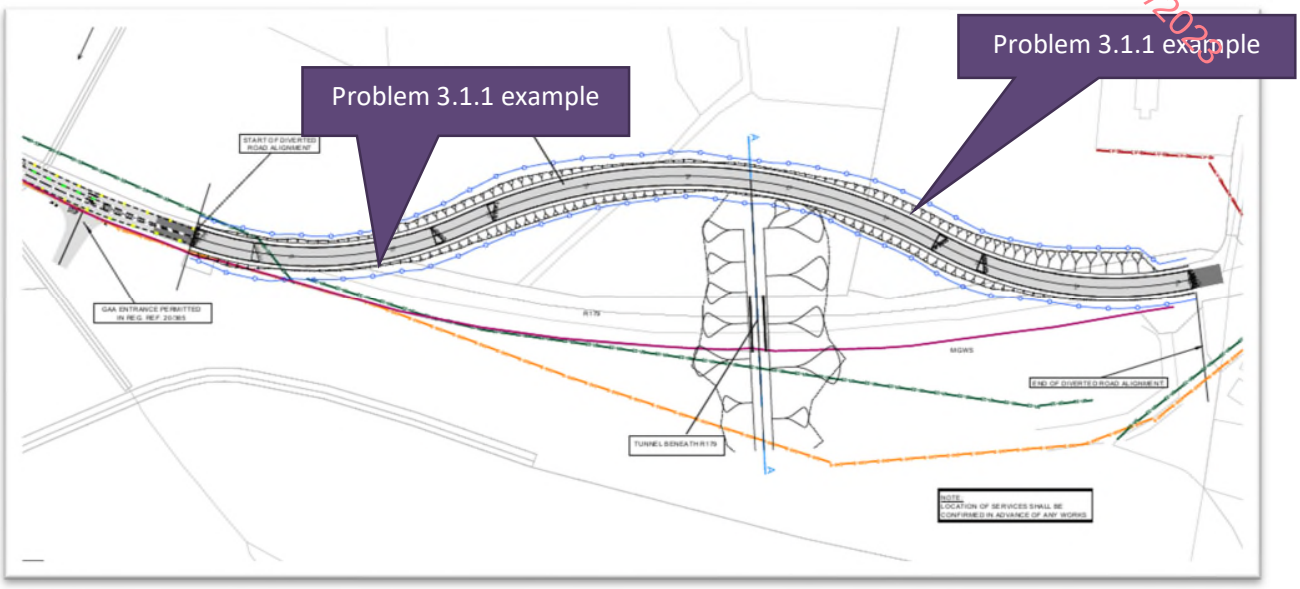
- Audit Brief.

Appendix B - Problem Location Map



Appendix C

Feedback Form

SAFETY AUDIT FORM – FEEDBACK ON AUDIT REPORT

Scheme: Knocknacran Mine
Stage: 2 Road Safety Audit
Date Audit (Site Visit) Completed: 15-10-2022

Paragraph No. in Safety Audit Report	Problem accepted (yes/no)	Recommended measure accepted (yes/no)	Alternative measures (describe)	Alternative measures accepted by Auditors (Yes/No)
3.1.1	Yes	Yes		
3.3.1	Yes	Yes		
3.3.2	Yes	Yes		

Signed.....Peter J. Monaghan..... **Date**.....18th October 2022
Design Team Leader (Mine Access)

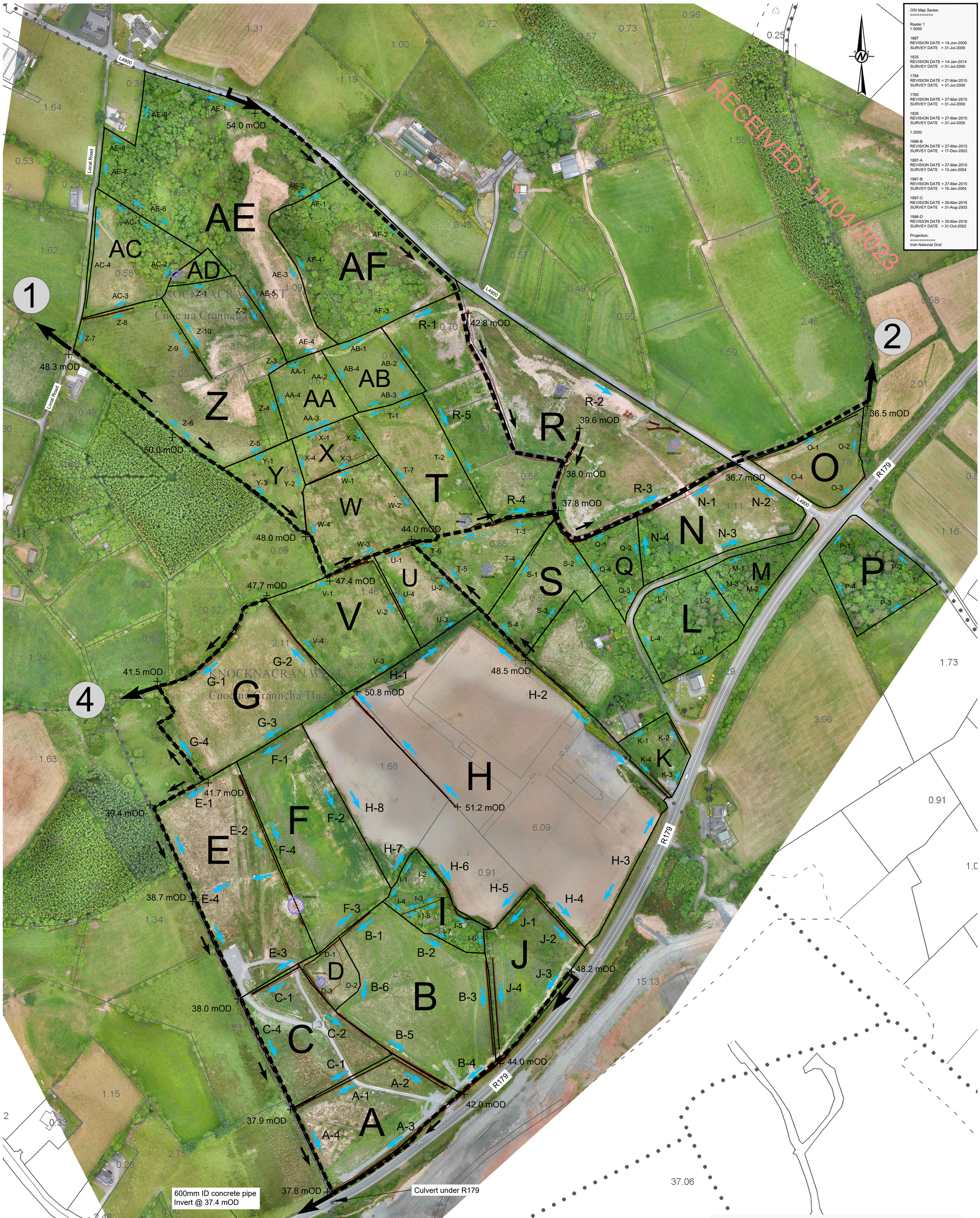
Signed.....Seamus Lynch..... **Date**.....18th October 2022
Design Team Leader (R179 Diversion & Reinstatement)

Signed.....Norman Bruton..... **Date**...19-10-2022.....
Audit Team Leader

Signed.....P.J. Lowe..... **Date**...19-10-2022...
Employer/Developer

APPENDIX E

Drainage Design



OSI Map Series:
==========

Raster 1
1:5000

1887
REVISION DATE = 14-Jun-2009
SURVEY DATE = 31-Jul-2000

1825
REVISION DATE = 14-Jan-2014
SURVEY DATE = 31-Jul-2000

1764
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1765
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1826
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1:2500

1886-B
REVISION DATE = 27-Mar-2015
SURVEY DATE = 17-Dec-2003

1887-A
REVISION DATE = 27-Mar-2015
SURVEY DATE = 13-Jan-2004

1887-B
REVISION DATE = 27-Mar-2015
SURVEY DATE = 15-Jan-2004

1887-C
REVISION DATE = 30-Mar-2016
SURVEY DATE = 31-Aug-2003

1886-D
REVISION DATE = 30-Mar-2016
SURVEY DATE = 31-Oct-2002

Projection:
==========
Irish National Grid

LEGEND:

- FIELD BOUNDARY
- A — FIELD ID
- A-2 — FIELD BOUNDARY ID
- DRAINAGE ARROWS
- OUTFALL POINTS (1 to 4)
- MAIN DRAINAGE ROUTES

NOTES:

GRID REFERENCES ARE IN METRES & TO IRISH NATIONAL GRID

DIMENSIONS ARE IN METRES.

DRONE BACKGROUND IMAGE AS SUPPLIED BY ASM (June 2020)

DRAWING 02 TO BE READ IN CONJUNCTION WITH THE ASSESSMENT SUMMARY SHEETS IN APPENDIX B OF THE REPORT

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS IRELAND LTD.

CONSULTANT

WSP GOLDER

YYYY-MM-DD	2022-Oct-20
DESIGNED	POB
PREPARED	BK/POB
REVIEWED	DH
APPROVED	BK

PROJECT

KNOCKNACRAN WEST

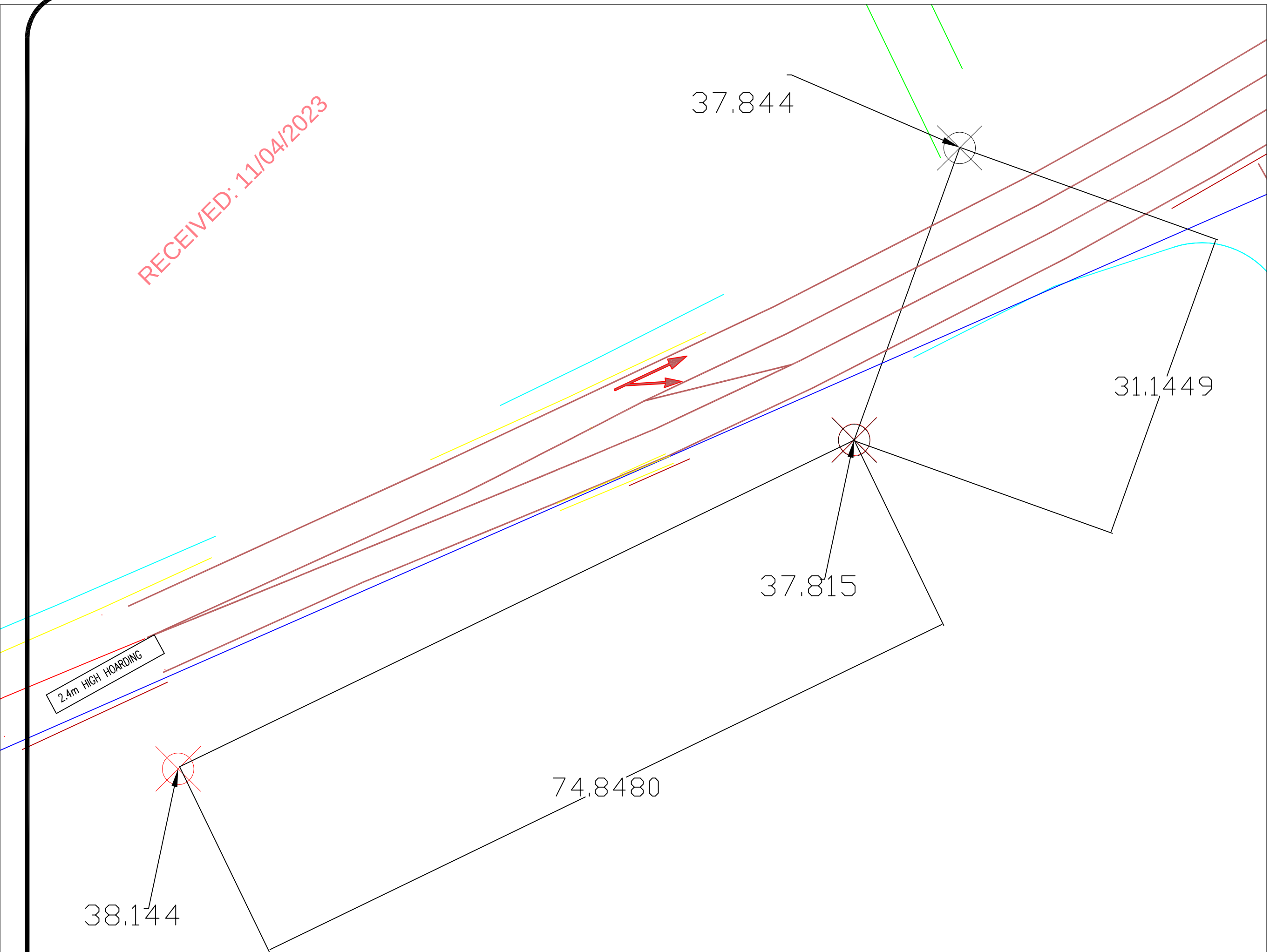
TITLE

DIVERSION ROAD AND TUNNEL
EXISTING DRAINAGE ROUTES FOR KNOCKNACRAN WEST
RFI. 20

PROJECT NO.	DRAWING NO.	REV.	SCALE
19120130	-00011	A	1:2,000 A1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A1

0 25 mm



General Notes

No.	Revision/Issue	Date

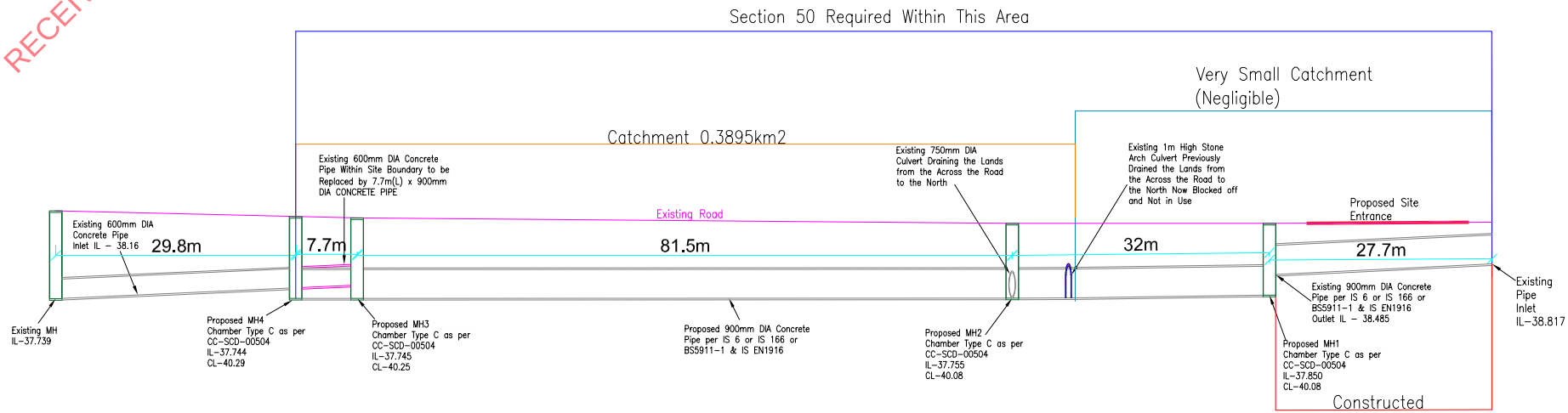
SEM CONSTRUCTION
Build · Civil · Plant

Project Name and Address

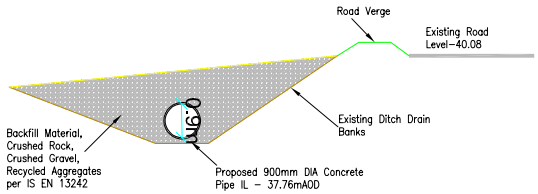
Maghernacloonse
GAA PITCH.
EXISTING 900MM
STORM LINE

Project	GAA	Sheet
Date:	18.01.22	
Scale:		

CULVERT LONG SECTION



CULVERT CROSS SECTION



HYDROCARE ENVIRONMENTAL LTD
Tel: 0419842378 / 0877905155
E-mail: info@hydrocareenvironmental.ie

PROPOSED CULVERT SECTIONS
REVISION C

Saint-Gobain Mining Ireland Ltd.
Drummond TD, Derrynaglah and Knocknacran West, Magheracloone Co. Monaghan

SCALE: 1:200 A4 DATE: 19 Jan 2022

OPW Oifig na nOibreacha Poiblí Office of Public Works

Mr. Daniel Nolan
Hydrocare Environmental Ltd
Rahardrum
Virginia
Co Cavan

daniel@hydrocare.ie

Our Ref: 457 - 2021

Re: Section 50 Application – New culvert on channel C43(3A), Magheraclune, Co. Monaghan.

Dear Mr Nolan,

I refer to the above Section 50 application received by this office.

The documentation submitted has been examined and I recommend that the consent of the Commissioners of Public Works under Section 50 of The Arterial Drainage Act, 1945 be given for the proposed culvert as follows:

A new 900mm diameter culvert 141.2m in length with five manhole access points, as per that detailed in the following drawings submitted;
Proposed culvert section Rev B and Proposed Pipe layout subject to section 50 Rev B.

It should be noted that consent is given only for the purpose of Section 50 and does not absolve the recipient of responsibility for any adverse effects caused by this installation to any third party.

The Commissioners of Public Works are not responsible and accept no liability for any loss or damage whatsoever caused because of this development.

Yours sincerely,

Karen Donovan
Engineering Services Administration Unit
22nd February 2022

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	17.300
Region	Scotland and Ireland	Ratio R	0.300
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	600.0	DVD Status	ON
Analysis Timestep	2.5 Second Increment (Extended)	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 5, 30, 100, 101
Climate Change (%)	20, 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
N1/1.000	N1/001	15 Winter	1	+20%	100/15 Winter				51.321	-0.129	0.000	0.35		11.0
N1/1.001	N1/002	15 Winter	1	+20%	101/15 Summer				50.928	-0.182	0.000	0.31		19.9
N1/1.002	N1/003	15 Winter	1	+20%					50.578	-0.222	0.000	0.15		21.4
N1/1.003	N1/004	15 Winter	1	+20%					48.785	-0.235	0.000	0.10		22.2
N1/1.004	N1/005	15 Winter	1	+20%					45.098	-0.232	0.000	0.11		23.6
N1/1.005	N1/006	15 Winter	1	+20%	101/15 Winter				41.401	-0.219	0.000	0.16		24.7
N1/2.000	N1/007	15 Winter	1	+20%					51.441	-0.119	0.000	0.09		1.5
N1/2.001	N1/008	15 Winter	1	+20%	101/15 Summer				50.543	-0.097	0.000	0.27		6.6
N1/3.000	N1/009	15 Winter	1	+20%					49.649	-0.151	0.000	0.22		6.5
N1/2.002	N1/010	15 Winter	1	+20%					49.439	-0.151	0.000	0.24		17.2
N1/2.003	N1/011	15 Winter	1	+20%	101/15 Summer				48.422	-0.148	0.000	0.25		25.4
N1/2.004	N1/012	15 Winter	1	+20%	100/15 Summer	101/15 Summer			44.741	-0.129	0.000	0.37		34.8
N1/2.005	N1/013	15 Winter	1	+20%	30/15 Winter	101/30 Winter			41.370	-0.170	0.000	0.39		42.2
N1/4.000	N1/014	30 Winter	1	+20%					42.584	-0.116	0.000	0.11		9.0
N1/2.006	N1/015	15 Winter	1	+20%	30/15 Summer	101/30 Winter			40.969	-0.161	0.000	0.44		48.9
N1/2.007	N1/016	15 Winter	1	+20%	30/15 Summer				40.502	-0.188	0.000	0.30		48.8
N1/1.006	N1/017	15 Winter	1	+20%	30/15 Summer				40.080	-0.170	0.000	0.56		79.7
N1/1.007	N1/018	15 Winter	1	+20%	5/15 Summer				39.612	-0.088	0.000	0.94		79.0

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

PN	US/MH Name	Status	Level Exceeded
N1/1.000	N1/001	OK	
N1/1.001	N1/002	OK	
N1/1.002	N1/003	OK	
N1/1.003	N1/004	OK	
N1/1.004	N1/005	OK	
N1/1.005	N1/006	OK	
N1/2.000	N1/007	OK	
N1/2.001	N1/008	OK	
N1/3.000	N1/009	OK	
N1/2.002	N1/010	OK	
N1/2.003	N1/011	OK	
N1/2.004	N1/012	OK	4
N1/2.005	N1/013	OK	1
N1/4.000	N1/014	OK*	
N1/2.006	N1/015	OK	1
N1/2.007	N1/016	OK	
N1/1.006	N1/017	OK	
N1/1.007	N1/018	OK	

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

Simulation Criteria

Areal Reduction Factor 1.000 | Manhole Headloss Coeff (Global) 0.500 | MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 | Foul Sewage per hectare (l/s) 0.000 | Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 | Additional Flow - % of Total Flow 0.000 | Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 | Number of Offline Controls 0 | Number of Time/Area Diagrams 0
Number of Online Controls 0 | Number of Storage Structures 0 | Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR | M5-60 (mm) 17.300 | Cv (Summer) 0.750
Region Scotland and Ireland | Ratio R 0.300 | Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 600.0 | DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) | Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 5, 30, 100, 101
Climate Change (%) 20, 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
N1/1.000	N1/001	15 Winter	5	+20%	100/15 Winter				51.347	-0.103	0.000	0.52		16.3
N1/1.001	N1/002	15 Winter	5	+20%	101/15 Summer				50.959	-0.151	0.000	0.47		29.8
N1/1.002	N1/003	15 Winter	5	+20%					50.597	-0.203	0.000	0.23		31.9
N1/1.003	N1/004	15 Winter	5	+20%					48.799	-0.221	0.000	0.16		33.3
N1/1.004	N1/005	15 Winter	5	+20%					45.114	-0.216	0.000	0.17		35.3
N1/1.005	N1/006	15 Winter	5	+20%	101/15 Winter				41.421	-0.199	0.000	0.25		36.9
N1/2.000	N1/007	15 Winter	5	+20%					51.448	-0.112	0.000	0.13		2.3
N1/2.001	N1/008	15 Winter	5	+20%	101/15 Summer				50.556	-0.084	0.000	0.40		9.9
N1/3.000	N1/009	15 Winter	5	+20%					49.668	-0.132	0.000	0.34		9.8
N1/2.002	N1/010	15 Winter	5	+20%					49.458	-0.132	0.000	0.36		25.9
N1/2.003	N1/011	15 Winter	5	+20%	101/15 Summer				48.441	-0.129	0.000	0.38		38.4
N1/2.004	N1/012	15 Winter	5	+20%	100/15 Summer	101/15 Summer			44.768	-0.102	0.000	0.56		52.5
N1/2.005	N1/013	15 Winter	5	+20%	30/15 Winter	101/30 Winter			41.406	-0.134	0.000	0.58		63.6
N1/4.000	N1/014	30 Winter	5	+20%					42.591	-0.109	0.000	0.17		13.4
N1/2.006	N1/015	15 Winter	5	+20%	30/15 Summer	101/30 Winter			41.008	-0.122	0.000	0.66		73.9
N1/2.007	N1/016	15 Winter	5	+20%	30/15 Summer				40.532	-0.158	0.000	0.45		73.5
N1/1.006	N1/017	15 Winter	5	+20%	30/15 Summer				40.152	-0.098	0.000	0.85		119.9
N1/1.007	N1/018	15 Winter	5	+20%	5/15 Summer				39.750	0.050	0.000	1.41		118.9

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

PN	US/MH Name	Status	Level Exceeded
N1/1.000	N1/001	OK	
N1/1.001	N1/002	OK	
N1/1.002	N1/003	OK	
N1/1.003	N1/004	OK	
N1/1.004	N1/005	OK	
N1/1.005	N1/006	OK	
N1/2.000	N1/007	OK	
N1/2.001	N1/008	OK	
N1/3.000	N1/009	OK	
N1/2.002	N1/010	OK	
N1/2.003	N1/011	OK	
N1/2.004	N1/012	OK	4
N1/2.005	N1/013	OK	1
N1/4.000	N1/014	OK*	
N1/2.006	N1/015	OK	1
N1/2.007	N1/016	OK	
N1/1.006	N1/017	OK	
N1/1.007	N1/018	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.300 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 600.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 5, 30, 100, 101
Climate Change (%) 20, 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
N1/1.000	N1/001	15 Winter	30	+20%	100/15 Winter				51.383	-0.067	0.000	0.76		24.0
N1/1.001	N1/002	15 Winter	30	+20%	101/15 Summer				51.015	-0.095	0.000	0.73		46.6
N1/1.002	N1/003	15 Winter	30	+20%					50.625	-0.175	0.000	0.36		50.4
N1/1.003	N1/004	15 Winter	30	+20%					48.821	-0.199	0.000	0.24		52.0
N1/1.004	N1/005	15 Winter	30	+20%					45.136	-0.194	0.000	0.27		54.8
N1/1.005	N1/006	15 Winter	30	+20%	101/15 Winter				41.449	-0.171	0.000	0.38		57.0
N1/2.000	N1/007	15 Winter	30	+20%					51.456	-0.104	0.000	0.20		3.4
N1/2.001	N1/008	15 Winter	30	+20%	101/15 Summer				50.584	-0.056	0.000	0.69		17.1
N1/3.000	N1/009	15 Winter	30	+20%					49.692	-0.108	0.000	0.50		14.4
N1/2.002	N1/010	15 Winter	30	+20%					49.491	-0.099	0.000	0.59		42.5
N1/2.003	N1/011	15 Winter	30	+20%	101/15 Summer				48.479	-0.091	0.000	0.64		64.9
N1/2.004	N1/012	15 Winter	30	+20%	100/15 Summer	101/15 Summer			44.827	-0.043	0.000	0.97		90.1
N1/2.005	N1/013	15 Winter	30	+20%	30/15 Winter	101/30 Winter			41.595	0.055	0.000	0.97		106.2
N1/4.000	N1/014	30 Winter	30	+20%					42.601	-0.099	0.000	0.25		19.9
N1/2.006	N1/015	15 Winter	30	+20%	30/15 Summer	101/30 Winter			41.295	0.165	0.000	1.01		112.5
N1/2.007	N1/016	15 Winter	30	+20%	30/15 Summer				40.903	0.213	0.000	0.65		105.8
N1/1.006	N1/017	15 Winter	30	+20%	30/15 Summer				40.685	0.435	0.000	1.22		172.4
N1/1.007	N1/018	15 Winter	30	+20%	5/15 Summer				39.850	0.150	0.000	2.03		171.5

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

PN	US/MH Name	Status	Level Exceeded
N1/1.000	N1/001	OK	
N1/1.001	N1/002	OK	
N1/1.002	N1/003	OK	
N1/1.003	N1/004	OK	
N1/1.004	N1/005	OK	
N1/1.005	N1/006	OK	
N1/2.000	N1/007	OK	
N1/2.001	N1/008	OK	
N1/3.000	N1/009	OK	
N1/2.002	N1/010	OK	
N1/2.003	N1/011	OK	
N1/2.004	N1/012	OK	4
N1/2.005	N1/013	SURCHARGED	1
N1/4.000	N1/014	OK*	
N1/2.006	N1/015	SURCHARGED	1
N1/2.007	N1/016	SURCHARGED	
N1/1.006	N1/017	SURCHARGED	
N1/1.007	N1/018	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.300 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 600.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 5, 30, 100, 101
Climate Change (%) 20, 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
N1/1.000	N1/001	15 Winter	100	+20%	100/15 Winter				51.478	0.028	0.000	0.99		31.2
N1/1.001	N1/002	15 Winter	100	+20%	101/15 Summer				51.056	-0.054	0.000	0.94		60.4
N1/1.002	N1/003	15 Winter	100	+20%					50.644	-0.156	0.000	0.46		64.6
N1/1.003	N1/004	15 Winter	100	+20%					48.836	-0.184	0.000	0.31		66.4
N1/1.004	N1/005	15 Winter	100	+20%					45.153	-0.177	0.000	0.34		70.5
N1/1.005	N1/006	15 Winter	100	+20%	101/15 Winter				41.469	-0.151	0.000	0.49		73.2
N1/2.000	N1/007	15 Winter	100	+20%					51.463	-0.097	0.000	0.25		4.4
N1/2.001	N1/008	15 Winter	100	+20%	101/15 Summer				50.604	-0.036	0.000	0.90		22.2
N1/3.000	N1/009	15 Winter	100	+20%					49.713	-0.087	0.000	0.65		18.8
N1/2.002	N1/010	15 Winter	100	+20%					49.515	-0.075	0.000	0.76		55.3
N1/2.003	N1/011	15 Winter	100	+20%	101/15 Summer				48.506	-0.064	0.000	0.83		84.3
N1/2.004	N1/012	15 Winter	100	+20%	100/15 Summer	101/15 Summer			45.880	1.010	0.000	1.06		98.3
N1/2.005	N1/013	15 Winter	100	+20%	30/15 Winter	101/30 Winter			42.341	0.801	0.000	1.04		114.1
N1/4.000	N1/014	30 Winter	100	+20%					42.609	-0.091	0.000	0.33		26.0
N1/2.006	N1/015	15 Winter	100	+20%	30/15 Summer	101/30 Winter			41.960	0.830	0.000	1.13		126.0
N1/2.007	N1/016	15 Winter	100	+20%	30/15 Summer				41.400	0.710	0.000	0.77		126.2
N1/1.006	N1/017	15 Winter	100	+20%	30/15 Summer				41.140	0.890	0.000	1.46		207.1
N1/1.007	N1/018	15 Winter	100	+20%	5/15 Summer				39.935	0.235	0.000	2.44		206.2

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

PN	US/MH Name	Status	Level Exceeded
N1/1.000	N1/001	SURCHARGED	
N1/1.001	N1/002	OK	
N1/1.002	N1/003	OK	
N1/1.003	N1/004	OK	
N1/1.004	N1/005	OK	
N1/1.005	N1/006	OK	
N1/2.000	N1/007	OK	
N1/2.001	N1/008	OK	
N1/3.000	N1/009	OK	
N1/2.002	N1/010	OK	
N1/2.003	N1/011	OK	
N1/2.004	N1/012	FLOOD RISK	4
N1/2.005	N1/013	FLOOD RISK	1
N1/4.000	N1/014	OK*	
N1/2.006	N1/015	FLOOD RISK	1
N1/2.007	N1/016	FLOOD RISK	
N1/1.006	N1/017	FLOOD RISK	
N1/1.007	N1/018	SURCHARGED	

101 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.300 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 600.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 5, 30, 100, 101
Climate Change (%) 20, 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

101 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
N1/1.000	N1/001	15 Winter	101	+40%	100/15 Winter				51.634	0.184	0.000	1.13		35.6
N1/1.001	N1/002	15 Winter	101	+40%	101/15 Summer				51.156	0.046	0.000	1.05		66.9
N1/1.002	N1/003	15 Winter	101	+40%					50.652	-0.148	0.000	0.50		71.3
N1/1.003	N1/004	15 Winter	101	+40%					48.843	-0.177	0.000	0.35		73.8
N1/1.004	N1/005	15 Winter	101	+40%					45.159	-0.171	0.000	0.38		78.0
N1/1.005	N1/006	15 Winter	101	+40%	101/15 Winter				41.748	0.128	0.000	0.52		78.4
N1/2.000	N1/007	15 Winter	101	+40%					51.468	-0.092	0.000	0.30		5.2
N1/2.001	N1/008	15 Winter	101	+40%	101/15 Summer				50.665	0.025	0.000	1.01		25.0
N1/3.000	N1/009	15 Winter	101	+40%					49.730	-0.070	0.000	0.76		22.0
N1/2.002	N1/010	15 Winter	101	+40%					49.535	-0.055	0.000	0.87		63.0
N1/2.003	N1/011	15 Winter	101	+40%	101/15 Summer				48.834	0.264	0.000	0.88		89.5
N1/2.004	N1/012	15 Winter	101	+40%	100/15 Summer	101/15 Summer			46.073	1.203	3.433	1.07		99.9
N1/2.005	N1/013	30 Winter	101	+40%	30/15 Winter	101/30 Winter			42.740	1.200	0.026	0.99		108.5
N1/4.000	N1/014	30 Winter	101	+40%					42.615	-0.085	0.000	0.39		30.4
N1/2.006	N1/015	30 Winter	101	+40%	30/15 Summer	101/30 Winter			42.330	1.200	0.481	1.23		137.3
N1/2.007	N1/016	30 Winter	101	+40%	30/15 Summer				41.706	1.016	0.000	0.84		137.9
N1/1.006	N1/017	30 Winter	101	+40%	30/15 Summer				41.411	1.161	0.000	1.60		226.1
N1/1.007	N1/018	30 Winter	101	+40%	5/15 Summer				39.989	0.289	0.000	2.67		225.5

101 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network 1.sws

PN	US/MH Name	Status	Level Exceeded
N1/1.000	N1/001	SURCHARGED	
N1/1.001	N1/002	SURCHARGED	
N1/1.002	N1/003	OK	
N1/1.003	N1/004	OK	
N1/1.004	N1/005	OK	
N1/1.005	N1/006	SURCHARGED	
N1/2.000	N1/007	OK	
N1/2.001	N1/008	SURCHARGED	
N1/3.000	N1/009	OK	
N1/2.002	N1/010	OK	
N1/2.003	N1/011	SURCHARGED	
N1/2.004	N1/012	FLOOD	4
N1/2.005	N1/013	FLOOD	1
N1/4.000	N1/014	OK*	
N1/2.006	N1/015	FLOOD	1
N1/2.007	N1/016	FLOOD RISK	
N1/1.006	N1/017	FLOOD RISK	
N1/1.007	N1/018	SURCHARGED	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.300 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 600.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 5, 30, 100, 101
Climate Change (%) 20, 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
PED1/1.000	PED1/001	30 Winter	1	+20%					55.736	-0.264	0.000	0.02		2.8
PED1/1.001	PED1/002	15 Winter	1	+20%					55.473	-0.207	0.000	0.10		24.6
PED1/1.002	PED1/003	15 Winter	1	+20%					53.761	-0.439	0.000	0.06		45.1
PED1/1.003	PED1/004	15 Winter	1	+20%					52.971	-0.459	0.000	0.05		46.5
PED1/1.004	PED1/005	15 Winter	1	+20%					52.513	-0.487	0.000	0.03		46.2
PED1/1.005	PED1/006	15 Winter	1	+20%					50.578	-0.432	0.000	0.07		77.6
PED1/1.006	PED1/007	15 Winter	1	+20%					48.512	-0.468	0.000	0.04		77.8
PED1/1.007	PED1/008	15 Winter	1	+20%					47.242	-0.398	0.000	0.10		109.1
PED1/1.008	PED1/009	15 Winter	1	+20%					46.080	-0.380	0.000	0.12		122.2
PED1/1.009	PED1/010	15 Winter	1	+20%					44.409	-0.391	0.000	0.11		135.8
PED1/1.010	PED1/011	15 Winter	1	+20%					42.621	-0.389	0.000	0.11		143.4
PED1/1.011	PED1/012	15 Winter	1	+20%					41.644	-0.326	0.000	0.18		141.7
PED1/1.012	PED1/013	15 Winter	1	+20%					40.973	-0.357	0.000	0.14		141.1

PN	US/MH Name	Status	Level Exceeded
PED1/1.000	PED1/001	FLOOD RISK*	
PED1/1.001	PED1/002	FLOOD RISK*	
PED1/1.002	PED1/003	FLOOD RISK*	
PED1/1.003	PED1/004	FLOOD RISK*	
PED1/1.004	PED1/005	FLOOD RISK*	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

PN	US/MH Name	Status	Level Exceeded
PED1/1.005	PED1/006	FLOOD RISK*	
PED1/1.006	PED1/007	FLOOD RISK*	
PED1/1.007	PED1/008	FLOOD RISK*	
PED1/1.008	PED1/009	FLOOD RISK*	
PED1/1.009	PED1/010	FLOOD RISK*	
PED1/1.010	PED1/011	FLOOD RISK*	
PED1/1.011	PED1/012	FLOOD RISK*	
PED1/1.012	PED1/013	FLOOD RISK*	

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.300 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 600.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 5, 30, 100, 101
Climate Change (%) 20, 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
PED1/1.000	PED1/001	30 Winter	5	+20%					55.745	-0.255	0.000	0.03		4.2
PED1/1.001	PED1/002	15 Winter	5	+20%					55.497	-0.183	0.000	0.16		37.0
PED1/1.002	PED1/003	15 Winter	5	+20%					53.800	-0.400	0.000	0.09		68.1
PED1/1.003	PED1/004	15 Winter	5	+20%					53.007	-0.423	0.000	0.08		70.5
PED1/1.004	PED1/005	15 Winter	5	+20%					52.540	-0.460	0.000	0.05		69.8
PED1/1.005	PED1/006	15 Winter	5	+20%					50.619	-0.391	0.000	0.10		118.6
PED1/1.006	PED1/007	15 Winter	5	+20%					48.545	-0.435	0.000	0.07		118.2
PED1/1.007	PED1/008	15 Winter	5	+20%					47.291	-0.349	0.000	0.15		166.5
PED1/1.008	PED1/009	15 Winter	5	+20%					46.131	-0.329	0.000	0.18		186.2
PED1/1.009	PED1/010	15 Winter	5	+20%					44.458	-0.342	0.000	0.16		207.3
PED1/1.010	PED1/011	15 Winter	5	+20%					42.672	-0.338	0.000	0.17		218.9
PED1/1.011	PED1/012	15 Winter	5	+20%					41.705	-0.265	0.000	0.28		216.2
PED1/1.012	PED1/013	15 Winter	5	+20%					41.028	-0.302	0.000	0.22		215.5

PN	US/MH Name	Status	Level Exceeded
PED1/1.000	PED1/001	FLOOD RISK*	
PED1/1.001	PED1/002	FLOOD RISK*	
PED1/1.002	PED1/003	FLOOD RISK*	
PED1/1.003	PED1/004	FLOOD RISK*	
PED1/1.004	PED1/005	FLOOD RISK*	

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

PN	US/MH Name	Status	Level Exceeded
PED1/1.005	PED1/006	FLOOD RISK*	
PED1/1.006	PED1/007	FLOOD RISK*	
PED1/1.007	PED1/008	FLOOD RISK*	
PED1/1.008	PED1/009	FLOOD RISK*	
PED1/1.009	PED1/010	FLOOD RISK*	
PED1/1.010	PED1/011	FLOOD RISK*	
PED1/1.011	PED1/012	FLOOD RISK*	
PED1/1.012	PED1/013	FLOOD RISK*	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.300 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 600.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 5, 30, 100, 101
Climate Change (%) 20, 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
PED1/1.000	PED1/001	30 Winter	30	+20%					55.757	-0.243	0.000	0.04		6.3
PED1/1.001	PED1/002	15 Winter	30	+20%					55.542	-0.138	0.000	0.29		67.8
PED1/1.002	PED1/003	15 Winter	30	+20%					53.871	-0.329	0.000	0.16		120.6
PED1/1.003	PED1/004	15 Winter	30	+20%					53.067	-0.363	0.000	0.13		124.9
PED1/1.004	PED1/005	15 Winter	30	+20%					52.589	-0.411	0.000	0.09		122.3
PED1/1.005	PED1/006	15 Winter	30	+20%					50.686	-0.324	0.000	0.18		204.1
PED1/1.006	PED1/007	15 Winter	30	+20%					48.598	-0.382	0.000	0.12		204.8
PED1/1.007	PED1/008	15 Winter	30	+20%					47.370	-0.270	0.000	0.26		288.0
PED1/1.008	PED1/009	15 Winter	30	+20%					46.218	-0.242	0.000	0.31		322.8
PED1/1.009	PED1/010	15 Winter	30	+20%					44.536	-0.264	0.000	0.27		354.4
PED1/1.010	PED1/011	15 Winter	30	+20%					42.749	-0.261	0.000	0.28		372.5
PED1/1.011	PED1/012	15 Winter	30	+20%					41.802	-0.168	0.000	0.47		364.6
PED1/1.012	PED1/013	15 Winter	30	+20%					41.112	-0.218	0.000	0.37		364.5

PN	US/MH Name	Status	Level Exceeded
PED1/1.000	PED1/001	FLOOD RISK*	
PED1/1.001	PED1/002	FLOOD RISK*	
PED1/1.002	PED1/003	FLOOD RISK*	
PED1/1.003	PED1/004	FLOOD RISK*	
PED1/1.004	PED1/005	FLOOD RISK*	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

PN	US/MH Name	Status	Level Exceeded
PED1/1.005	PED1/006	FLOOD RISK*	
PED1/1.006	PED1/007	FLOOD RISK*	
PED1/1.007	PED1/008	FLOOD RISK*	
PED1/1.008	PED1/009	FLOOD RISK*	
PED1/1.009	PED1/010	FLOOD RISK*	
PED1/1.010	PED1/011	FLOOD RISK*	
PED1/1.011	PED1/012	FLOOD RISK*	
PED1/1.012	PED1/013	FLOOD RISK*	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.300 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 600.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 5, 30, 100, 101
Climate Change (%) 20, 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
PED1/1.000	PED1/001	30 Winter	100	+20%					55.767	-0.233	0.000	0.06		8.2
PED1/1.001	PED1/002	15 Winter	100	+20%					55.566	-0.114	0.000	0.37		88.8
PED1/1.002	PED1/003	15 Winter	100	+20%					53.910	-0.290	0.000	0.21		158.2
PED1/1.003	PED1/004	15 Winter	100	+20%					53.099	-0.331	0.000	0.18		163.7
PED1/1.004	PED1/005	15 Winter	100	+20%					52.616	-0.384	0.000	0.11		160.7
PED1/1.005	PED1/006	15 Winter	100	+20%					50.725	-0.285	0.000	0.23		267.1
PED1/1.006	PED1/007	15 Winter	100	+20%					48.630	-0.350	0.000	0.15		268.0
PED1/1.007	PED1/008	15 Winter	100	+20%					47.415	-0.225	0.000	0.34		376.8
PED1/1.008	PED1/009	15 Winter	100	+20%					46.265	-0.195	0.000	0.40		422.2
PED1/1.009	PED1/010	15 Winter	100	+20%					44.582	-0.218	0.000	0.36		464.8
PED1/1.010	PED1/011	15 Winter	100	+20%					42.795	-0.215	0.000	0.37		489.2
PED1/1.011	PED1/012	15 Winter	100	+20%					41.858	-0.112	0.000	0.61		478.1
PED1/1.012	PED1/013	15 Winter	100	+20%					41.163	-0.167	0.000	0.48		476.4

PN	US/MH Name	Status	Level Exceeded
PED1/1.000	PED1/001	FLOOD RISK*	
PED1/1.001	PED1/002	FLOOD RISK*	
PED1/1.002	PED1/003	FLOOD RISK*	
PED1/1.003	PED1/004	FLOOD RISK*	
PED1/1.004	PED1/005	FLOOD RISK*	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

PN	US/MH Name	Status	Level Exceeded
PED1/1.005	PED1/006	FLOOD RISK*	
PED1/1.006	PED1/007	FLOOD RISK*	
PED1/1.007	PED1/008	FLOOD RISK*	
PED1/1.008	PED1/009	FLOOD RISK*	
PED1/1.009	PED1/010	FLOOD RISK*	
PED1/1.010	PED1/011	FLOOD RISK*	
PED1/1.011	PED1/012	FLOOD RISK*	
PED1/1.012	PED1/013	FLOOD RISK*	

101 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.300 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 600.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 5, 30, 100, 101
Climate Change (%) 20, 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

101 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
PED1/1.000	PED1/001	30 Winter	101	+40%					55.773	-0.227	0.000	0.07		9.6
PED1/1.001	PED1/002	15 Winter	101	+40%					55.581	-0.099	0.000	0.44		103.3
PED1/1.002	PED1/003	15 Winter	101	+40%					53.935	-0.265	0.000	0.25		186.5
PED1/1.003	PED1/004	15 Winter	101	+40%					53.122	-0.308	0.000	0.21		192.1
PED1/1.004	PED1/005	15 Winter	101	+40%					52.635	-0.365	0.000	0.13		189.3
PED1/1.005	PED1/006	15 Winter	101	+40%					50.750	-0.260	0.000	0.27		313.9
PED1/1.006	PED1/007	15 Winter	101	+40%					48.650	-0.330	0.000	0.18		314.9
PED1/1.007	PED1/008	15 Winter	101	+40%					47.443	-0.197	0.000	0.40		442.5
PED1/1.008	PED1/009	15 Winter	101	+40%					46.296	-0.164	0.000	0.47		495.6
PED1/1.009	PED1/010	15 Winter	101	+40%					44.612	-0.188	0.000	0.42		545.3
PED1/1.010	PED1/011	15 Winter	101	+40%					42.825	-0.185	0.000	0.44		573.6
PED1/1.011	PED1/012	15 Winter	101	+40%					41.894	-0.076	0.000	0.72		561.3
PED1/1.012	PED1/013	15 Winter	101	+40%					41.196	-0.134	0.000	0.56		559.8

PN	US/MH Name	Status	Level Exceeded
PED1/1.000	PED1/001	FLOOD RISK*	
PED1/1.001	PED1/002	FLOOD RISK*	
PED1/1.002	PED1/003	FLOOD RISK*	
PED1/1.003	PED1/004	FLOOD RISK*	
PED1/1.004	PED1/005	FLOOD RISK*	

101 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for PED 1.sws

PN	US/MH Name	Status	Level Exceeded
PED1/1.005	PED1/006	FLOOD RISK*	
PED1/1.006	PED1/007	FLOOD RISK*	
PED1/1.007	PED1/008	FLOOD RISK*	
PED1/1.008	PED1/009	FLOOD RISK*	
PED1/1.009	PED1/010	FLOOD RISK*	
PED1/1.010	PED1/011	FLOOD RISK*	
PED1/1.011	PED1/012	FLOOD RISK*	
PED1/1.012	PED1/013	FLOOD RISK*	

APPENDIX F

Professional Indemnity Insurance

24 October 2022

Project No. 41009019.L01.B0

Monaghan County Council
Planning Offices
1 Dublin Street
Monaghan
H18 X982

SGMI KNOCKNACRAN WEST DEVELOPMENT - PROFESSIONAL INDEMNITY INSURANCE POLICY

Dear Sir / Madam,

I confirm that WSP's Global Professional Indemnity (PI) insurance policy will respond to any claims made by a client (or third-party) suggesting that they have suffered loss as a result of non-performance, breach of contract and/or professional negligence in the professional services provided by WSP, including for a period up to 12 years after practical completion, as required by the terms of a specific agreement relating to work being undertaken by WSP.

The extent and terms of the specific policy agreement will require clarification and agreement with Monaghan County Council.

WSP's PI policy also incorporates a General Principals Endorsement automatically indemnifying any principal, thereby avoiding the necessity for individual endorsements to be issued.

Yours Sincerely,

GOLDER-WSP IRELAND CONSULTING LIMITED

Brian Keenan

Associate Director, Geotechnical Engineer

BK/ld

CC: Mike Ritson, Insurance Manager for WSP UK & Ireland

Attachments:

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Town Centre House, Dublin Road, Naas,
Co. Kildare, W91 TD0P Ireland
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WSP Ireland Consulting Limited
Registered in Ireland
Registration No.302231, Registered office: Town Centre House, Dublin Road, Naas, Co. Kildare, W91 TD0P, Ireland, VAT No. 6322231R

APPENDIX G

Response to Item 20.q.

Memorandum

To:	Benson Plunkett	**At:**	Saint-Gobain Mining Ltd
From:	Xander Gwynn	**At:**	SLR Consulting Ltd
Date:	14th September 2022	**Ref:**	
Subject:	**Permanent solution to existing mine workings that go under the existing public road network**		

SLR Consulting (Ireland) Ltd (SLR) has been engaged by Saint-Gobain Mining Ireland Ltd (SGMI), to respond to a request for further information (RFI), Reg. Ref. 22/34, issued by Monaghan County Council (MCC). In particular, with reference to RFI Item 20. q, presented below:

'Permanent Solution to existing mine workings that go under the existing public road network: The applicant has not clearly demonstrated how they propose to address the issue of future road subsidence on the public road network where previous mine workings exist. The applicant must submit comprehensive proposals, including design reports, drawings, and other appropriate design details that demonstrate how the applicant proposes incorporating a permanent solution to the mine workings that go under the public roads as part of their open cast works.'

SGMI proposes to backfill existing mine workings that go under the R179 and L4900 public roads adjacent to the Application Site, and in doing so, provide a permanent solution to the issue of future road subsidence on the public road network where previous mine workings exist.

The locations of the underground workings for backfilling under the R179 and L4900 roads have been identified from mine survey records as shown in Figure 1.

Proposed Methodology for Backfilling under R179 & L4900

On intersecting an opening to the historical Drumgoosat underground mine workings during the development of the Knocknacran Open-Cast Mine, SLR recommend that the following actions be undertaken, dependant on safe working conditions:

- Confirm location of mine opening(s) with respect to historical mine survey plans.
- Conduct an initial Geotechnical Assessment by a competent Geotechnical Engineer on the mine opening(s) uncovered from historical gypsum mining where they intersect with the new open-cast mine excavation.
- Characterise mine opening(s) in terms of stability based on rockmass integrity using the Barton Q or RMR (Rock Mass Rating) systems.
- Based on the Geotechnical Assessment, carryout remediation of 'tunnel' entrances to allow safe access for further Geotechnical Assessment of the access tunnels to the workings under

=

the public roads. Possible access routes the mine workings under the R179 and L4900 are shown in Figure 2 to 5.

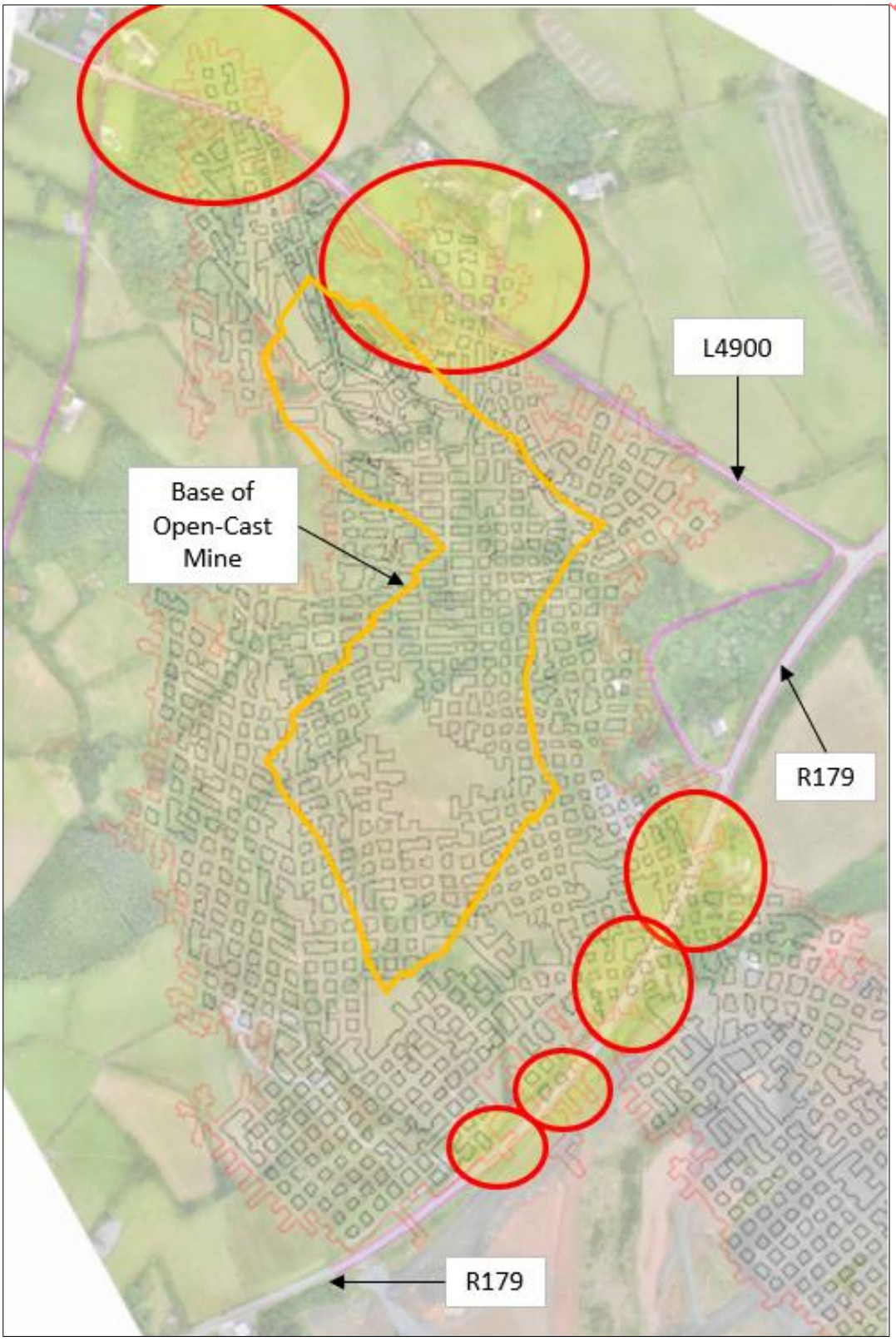

Figure 1: Areas for Backfilling under the R179 and L4900

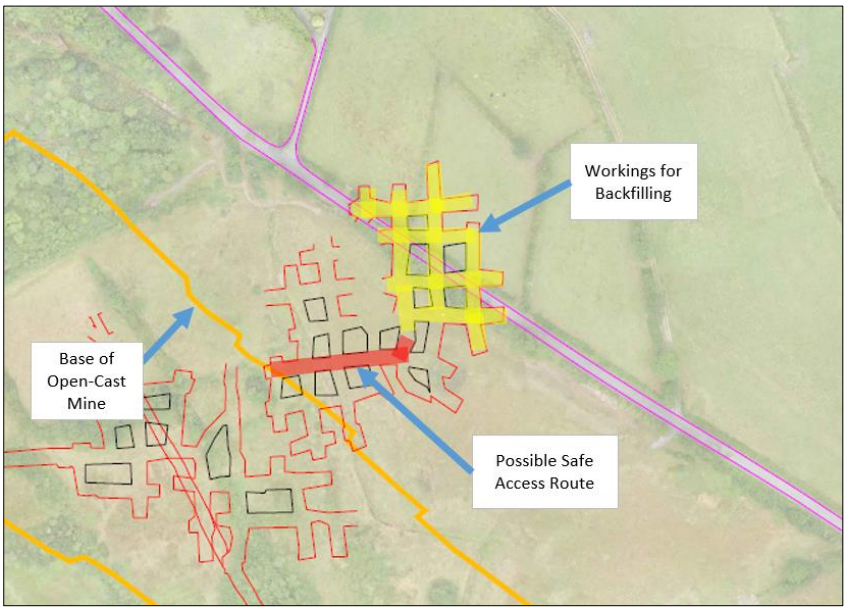

Figure 2: Possible access to the workings under the L4900 - Lower Seam, Upper Horizon

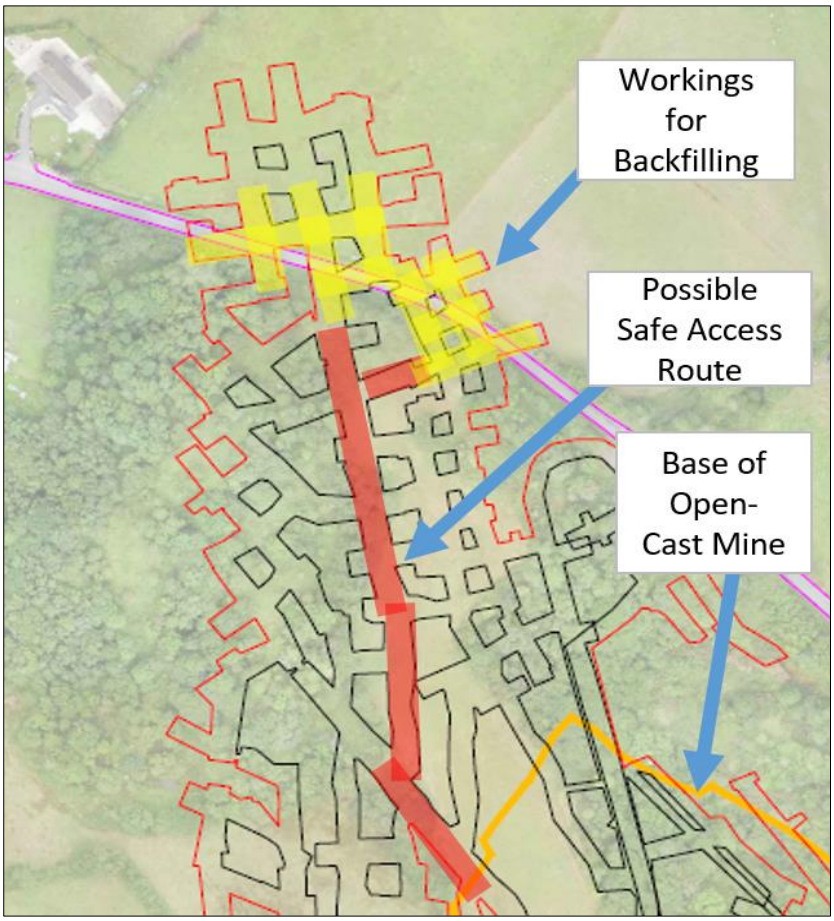

Figure 3: Possible access to the workings under the L4900 - Lower Seam, Upper Horizon

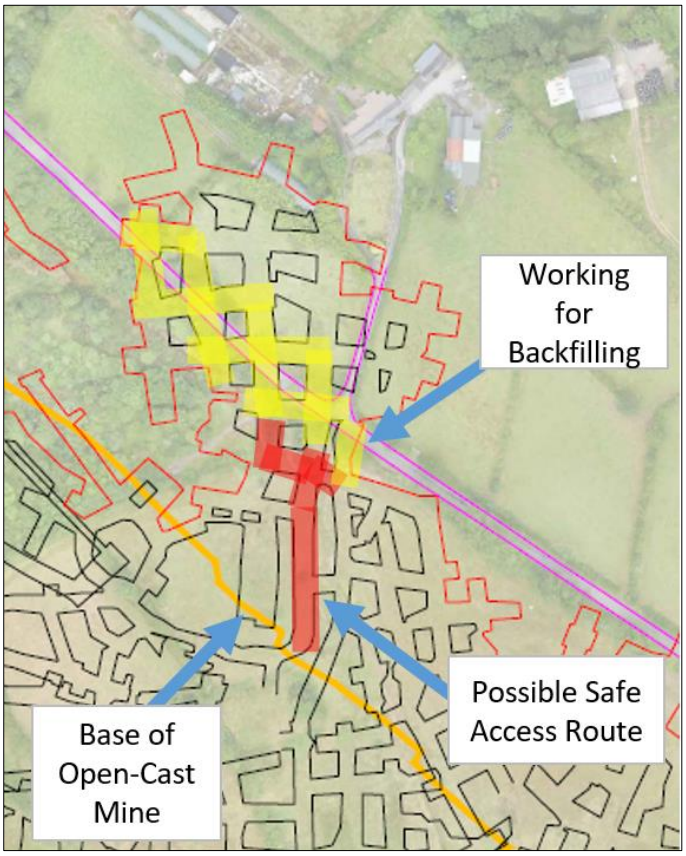

Figure 4: Possible access to the workings under the L4900 - Lower Seam, Upper Horizon

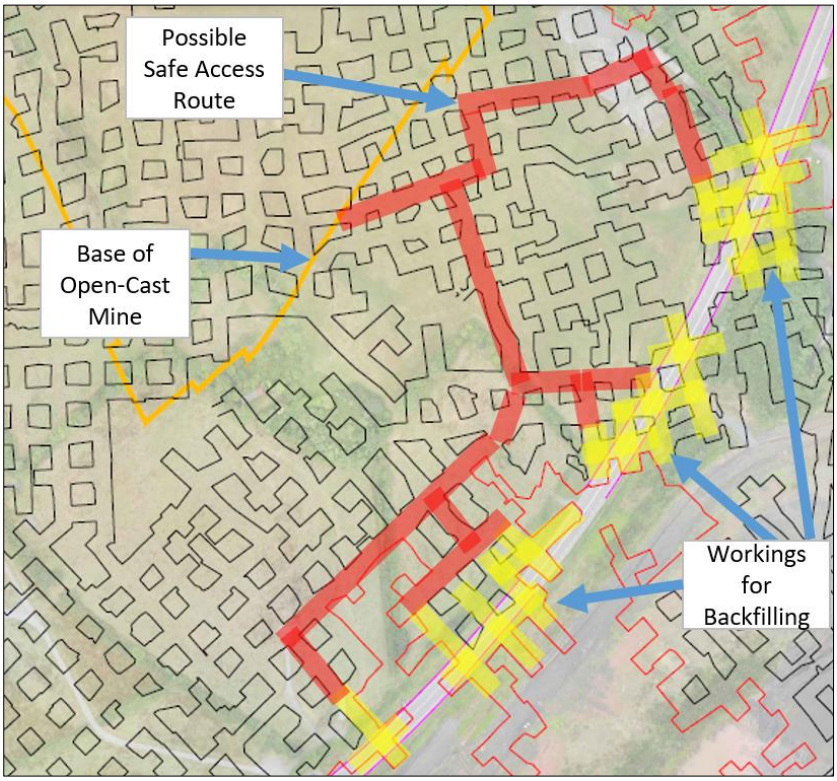

Figure 5: Possible access to the workings under the R179

- Lower Seam, Upper Horizon

- Based on the outcome of the further Geotechnical Assessment(s), conduct ground support remediation works along the length of the tunnels to provide safe access to workings under the roads. The final routes to the areas for backfilling and the areas for backfilling themselves will be confirmed following completion of Geotechnical Assessment(s) and any subsequent remediation works required to make the access tunnels to the areas under the public roads safe.

- Remedial work(s) along the access tunnels to the areas under the R179 and L4900 (and the areas for backfilling) will include a combination of the following, depending on the ground conditions encountered:
    - Scaling (both mechanical and by scaling-bar);
    - Rockbolting without mesh;
    - Installation of mesh with rockbolting.

  Figures 6 and 7 present photographs of example rock bolt and mesh installation, and a tunnel with installed rock bolts and mesh, respectively.

Figure 6: Rock bolt and mesh installation

Figure 7: Example of installed rock bolt and mesh

- Once access to the workings under the roads is made safe and secure, the access tunnels and locations recommended for backfilling will be surveyed (including all 4-way-junctions under the R179 and L4900).

- Buttress walls will then be constructed.

- Buttress wall dimensions and specifications will be determined based on the recommendations of the Geotechnical (and physical) Assessment(s) of the workings. Figure 8 provides a conceptual schematic plan and cross-section for the backfilling of a 4-way junction in the underground workings.

- The buttress walls will be constructed based on recommendations from the Geotechnical Assessments carried out, and will be designed to ensure that backfill will not 'run' or move after it has been emplaced.

- Following construction of buttress walls, rockfill will be placed as backfill in all 4-way-junctions under the R179 and L4900 to provide long-term stability of underground mine workings. Backfill will be in the form of 6" down or similar material, sourced from local quarries (as recommended following the Geotechnical Assessment);

    - Fill material will be placed in lifts and pushed against the walls of the underground workings, pillars and buttresses.
    - Fill will be compacted as it is placed.
    - A final buttress wall will be put in place to contain the backfill material.
    - As "tight" a fill as possible will be achieved. Due to the undulating nature of the roof and the material used for backfilling, there will be small gaps between the backfill and roof. If the roof were to move, it would only be into this small space and very limited movement will be translated into the strata above.

- A photographic record of the works will be made for each location.
- A final topographical survey of the buttress locations will be completed prior to vacating the underground mine workings.

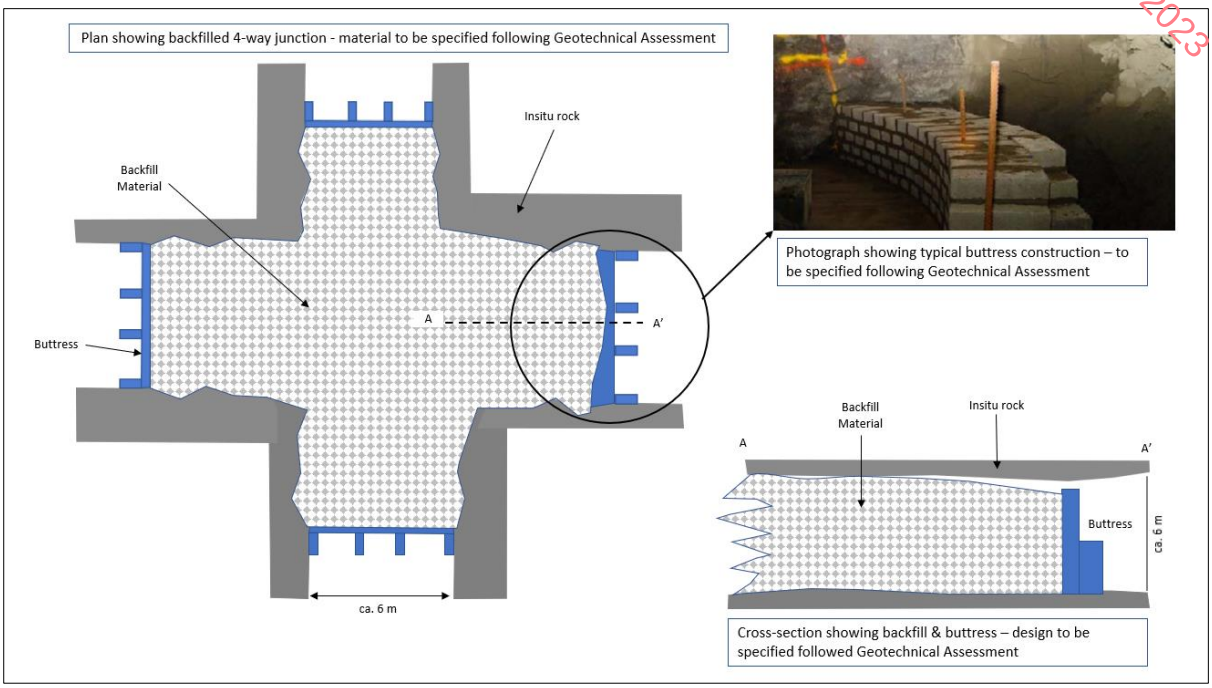

Figure 8: Schematic plan and cross-section for the backfilling of a 4-way junction

Existing ground control monitoring systems of in situ extensometers and surface level monitoring will be maintained and used to monitor underground mine workings under the R179 and L4900 (using the existing TARP (Trigger Action Response Plan)) for a period to be agreed with the Authorities.

Geotechnical Assessments will be carried out by a competent Geotechnical Engineer. Geotechnical Assessment reports will be submitted to the Authorities (including the GSRO) for their agreement prior to any works being carried out.

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Appendix 3.6

Resource Waste Management Plan (RWMP) inc. Asbestos Survey

REPORT

Resource Waste Management Plan

Saint-Gobain Mining (Ireland) Limited

Submitted to:

Monaghan County Council (MCC)
on behalf of
Saint-Gobain Mining (Ireland) Limited
Gyproc Ireland
Kingscourt
Co. Cavan
A82 PF99

Submitted by:

Golder-WSP Ireland Consulting Ltd
Town Centre House, Dublin Road, Naas,
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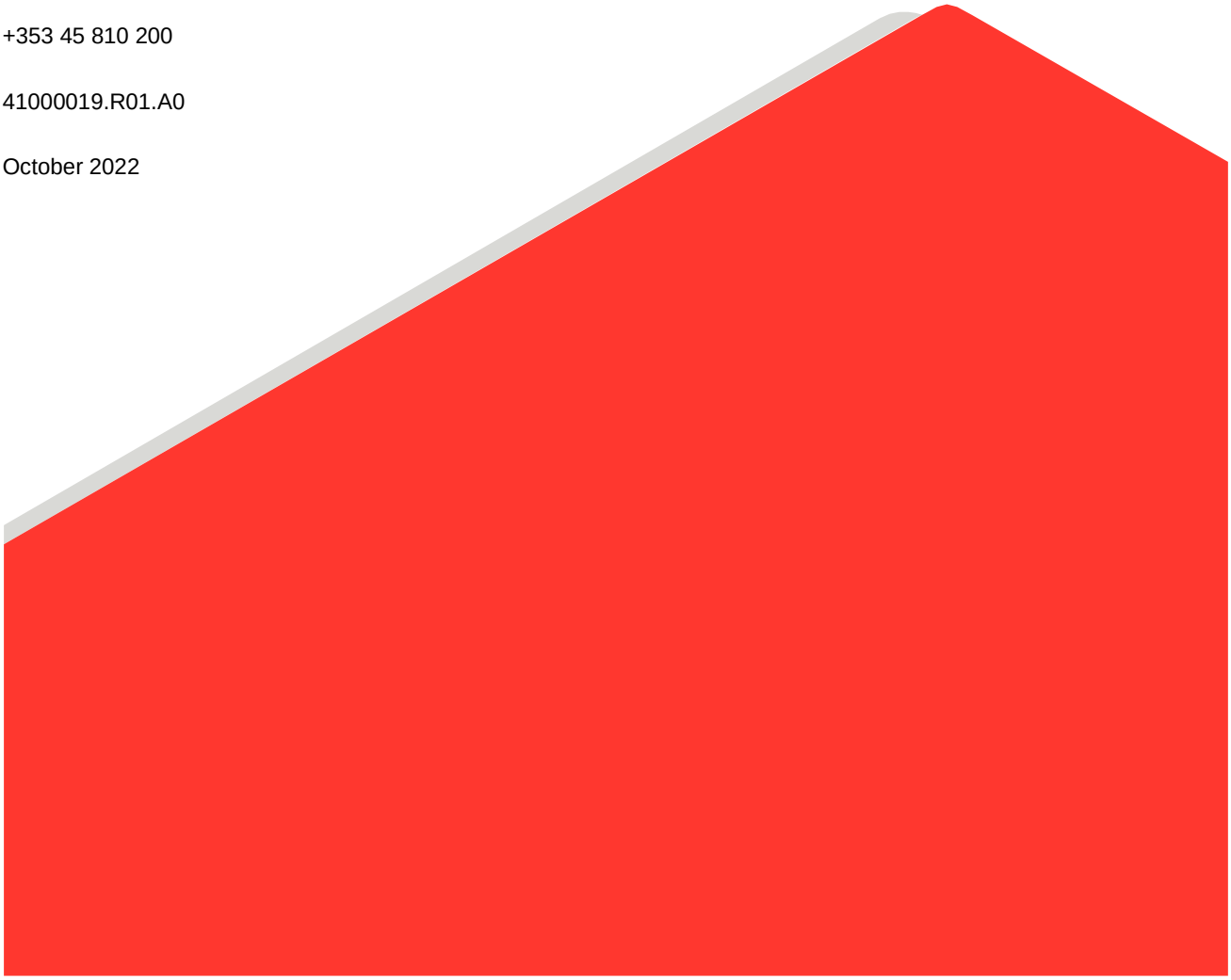
October 2022



Distribution List

Golder-WSP Ireland Consulting Ltd - 1 copy (PDF)

MCC - 1 copy (PDF)

SGMI - 1 copy (PDF)

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FIGURES

APPENDICES

1.0 INTRODUCTION

Golder-WSP Ireland Consulting Ltd (Golder-WSP) has been commissioned to prepare this Resource Waste Management Plan (RWMP) in accordance with the '*Best Practice Guidelines for the Preparation of Resource and Waste Management Plans for Construction and Demolition Projects'* (EPA 2021) on behalf of Saint-Gobain Mining (Ireland) Limited (SGMI) for submittal to Monaghan County Council (MCC).

The demolition works scheduled as part of the proposed development relate to one residential house (which has been purchased by SGMI) and three unoccupied houses and sheds located on the proposed Knocknacran West site, see Section 5.2 and Appendix B.

This plan has been prepared to provide a response to the following additional information items requested by MCC for Planning Ref. 22/34:

- **RFI. 4.d.** Details on the proposed demolition of the dwellings and associated structures on site are insufficient. Further details shall be provided on the methods of demolition, whether salvage is possible (re-use) and/or whether these buildings will be used as infill or waste removed from the site.
- **RFI. 19.a.** A Construction and Demolition Plan and By-Products Management Plan for the proposed development works shall be prepared and submitted using "Best Practice Guidelines for the preparation of resource & waste management plans for construction and demolition projects" — EPA, 2021
- **RFI. 19.c.** An Asbestos Survey and Removal Plan for the proposed demolition development works shall be prepared and submitted.
- **RFI. 19.h.** Construction and Demolition Plan and By-Products Management Plan for the proposed development works shall be provided using "Best Practice Guidelines for the preparation of resource & waste management plans for construction and demolition projects" — EPA, 2021.

The above RFIs are address by the preparation of this document (RWMP) which has replaced Construction and Demolition Waste Management Plans (CDWMP) in the document '*Construction and Demolition Plan and By-Products Management Plan'* in accordance with the '*Best Practice Guidelines for the Preparation of Resource & Waste Management Plans for Construction and Demolition Projects'* (EPA 2021).

A 'Refurbishment & Demolition Asbestos Survey' for the four buildings scheduled for demolition during the proposed development works has been completed by About Safety Ltd. on 16 August 2022 and is provided in Appendix B. A summary of the findings from the survey is provided in Section 5.2.

The RWMP shall detail how the construction and demolition materials are proposed to be managed primarily as resources on Site, where possible to prevent waste generation as encouraged by '*A Waste Action Plan For a Circular Economy. Ireland's National Waste Policy. 2020-2025*', DECC 2021.

Materials not suitable for re-use on the Site to complete the proposed Development as described in Section 2.0 will be recovered and recycled offsite under appropriate waste authorisation and disposal will be considered as the least favourable waste management option for the project.

This document is considered a 'live document' and should be updated as information becomes available or where there is any significant change to the overall resource and waste management strategy for the project.

1.1 Objective

The objective of this RWMP is to ensure that the project demolition and construction waste generated is managed in accordance with applicable legislation, local authority plans and policies and regional waste management targets. This RWMP forms the appointed Main Contractor's operational RWMP.

The overall aims of this project are primarily to prevent waste where possible and to efficiently manage resources

and waste generated during the project lifespan for both the demolition and construction phases.

The main objectives of the RWMP are as follows:

- Promote an integrated approach to waste and resource management throughout the project lifecycle and set out appropriate responsibilities;
- Promote sustainable waste and resource management in line with the waste management hierarchy; and
- Provide an outline for the management of waste arising from demolition and construction phase works for the project in accordance with relevant Irish and EU waste management legislation.

The RWMP outlines methods to achieve waste prevention, maximize reuse and recycling of resources (both onsite and offsite), and recovery/disposal of waste. The RWMP also includes recommendations for the management of various anticipated waste streams.

This plan has been developed to establish specific objectives and guidelines prior to the demolition and construction works and to be flexible to allow the plan to evolve throughout the demolition and construction phases as required by the Main Contractor.

1.2 Waste Policy & Legislative Background

The RWMP describes the applicable legal and policy framework for Construction and Demolition (C&D) waste management in Ireland (both nationally and regionally). A list of relevant waste legislation is listed below.

The Waste Framework Directive sets down basic requirements for handling waste and defines what defines "waste". It provides a set of requirements that EU member states must adhere to. The waste directives are implemented in Ireland by the Environmental Protection Agency Act 1992, the Waste Management Act 1996, as amended, the Waste Management (Amendment) Act 2001, European Communities (Waste Directive) Regulations 2011-2020 and the Protection of the Environment Act 2003. Waste Policy and legislation in Ireland is implemented by the EPA and local authorities.

The Waste Framework Directive sets down some basic waste management principles. It requires that waste be managed as follows:

- Without endangering human health and harming the environment;
- Without risk to water, air, soil, plants or animals;
- Without causing a nuisance through noise or odours; and
- Without adversely affecting the countryside or places of special interest.

The Waste Framework hierarchy sets out that preventing waste is the preferred option with disposal of waste to landfill being the last option considered when managing waste as illustrated in the Waste Hierarchy below in Figure 1.

Traditionally Irelands waste management behaviors has been linear with disposal of waste being the main waste management option utilized. Ireland has committed to transitioning from a linear waste economy to a circular economy and Ireland's National Waste Policy and objectives were set out in *'A Waste Action Plan for a Circular Economy'* issued in September 2020 actively moving towards waste prevention, recovery, recycling and re-use.

Figure 2 below provides an infographic on linear model versus circular economy model.

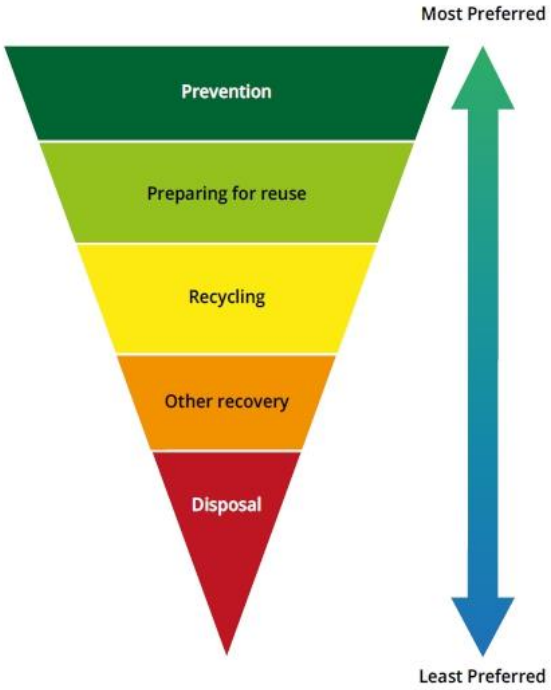


Figure 1: Waste Hierarchy (EPA 2021)

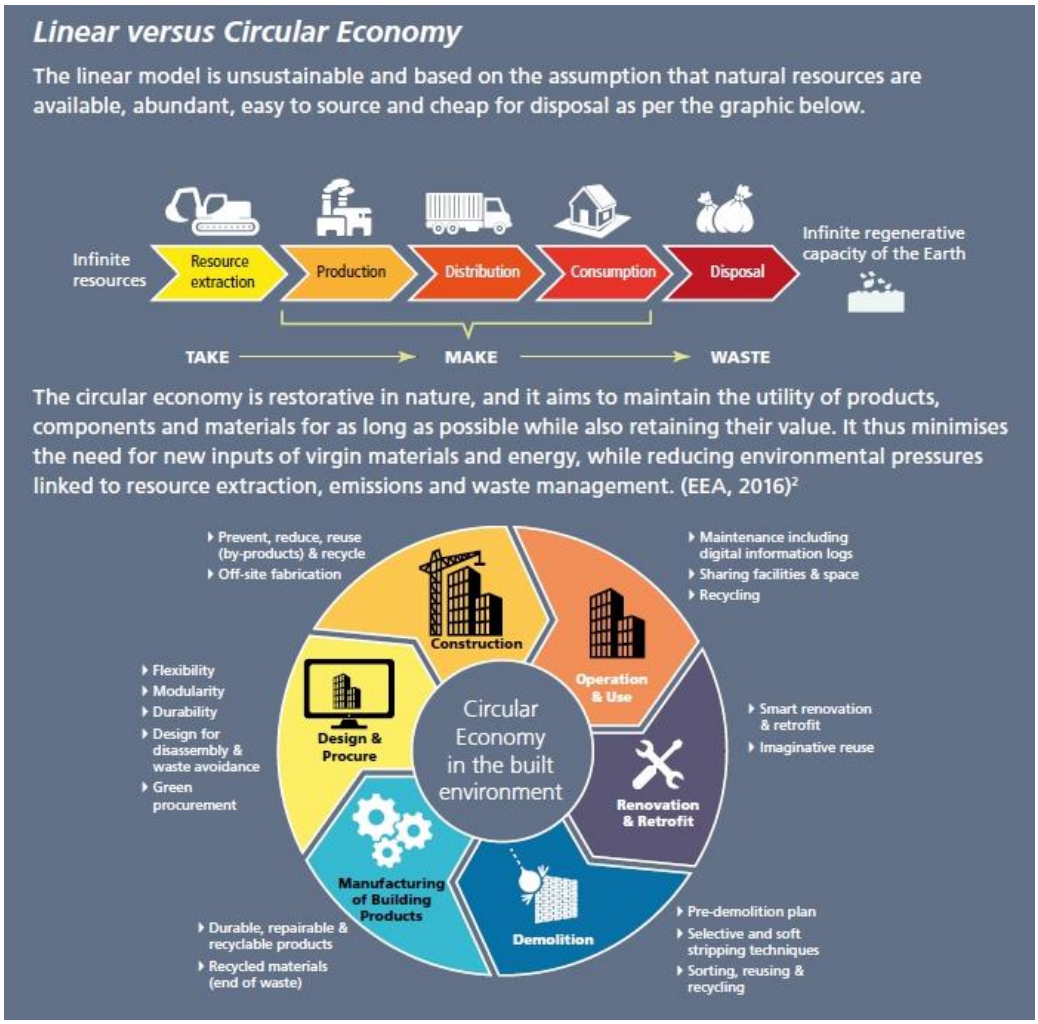


Figure 2: Linear versus Circular Economy (EPA 2021)

The General Scheme of the Circular Economy Bill[1] was published in 2021 and is intended to implement many of the actions in the Government's Waste Action Plan for a Circular Economy and the forthcoming Circular Economy Strategy and will put that strategy on a statutory footing.

The key focus areas of the Waste Action plan with respect to Construction and Demolition waste are:

- Reducing the use of virgin resources;
- Keeping materials in the economy as long as possible;
- Maintaining their intrinsic value/quality as high as possible; and
- Reducing hazardous substances in products and waste.

The EPA issued *'Best Practice Guidelines for The Preparation of Resource Management Plans for Construction & Demolition Projects'* in November 2021. The guidelines provide a practical and informed mechanism to document the prevention and management of C&D wastes and resources from design to construction or demolition of a project. The guidelines provide clients, developers, designers, practitioners, contractors, sub-contractors and competent authorities with a unified approach to preparing and determining Resource and Waste Management Plans (RWMP's) for the construction and demolition sector in Ireland.

The EU '*Guidelines for the waste audits before demolition and renovation works of buildings*' (May 2018) provides best practice guidelines for the assessment of waste streams prior to demolition or renovation through pre demolition audits. The objective of the guidance is to maximize recovery of resources from demolition for beneficial reuse and recycling.

1.3 Legislation

The main legislation that governs waste management in Ireland and relates to the C&D activities at the Development site are:

- Waste Framework Directive 2008/98/EC. The Waste Framework Directive (Directive 2008/98/EC) sets down basic requirements for all EU member states for handling waste, and it also defines what is meant by "waste". To comply with the Directive EU member states must:
  - Ensure that the waste disposal does not present a risk to air, water, soil, plants, and animals;
  - Waste disposal must not be allowed to constitute a public nuisance, (e.g., through noise, unpleasant odours, or the degradation of places of special natural interest);
  - Prohibit uncontrolled disposal of waste or illegal dumping;
  - Establish an integrated and effective network of waste disposal plants;
  - Ensure a proper licence system for waste collection and disposal operations; and
  - Audit and inspect entities involved in waste collection and disposal.
- Landfill Directive 1999/31/EC. This Directive seeks to further the aims of the 1991 Directive in relation to the role of the landfill. It aims to prevent, or reduce as far as possible, the negative effects on the environment from landfilling waste. In order to achieve this, it seeks to:

[1] https://www.gov.ie/en/publication/89838-circular-economy-bill-2021/

- End co-disposal of hazardous and non-hazardous waste in landfill;
- Introduce rigorous technical requirements for landfills and waste;
- Phase in the prohibition of landfilling specific wastes including liquid hazardous waste, other hazardous waste, whole tyres, and shredded tyres;
- Oblige operators to pre-treat all hazardous waste and all other wastes; and
- Introduce phased targets for the reduction of biodegradable waste being landfilled in 2010, 2013 and 2020.

- Waste Management Act 1996 (No. 10 of 1996) as amended 2001 (No. 36 of 2001), 2003 (No. 27 of 2003) and 2011 (No 20 of 2011). Sub-ordinate and associated legislation include:
  - European Communities (Waste Directive) Regulations 2011 (S.I. No. 126 of 2011) as amended;
  - Waste Management (Collection Permit) Regulations 2007 (S.I. No. 820 of 2007) as amended;
  - Waste Management (Facility Permit and Registration) Regulation 2007 (S.I No. 821 of 2007) as amended;
  - Waste Management (Licensing) Regulations 2000 (S.I No. 185 of 2000) as amended;
  - European Union (Packaging) Regulations 2014 (S.I. No. 282 of 2014) as amended;
  - Waste Management (Planning) Regulations 1997 (S.I. No. 137 of 1997) as amended;
  - Waste Management (Landfill Levy) Regulations 2015 (S.I. No. 189 of 2015);
  - European Communities (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014);
  - Waste Management (Batteries and Accumulators) Regulations 2014 (S.I. No. 283 of 2014) as amended;
  - Waste Management (Shipments of Waste) Regulations 2007 (S.I. No. 419 of 2007) as amended; and
  - European Communities (Transfrontier Shipment of Waste) Regulations 1994 (SI 121 of 1994).
- Environmental Protection Act 1992 (S.I. No. 7 of 1992) as amended;
- Litter Pollution Act 1997 (Act No. 12 of 1997) as amended; and
- Planning and Development Act 2000 (No. 30 of 2000) as amended.

These Acts and subordinate regulations enable the transposition of relevant European Union Policy and Directives into Irish law.

1.4 Plans

1.4.1 Regional and County Development Plans

The Monaghan County Development Plan (2019-2025) identifies that waste management planning is the responsibility of the local authorities (Part II of the Waste Management Act 1996, as amended) and that County Monaghan is located in the Connaught-Ulster Region, which developed the Connaught-Ulster Waste Management Plan (CUWMP) in May 2015. Three key targets are set out in this plan:

- A 1% reduction per annum in the quantity of household waste generated per capita over the plan period;
- To achieve a recycling rate of 50% of managed recycling waste by 2020; and
- Reducing to zero the direct disposal of unprocessed residual municipal waste to landfill in favour of higher value pre-treatment option.

Monaghan is implementing the CUWMP to help shift the view of waste management from waste products to valuable material resources. Monaghan is strongly committed to the promotion of the waste hierarchy as defined by EU legislation, recommending where appropriate that excavated materials should be reused on the subject site. The management of construction and demolition (C&D) waste is a National Enforcement Policy of the Waste Enforcement Regional Lead Authorities (WERLA). The management and disposal of C&D waste is regulated by way of Waste Facility Permit Regulations 2007 and requires planning permission.

The Monaghan County Development Plan (2019-2025) has identified eleven waste management policies to shift towards the concept of a 'circular economy', eight of which are applicable to the proposed development:

Table 1: Monaghan Waste Management Policies (Monaghan County Development Plan (2019-2025)

WMP ID	Waste Management Policies
WMP 1	To implement and support the strategic objectives of the Connaught-Ulster Regional Waste Management Plan (2015-2021) and any subsequent Waste Management Plan adopted during the current plan period.
WMP 2	To implement the provisions of the Litter Management Plan 2014-2016 and any subsequent revisions.
WMP 3	To apply the 'Polluter Pays' Principle, proximity principle, and the precautionary principle in respect of all waste management activities**.**
WMP 4	To require that all construction projects are carried out in accordance with Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects.
WMP 5	To encourage best environmental practice in all agricultural, industry, business and local authority activities**.**
WMP 6	To support the circular and bio-economy through the efficient use of resources and to support any development proposals which contribute to this concept.
WMP 7	To support the minimisation of waste creation and promote a practice of reduce, reuse and recycle where possible and to safeguard the environment by seeking to ensure that residual waste is disposed of appropriately.
WMP 8	To continue to fulfil its duties under the Waste Management (certification of historic unlicensed waste disposal and recovery activity) Regulations 2008 (S.I. No 524 of 2008), including those in relation to the identification and registration of closed landfills.

1.4.2 National Waste Policy

In September 2020, the Department of Communications, Climate Action and Environment (DCCAE) published 'Ireland's National Waste Policy 2020-2025' (A Waste Action Plan for a Circular Economy). This new national waste policy will inform and give direction to waste planning and management in Ireland over the coming years. The policy shifts the focus from waste disposal and treatment to ensure that materials and products remain in productive use for longer. This aims to prevent waste and supports reuse through discouraging the wasting of resources and rewarding circularity.

The policy document contains over 200 measures across various waste areas including C&D. C&D waste related goals of the policy are to

- Revise the 2006 Best Practice Guidelines for C&D waste;
- Streamline by-product notification and end-of-waste decision making processes; and
- Working group to develop national end-of-waste applications for priority waste streams.

The policy outlines the significant projected contributions that soils, and stones makes to overall C&D wastes between 2020 and 2022. These projections are provided below in Table 2 below.

Table 2: Construction and Demolition Projections, (Source: 'A Waste Action Plan for a Circular Economy, Ireland's National Waste Policy 2020-2025)

	2020 (tonnes)	2021 (tonnes)	2022 (tonnes)
Total C&D Waste	6,410,000	6,570,000	6,930,00
Of which soils and stones	5,000,000	5,130,000	5,410,000

The policy identifies the need to promote waste prevention in the first instance and the need to plan for C&D wastes at the earliest possible stage in a construction project.

1.5 Guidance

This plan has been written in accordance with the Department of the Environment, Heritage and Local Government's (2006) *'Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects'*; and subsequently, '*Best practice guidelines for the preparation of resource & waste management plans for construction & demolition projects*' (EPA 2021).

These Guidelines provide guidance on the preparation of Project Construction and Demolition Waste Management Plans for certain classes of project, which exceed specified threshold limits.

The Guidelines aim to provide clients, developers, designers, practitioners, contractors, sub-contractors and competent authorities with an agreed basis for determining the adequacy of C&D Waste Management Plans.

2.0 DESCRIPTION OF THE PROJECT AND SITE

2.1 Development Activities

The proposed Development (see Figure 3 below) comprises of the following activities:

- Excavation of the former (Drumgoosat) underground mine by open cast mining methods for the purposes of gypsum extraction at Knocknacran (East & West) and Drumgoosat, Co. Monaghan. Development will include the construction of a Cut-and-Cover Tunnel under the Carrickmacross to Kingscourt regional road (R179) for the transport of gypsum (by haulage truck and covered conveyor) to the existing processing plant area at Knocknacran, and for the transport of overburden and interburden (by haulage truck) to the existing Knocknacran Open-Cast Mine site for ongoing restoration purposes. The construction of the proposed tunnel will necessitate a temporary realignment of the R179 during the tunnel construction period to allow the R179 to remain in constant use.

- Demolition of one currently occupied house (following the building of a replacement house which has been granted planning permission under Reg. Ref.: 21/326) and three unoccupied houses and sheds in the townlands of Knocknacran (East & West), Co. Monaghan; and the pumping of water from the existing Drumgoosat underground workings via an existing borehole on the Knocknacran West Mine site. The drawing for these houses are provided in Appendix A.

- The continued ongoing restoration of the existing Knocknacran Open-Cast Mine located in the townlands of Derrynascobe, Derrynaglah, Enagh, Knocknacran (East & West) and Drummond, Co. Monaghan, permitted under Reg. Ref. 17/217 and operating subject to Industrial Emissions (IE) Licence P0519-04 and Mining Lease M139. The proposed development includes a modification to the existing (approved) restoration plan to return the existing Knocknacran Open-Cast Mine to near ground levels.

- The continuation of use and refurbishment of the existing Knocknacran Processing Plant area, including water treatment facilities and associated infrastructure (including discharge pipeline to the River Bursk) in the townlands of Enagh, Derrynaglah, Drummond, Derrynascobe and Clontrain, Co. Monaghan.

  The Proposed Development will include a replacement vehicular access to the existing Knocknacran Open-Cast Mine and Knocknacran Processing Plant area site from the L4816.

- The further development of a Community Sports Complex (permitted under Reg. Ref. 20/365) located in the townlands of Drummond, Derrynaglah and Knocknacran West, Co. Monaghan which provided for a playing pitch, dressing rooms, welfare facilities, parking and associated drainage/wastewater infrastructure. This proposed development includes the next phase of the Community Sports Complex to include: 2 no. further playing pitches (one with perimeter running track and the other is an all-weather pitch) with associated goal posts, ball stops, dugouts, pitch fencing, flood lighting; a new building to incorporate reception, meeting / club rooms, sports hall, handball alley, changing rooms and toilets, viewing gallery; a part covered grandstand and additional parking and all associated siteworks.

The overall Application Site area is ca. 140.4 ha[2], of which the proposed Knocknacran West Mine comprises ca. 54.3 ha, ca. 24.6 ha comprises the processing plant, ca. 8.6 ha will comprise the Community Sports Complex and ca. 51.5 ha will comprise the restoration area for the existing Knocknacran Mine. Each of these developments will be elaborated on in the following sub-sections.

[2] The red line area encompasses a small area of the R179 (ca. 1.4 ha) which accounts for the slight discrepancy in total site area.

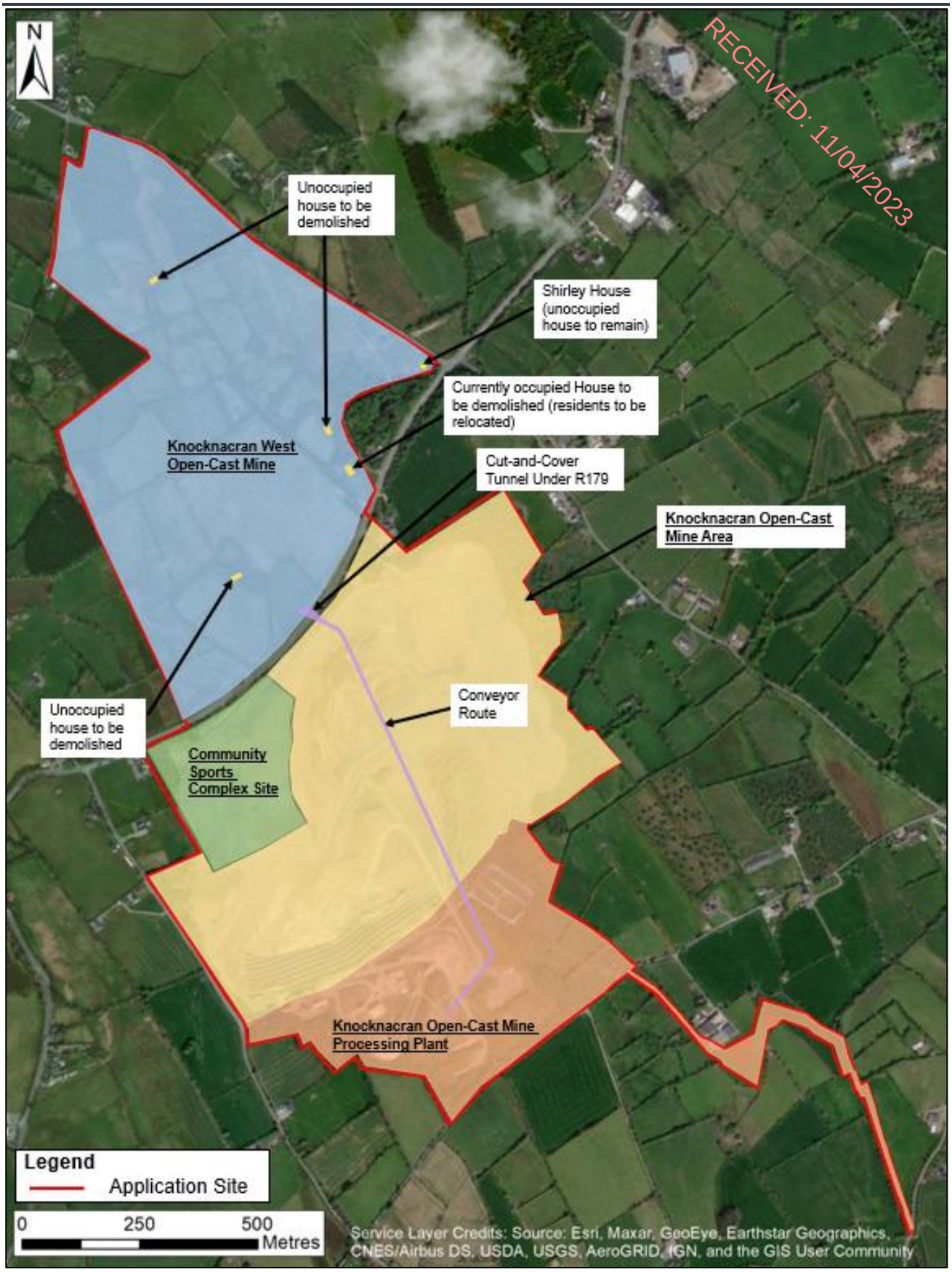


Figure 3: Proposed Development Location Plan (showing 4 x houses scheduled for demolition)

2.2 Existing Site

The Knocknacran West Mine site encompasses the former Drumgoosat Mine underground workings to the north of the R179, see Figure 3.

Prior to the initial subsidence event in September 2018 (refer to EIAR Chapter 7.0), activity on the site was mixed use. Above ground the land was previously used for pastoral farming, amenity uses (former Magheracloone Mitchell's GAA Club grounds and Community Centre) and a brownfield area to the north of the site which was the site of the former Drumgoosat Mine surface plant area which has become an area of semi-natural woodland. Below ground the majority of the site comprised (and continues to comprise) the former Drumgoosat Mine underground workings.

Former Drumgoosat Mine underground workings extend under the majority of the site, with some workings extending under the R179 and L4900 (Figure 4). The gypsum associated with the underground workings to the south of the R179 has been excavated during mining of the Knocknacran Open-Cast Mine. Since the subsidence event in September 2018, work has been undertaken by SRK (with review by Wardell Armstrong for the Department of the Environment, Climate and Communications) to assess the causes and current, and future, stability of the existing underground workings beneath the site (refer to EIAR Chapter 7.0 and Appendices).

The former Drumgoosat Mine underground workings have historically been used to store water however, this is no longer taking place. Instead, the workings are being gradually dewatered by the 'Drumgoosat dewatering borehole' located to the south of the R179. As part of the proposed Development this borehole will be decommissioned, with future dewatering of the Drumgoosat Mine underground workings taking place via an existing monitoring borehole located to the north of the R179 (refer to EIAR Chapter 8.0).

Since the September 2018 subsidence event, the only activities which have taken place on the Site have related to remediation; through the removal of buildings, filling of subsidence features and regrading of the site, monitoring and management of the site. The former GGA Club Grounds, Community Centre buildings and pitches were removed as part of site remediation works. Remediation of crown-holes and fissures associated with this subsidence event have also taken place (refer to Construction Quality Assurance (CQA) Validation Report for the remediation of the disturbance zone at the former Magheracloone GAA grounds).

The site of the former GAA grounds remains not in use, as does the wider site over the former Drumgoosat Mine underground workings and will continue to remain not in use for the foreseeable future. Areas which were not directly impacted by recent subsidence events, are currently unmanaged fields and woodland areas.

A monitoring programme has been established at the site and for the R179 and L4900. As part of the programme, visual inspections, including drone surveying and geotechnical monitoring are undertaken on a continuous (real time) basis.

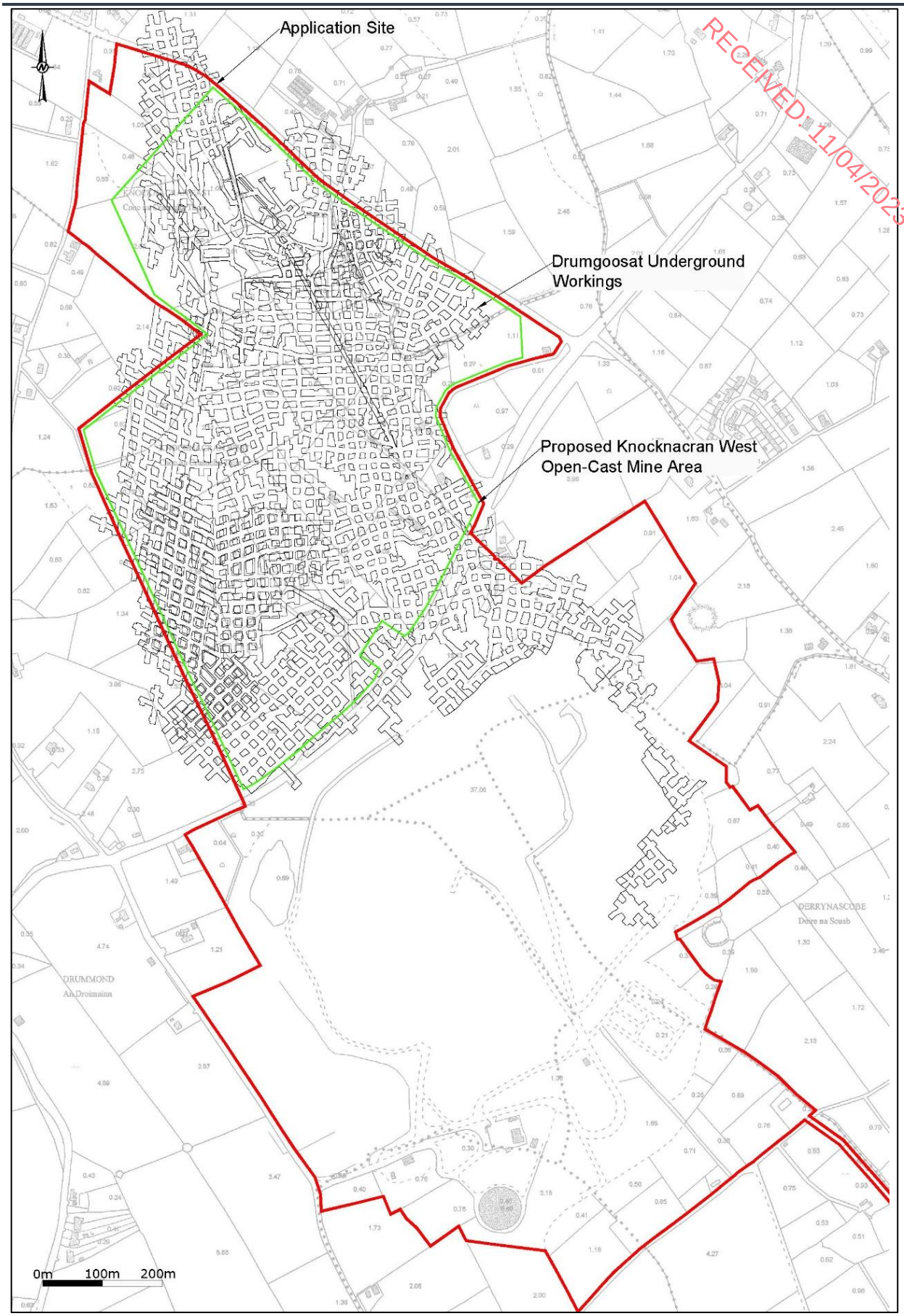


Figure 4: Plan showing extent of the former Drumgoosat Mine underground workings

2.3 Construction Sequencing

The proposed Development is for the extraction of material from the site (the former Drumgoosat Underground Mine) using open-cast mining methods. Material will be extracted from the remaining pillars, overlying room beam / pillar and previously un-mined areas from both the Upper and the Lower Gypsum Units.

The construction sequencing will comprise an initial construction stage for enabling works (ca. 6 months to 1 year), followed by a site development works stage (ca. 1 to 2 years) and mine operations stage (ca. 30 to 35 years) which will see the Knocknacran West site developed in Phases of overburden stripping, extraction of gypsum and backfilling of extracted areas as the Open Pit progresses. As part of the proposed Knocknacran Mine Restoration, materials (overburden and interburden) initially stripped from the proposed Knocknacran West Mine will be transferred via haul truck under the R179 to the Knocknacran Mine to be used in phased restoration.

The detailed construction phasing is provided in EIAR Chapter 3.0, and a summary is provided below.

2.3.1 Construction Stage – Enabling Works

The construction stage – enabling works will see the development of a:

- Temporary Diversion Road on the north side of the R179.
- Cut-and-Cover Tunnel beneath the R179 and the construction of a semi-mobile primary crusher (and ancillary services) on the Knocknacran West Mine site. A service area (including office/canteen and welfare facilities) will be constructed adjacent to the entrance of the Cut-and-Cover Tunnel.

Once the Cut-and-Cover Tunnel has been commissioned and the R179 reinstated, then the Temporary Diversion Road will be closed and removed as part of the site development works.

2.3.2 Site Development Works Stage

The site development works will include:

- A temporary Contractor's Compound will be established in the northeast part of the Site, accessed through an existing entrance from the L4900.
- Phase 1 of mining operations comprises the development of the Upper and Lower Gypsum Units in the eastern part of the Knocknacran West Mine site. The initial works will comprise stripping overburden and interburden in a westerly direction and overlaps with the site development works. These initial site won materials will be used to construct screening berms around the perimeter of the Knocknacran West Mine site inside a newly constructed security fence. The existing hedgerow around the perimeter of the site will be enhanced (i.e., 'thickened-up') with the planting of additional native hedgerow species.
- A new entrance on the existing Knocknacran Mine site will be constructed and will be used by employees, service vehicles and for the dispatch of materials off-site. Five other existing site entrances will act as points for emergency access and exit to the Site, and as access points for environmental monitoring (Figure 5).
- In addition to the construction of a covered conveyor from the Knocknacran West Mine, upgrading of the existing materials handling system at the processing plant site is proposed, to include the construction of a Tripping Conveyor, Reclaim Stockpile Conveyor, extension to the existing Rock Shed and ancillary infrastructure.
- Demolition of one residential house and three unoccupied houses (with sheds) located on the site of the proposed Knocknacran West Mine.
- Construction of the Community Sports Complex on the site of ca. 8.6 ha located to the south of the R179 and to the immediate west of the existing Knocknacran Mine site (see Figure 5).

2.3.3 Mine Operations Stage

A materials handling economic trade-off assessment was undertaken and established that in-pit primary crushing with crushed gypsum being transferred to the processing plant via a series of conveyors through a Cut-and-Cover Tunnel was the optimal solution for the development of Knocknacran West.

Following the removal of the overburden in defined Phases, it is intended to extract gypsum (by blasting) from the proposed Knocknacran West Open-Cast Mine, which has an overall footprint of ca. 54.3 ha for mining activities.

Approximately 12 Mt of stripped materials, comprising overburden and interburden (mudstone and dolerite) will be transported on haul roads, through the Cut-and-Cover Tunnel and used to backfill the existing open-cast at Knocknacran Mine. The balance of the stripped materials, making up approximately 16.5 Mt, will be deposited in the northern pit area of the Knocknacran West Open-Cast as part of the mine's phasing sequence. Upon the completion of extraction of gypsum from Knocknacran West Mine, a portion of the stripped materials will be used to profile and remediate the open-cast.

Approximately 9 Mt of gypsum (and anhydrite) from the Upper and Lower Gypsum Units will be hauled to a semi-mobile primary crusher on the pit floor, before being transported by covered conveyor to the Knocknacran Processing Plant site via the Cut-and-Cover Tunnel, under the R179, for processing prior to being transported off-site by truck.

- **Phase 1** (Years 1 and 2) - will comprise stripping of overburden and interburden material within the eastern portion of the Pit.
- **Phase 2** (Years 3 to 5) - will comprise stripped of overburden and interburden material within the northern portion of the Pit.
- **Phase 3** (Years 6 to 10) - will advance the southern face of the northern part of the pit by stripping additional interburden to deepen the pit and expose more of the Lower Gypsum Unit.
- **Phase 4** (Years 11 to 15) - will comprise extending the northern pit further.
- **Phase 5** (Years 16 to 20) - will comprise stripping the overburden and interburden within the southern portion of the Pit.
- **Phase 6** (Years 21 to 30+) **-** will extend the southern pit to the southwest
- **Phase 7** (Restoration) - Following cessation of mining at Knocknacran West Mine, all plant and infrastructure will be removed prior to restoration of the site and disposed of by auction or through a licenced contractor. Excess stripped material stored in the northern pit area will be used to backfill and profile the southern part of the Knocknacran West Mine. Final profiling of the open-cast slopes will be completed to ensure that any in-situ gypsum is covered, and benches are made safe. This will allow the planting of native grasses, wildflowers, scrub and trees to be undertaken and biodiverse habitats to be developed. Features will include a lake (following cessation of mining, pumps will be turned off and water levels allowed to rebound to natural levels – see EIAR Chapter 8.0), and areas of natural grassland/wildflowers and woodland.

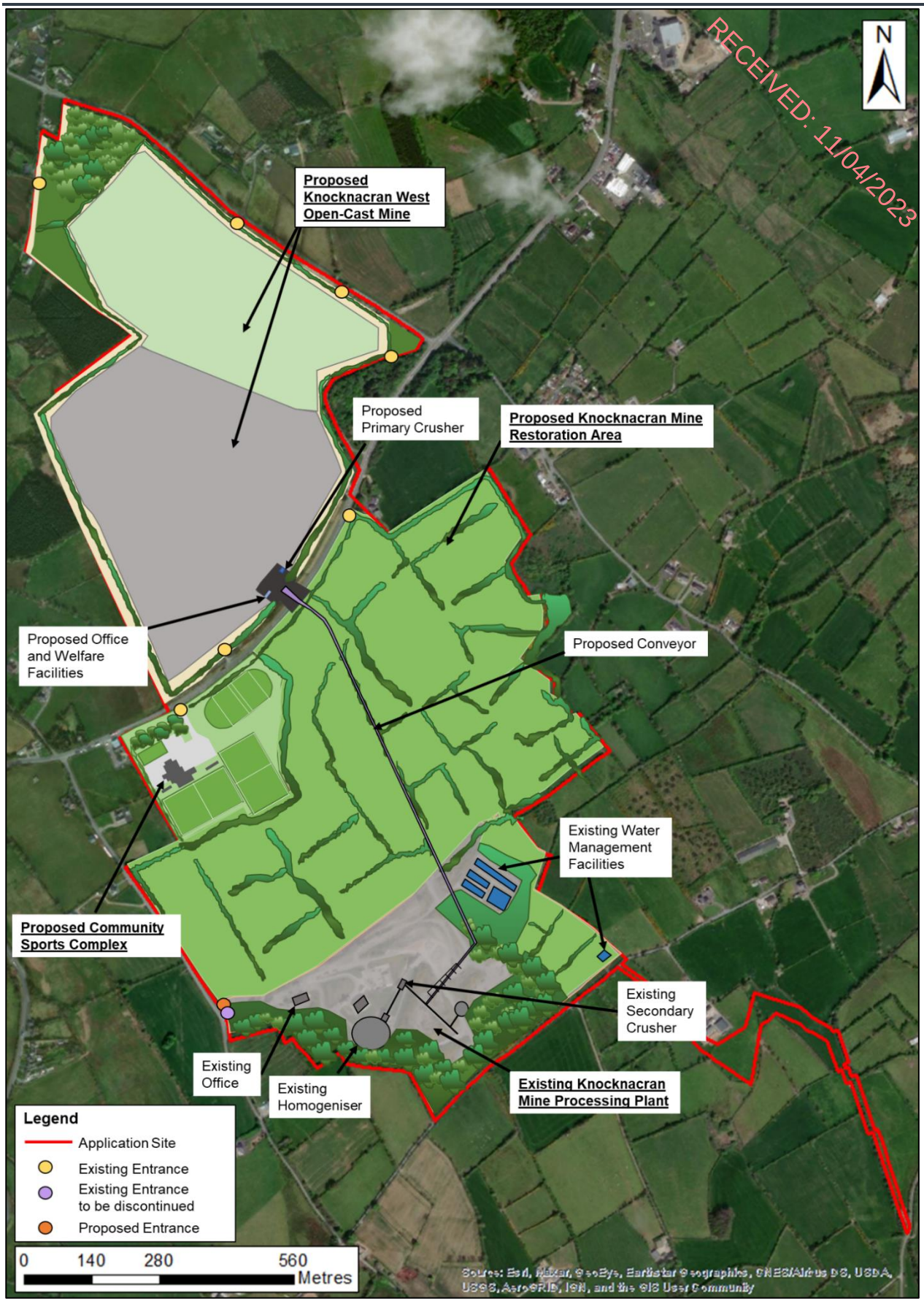


Figure 5: Proposed Development Site Layout

3.0 ROLES & RESPONSIBILITIES

The '*Best Practice Guidelines on the Preparation of Resource Waste Management Plans for Construction and Demolition Projects'* promotes that a Resource Manager (RM) should be appointed.

The Resource Manager role may be performed by a number of different individuals over the life-cycle of the Project; however, it is intended to be a reliable person chosen from within the Contracting Team, with adequate knowledge and understanding of waste practices and waste legislation, who takes the responsibility to ensure that the objectives and measures within the Resource Waste Management Plan are complied with.

The Resource Manager shall have the authority to ensure the objective and obligations of the RWMP are met. The role will include activities such as conducting waste checks/audits and adopting construction and demolition methodology that is designed to facilitate maximum reuse and/or recycling of waste.

3.1 Role of the Client

The 'Client' is typically the party that funds the project and are also usually the original 'waste producer' which means anyone whose activities produce waste or anyone who carries out pre-processing, mixing or other waste operations. For the purposes of this document, the 'Client' can be interpreted to be the 'waste holder' which means the waste producer or legal person who is in possession of the waste or resource until such time it is legally transferred to another party. The Client is the body establishing the aims and the performance targets for the project (often in conjunction with the 'Client Advisory Team' described below).

- The Client should require the preparation and submission of a preliminary RWMP as part of the design and planning submission;
- The Client should commission the preparation and submission of an updated RWMP as part of the construction tendering process;
- The Client should ensure that the RWMP is agreed and submitted to the local authority prior to commencement of works on site; and
- The Client should request the end-of-project RWMP from the Contractor.

3.2 Role of the Client Advisory Team

The Client Advisory Team or Design Team is formed of consultants and engineers and are responsible for:

- Drafting and maintaining the RWMP through the design, planning and procurement phases of the project;
- Appointing a Resource Manager (RM) to track and document the design process, inform the Design Team and prepare the preliminary RWMP;
- Including details and estimated quantities of all projected waste streams with the support of Environmental consultants/scientists. This should also include data on waste types (e.g., waste characterisation data, contaminated land assessments, site investigation information) and prevention mechanisms (such as by-products) to illustrate the positive circular economy principles applied by the Design Team;
- Managing and valuing the demolition and construction work with the support quantity surveyors;
- Handing over of the preliminary RWMP to the selected Contractor at commencement of construction for the development of the RWMP in a similar fashion to how the safety file is handed over to the Contractor for updating and maintaining as a 'Live' document for the duration of the works; and
- Working with the Contractor as required to meet the performance targets for the project.

3.3 Role of the Contractor

The Contractor shall implement this RWMP. However, once selected they shall have major roles to fulfil (Table 3). They shall be responsible for:

- Preparing, implementing, and reviewing the (including the Construction) RWMP through demolition and construction stage (including the management of all suppliers and sub-contractors) as per the requirements of these guidelines [3];
- Identifying a designated and suitably experienced and knowledgeable Resource Manager (RM) at construction and demolition stage who will be responsible for implementing the RWMP:
- Identifying suitably permitted/licenced haulier hauliers with the appropriate waste collection permits, to be engaged to transport each of the resources / wastes off-site;
- Implementing waste management practices whereby waste/resource materials generated on site are to be segregated, reused and recycled as far as practicable;
- Providing and operating a mobile-crusher to crush concrete for reuse;
- Identifying all destinations for resources and resources taken off-site. As above, any resource that is legally a 'waste' must only be transported to an authorised waste facility;
- Clarification and implementation of any other statutory waste management obligations, which could include on-site processing;
- Full records of all resources (both wastes and other resources) should be maintained for the duration of the project (records should include waste/resource description, LoW Code where applicable and tonnage/volumes; and
- Preparing a RWMP Implementation Review Report at project handover.

Table 3: Roles & Responsibilities

Responsible Party	Responsibility	Project Stage
Client	Appointment of competent Main Contractor and Design Team. Responsible for waste management for lifespan of the project including all documentation.	Project commencement and tender award. All project stages (Design, demolition, and construction stage).
Main Contractor	Resource Waste Management Plan. Updating and implementation of RWMP. Appoint authorised waste management contractors. Appoint trained and competent Contractor.	Project Implementation. Construction Stage.

[3] Practice Guidelines for the preparation of resource & waste management plans for construction and demolition projects, EPA, 2021.

Responsible Party	Responsibility	Project Stage
Resource Manager (RM)	RWMP Implementation.	Project Implementation.
	Ensure that's the objectives of both the RWMP and the Contractor's RWMP are put in place.	Construction stage.
	Waste characterisation. Selection of techniques and design to minimize waste and to maximize recovery and recycling of waste during the project.	Project Design Phase and during project implementation.
	Maintenance of Waste Documentation for 3 years. Completion of Final Waste Management Report.	Post-construction stage.
	Educate colleagues, site staff, external contractors and suppliers about alternatives to conventional construction waste disposal.	Construction stage.
Design Team	Identification of Key Waste Streams.	Project Design Stage.
	Design to minimize waste generation in lifecycle of completed construction.	Project Design Stage.
	Adequately provide for waste management in tender documents and declare all relevant information & data.	Procurement Stage.

4.0 PROJECT RESOURCE TARGETS

Project specific resource and waste management targets for the site have not yet been set and this information should be updated for these targets once these targets have been confirmed by the Client. However, it is expected for projects of this nature that a target of 70% of waste is fully re-used, recycled, or recovered. Typical Key Performance Indicators (KPIs) that may be used to set targets include (as per EPA 2021 guidelines):

- Weight (tonnes) or Volume (m^3) of waste generated per construction value;
- Weight (tonnes) or Volume (m^3) of waste generated per construction floor area (m^2);
- Fraction of resource reused on site;
- Fraction of resource notified as by-product;
- Fraction of waste segregated at source before being sent off-site for recycling/recovery; and
- Fraction of waste recovered, fraction of waste recycled, or fraction of waste disposed.

5.0 DESIGN APPROACH

It is understood that the Client has considered a designing out waste approach early in the design of the overall Project by establishing the potential for any reusable site assets such as soils and other materials. The Client has considered the following:

- Re-use of topsoil and subsoil for screening berms or future landscaping;
- Re-use of topsoil, subsoil overburden and interburden soil materials for restoration;
- Re-use of inert material from demolition for capping for site roads and compounds;
- Re-use of inert materials used to infill crown-holes and fissures;
- Optimum recovery of assets/resource on site; and
- Assessing site levels, design slopes, ground conditions and material balance to minimise excavations.

The design proposal is deemed to provide substantial economic savings and provides a high level of sustainability through design that incorporates waste prevention, re-use, and recycling of resources on Site.

Where possible, materials arising from demolition that are suitable for re-use will be stored in the stockpile yard, where it is readily available for capping site roads and compounds. A low volume of inert demolition material is expected to be gained from the proposed demolition works in the site development works stage and is expected to be put to re-use immediately in the construction of site access roads and compound yards.

The design approach for designing out waste, re-use, recycling, green procurement, offsite construction, materials optimization and design for flexibility and deconstruction are discussed below.

5.1 Reuse and Recycling

The Contractor will be obliged to implement Saint-Gobain Contractor Environmental Procedures which is presented in the Saint-Gobain Gyproc / Isover Contractor's Safety and Environmental Handbook and any other Site relevant IE License or Planning Conditions.

The Saint-Gobain Gyproc / Isover Contractor's Safety and Environmental Handbook is provided in Appendix C.

All residual resources legally classified as a 'waste' taken from site will be sent to suitably authorised waste facilities for disposal or recovery.

5.1.1 Construction Stage – Enabling Works

Significant construction and operational wastes are expected to be generated during the construction stage – enabling works.

The bituminous surfacing from the R179 footprint of the Tunnel and the tie-ins at either end of the Temporary Road Diversion will be removed from site and transported off-site to a licensed facility for reuse, recovery and/or recycling. Similarly, the removal of the bituminous surfacing from the Temporary Diversion Road when no longer required will generate waste volumes. The capping rock fill layers will be available for re-sue in the works for the construction of site access roads and compound yards.

The excavated soil materials from the footprint of the Temporary Diversion Road and the Cut-and-Cover Tunnel will be available for re-use in the works for the construction of the screening berm or placed for restoration in the Knocknacran Pit.

Scraps and offcuts from the construction items (fencing, pipes and geosynthetics) for the Temporary Diversion Road and the Cut-and-Cover Tunnel will be collected and segregated at the work areas by the Contractor and transported off-site to suitably authorised waste facilities for reuse, recovery and/or recycling.

Maintenance of construction plant is expected to be undertaken within the Site by the Contractor and all maintenance wastes, including lubricants, shall be handled, stored and disposed of to suitably authorised waste facilities by the Contractor.

5.1.2 Site Development Works Stage

A level of construction and operational wastes are expected to be generated during the site development works stage.

Scraps and offcuts from the construction items (fencing, pipes and geosynthetics) for the Contractor's Compound, the new Site Entrances, the Screening Berm and Security Fencing will be collected and segregated at the work areas by the Contractor and transported off-site to suitably authorised waste facilities for reuse, recovery and/or recycling.

Scraps and offcuts from the construction items relating to upgrades to the Knocknacran Processing Plant and the Covered Conveyor will be collected and segregated at the work areas by the Contractor or internally transported to the designated SGMI internal waste transfer locations, as required, and subsequently transported off-site to suitably authorised waste facilities for reuse, recovery and/or recycling.

Demolition wastes will be generated by the demolition of one residential house and three unoccupied houses (with sheds) located on the Site (see Section 5.2 below). The waste streams will be collected and segregated by the Contractor and inert material suitable for re-use in the works shall be stockpiled or hauled directly for placement. Other materials transported off-site to suitably authorised waste facilities for reuse, recovery and/or recycling.

Maintenance of construction plant is expected to be undertaken within the Site by the Contractor and all maintenance wastes, including lubricants, shall be handled, stored and disposed of to suitably authorised waste facilities by the Contractor.

5.1.3 Mine Operations Stage

Limited construction and operational wastes are expected to be generated during the mine operations stage.

Maintenance of construction plant is expected to be undertaken within the Site by the Contractor and all maintenance wastes, including lubricants, shall be handled, stored and disposed of to suitably authorised waste facilities by the Contractor.

5.2 Demolition

A Refurbishment & Demolition Asbestos Survey has been conducted for the houses scheduled for demolition in order to ascertain the presence of asbestos based materials, identify any other potentially hazardous materials and to provide a preliminary assessment of other materials present.

Asbestos has been confirmed in three of the structures; in insulation board, slate strips on gables, gaskets, pipe and cowl, roof sheeting and gutter. A specialist asbestos contractor will be engaged to remove this material during the demolition works.

Salvage of items such as exterior brickwork on the structures will be implemented where possible. If re-use is possible of this material and the material is inert, then this will be implemented rather than re-use capping for site access roads or compound yards.

A specialist demolition waste Contractor will also be appointed to oversee the removal, collection and segregation waste streams on the site and their appropriate and authorised removal from Site during demolition works.

Inert materials comprising concrete, blockwork and rock fill will be separated and stockpiled for re-use as capping for site access roads and compound yards.

Timber will be segregated into separate skips onsite, other wastes (e.g., bulky waste) will be placed in a combined skip for handling at an authorised waste facility.

Valuable materials such as cut building stone and natural roofing slates will be removed carefully to avoid damage and make available for re-use.

5.3 Design for Green Procurement

The Contractor will discuss design solutions, encourage innovation in supply chain and recognize sustainable approaches. The contractor shall also discuss options for packaging reduction with subcontractors/suppliers using measures such as 'Just-in-Time' delivery and use ordering procedures that avoid excessive waste.

5.4 Design for Off-Site Construction

A limited number of components for this development will be manufactured Off-Site i.e., precast concrete elements for the Temporary Diversion Road and Tunnel. This will reduce offcuts of these elements on-site reducing waste.

It will also curb the likelihood of on-site breakages as constructed units are often more resistant to damage. The manufacturers also produce construction sets that are made to measure with components numbered for assembly, eliminating over-ordering, and wasting of materials.

5.5 Design for Materials Optimisation during Construction

As explained above, materials are already proposed to be optimized. This avoids ordering a very large amount of virgin aggregate and concrete for the same purpose which is an efficient use of material and aligns with the EPA's Circular Economy Programme.

6.0 RESOURCE AND WASTE MANAGEMENT

The Main Contractor(s) will be responsible for defining and maintaining resource management across the Site during the various construction, site development, demolition and operation stages.

The Main Contractor(s) shall be responsible for the segregation of all waste arising from the work except where otherwise agreed. Segregation must be done in accordance with legislation and SGMI's procedures for the types of waste produced. The prevention, reuse, recycling, recovery and disposal of waste will be performed as the construction phase progress and the materials are generated.

The off-site handling of waste generated by this project are subject to the required statutory authorizations under the Waste Management Act, there is also a requirement that the management of waste complies with the Waste Hierarchy. This hierarchy outlines that waste prevention and minimization are the first priority in managing wastes, followed by waste reuse and recycling with disposal being considered as a last resort (Figure 1). The EU Waste Directive (2008/98/EC) also mandates that hazardous waste generation should be avoided or at least minimized.

6.1 Waste Prevention and Minimisation

The following waste minimization measures will be implemented during the course of the works:

On site segregation of all waste/resource materials arising during the various construction, site development works, demolition and mine operation stages to the appropriate categories are assessed to include (non-exhaustive list):

- Concrete / Concrete Blocks / Plaster;
- Bricks;
- Tiles and Ceramics;

- Timber / Wood;
- Glass;
- Plastic including wrapping and packaging;
- Bituminous mixtures containing coal tar;
- Scrap metals;
- Cables;
- Insulation material;
- Mixed C&D waste;
- Construction materials containing asbestos;
- Scrap and offcuts of geosynthetic materials (geotextiles, bituminous membranes, composite drainage products);
- Cardboard and other packaging;
- Paper;
- Uncontaminated clean cloths and rags used in various site activities;
- Mixed municipal general wastes;
- Damaged materials;
- Oils, fuels and lubricants from machinery and equipment *;
- Oily and contaminated rags from vehicle and plant maintenance *;
- Batteries *;
- Tyres;
- Sewage Waste from onsite portable toilets; and
- Mixed municipal general wastes.

All waste assessed by the Resource Manager as ‘not suitable for reuse’ will be stored in skips or other suitable receptacles in a designated area of the site, to prevent cross contamination between waste streams.

Uncontaminated excavated material (soil, stone, brick concrete blocks, concrete etc.) will be segregated, stockpiled and re-used on site in preference to importation of clean fill, where possible.

All soil materials identified for re-use will be subject to testing and quality assurance controls to be protective of the environment.

Where possible, the Contractor will co-ordinate with the Client to ensure that all waste leaving site will be recycled or recovered.

6.2 Waste / Resource Generation & Quantification

Quantities of construction resource/waste materials may vary depending on methodologies of construction. Therefore, the difficulty of estimating resource/waste quantities is noted which depends on the approach of the appointed Main Contractor. During construction these quantities may be subject to change.

This RWMP incorporates the provisions to promote sustainable waste management in line with the waste hierarchy and focus on integrating good site management practices to ensure efficiency and reduce potential for any other negative environmental effects.

This project comprises of demolition and construction activities and the main wastes and resources generated by the project are listed below in Table 4. Estimated quantities are also provided and should be updated as the tender packages are prepared and the project advances.

Table 4: Construction Waste / Resource Arisings

Waste Material	LoW Code	Anticipated tonnages for off-site disposal *
Concrete / Concrete Blocks / Plaster	17 01 01	≈ 600 tonnes generated (total) < 10 tonnes estimated for off-site disposal
Bricks	17 01 02	≈ 30 tonnes generated (total) < 1 tonne estimated for off-site disposal
Tiles and Ceramics	17 01 03	< 1 tonne (total)
Timber / Wood	17 02 01	< 1 tonne
Glass	17 02 02	< 1 tonne
Plastic including wrapping and packaging;	17 02 03	< 1 tonne
Bituminous Mixtures	17 03 02	≈ 600 tonnes generated (total R179) ≈ 3,000 tonnes generated (total Temporary Diversion Road)
Scrap metal	17 04 01 17 04 02 17 04 05 17 04 07	< 1 tonne
Cables	17 04 11	< 1 tonne
Insulation Material	17 06 04	< 2 tonnes (total)
Mixed C&D Waste	17 09 04	< 10 tonnes (total)
Scrap and offcuts from geosynthetic materials	17 09 04	< 1 tonne
Cardboard, Paper and other packaging	15 01 01	< 1 tonne
Uncontaminated clean cloths and rags used in various site activities	15 02 03	< 1 tonne
Damaged materials	17 09 04	< 1 tonne
Oils, fuels and lubricants from machinery and equipment	13 02 08*	< 10 tonnes
Absorbents, filter materials (including oil filters not otherwise specified), wiping	15 02 02*	< 2 tonnes

Waste Material	LoW Code	Anticipated tonnages for off-site disposal *
cloths, protective clothing contaminated by hazardous substances		
Batteries – lead acid	16 06 01*	< 2 tonnes
Tyres	16 01 03	< 5 tonnes
Sewage Waste from onsite portable toilets	20 03 04	< 10 tonnes
Mixed municipal general wastes	20 03 01	< 20 tonnes
* The quantity waste generated will be dependent on Main Contractor work practices and methods. These quantities are based on a review of Refurbishment & Demolition Asbestos Survey Report and the plans for the houses scheduled for demolition and previous construction and operational stages of the Knocknacran Pit.		

6.3 Waste Management Options

6.3.1 Waste Management

The Main Contractor(s) will be responsible for maintaining waste storage areas within the respective construction areas so that they are secured, and waste materials are appropriately organised. The relocation of these areas will be planned appropriately by SGMI, and the Main Contractor as works progress.

The Main Contractor will implement SGMI waste management policies whereby materials generated on-site are to be segregated as far as practicable.

6.3.2 Waste Disposal and Collection

The Main Contractor(s) will be responsible for the removal of wastes from the Site at the various construction, site development works, demolition and mine operation stages.

The Main Contractor(s) will ensure that all waste which arises and requires removal from the Site will be removed by an authorized waste contractor. These waste contractors will be required to hold a valid waste collection permit. Furthermore, all waste materials which are required to be disposed off-site will be reused, recycled, recovered or disposed of at an appropriate facility which holds appropriate registration, permit or licence. Up-to-date copies of the relevant collection permits, and facility registrations, permits and licences will be retained on file by Main Contractor(s) and SGMI (as the dispatcher of waste).

All materials being transferred from the facility, whether for recycling or disposal, will be subject to a documented tracking system which can be verified and validated. This information will include the below at a minimum:

- Date and time of removal;
- Waste type and description;
- EWC Code;
- Volume / tonnage of waste;
- Name of waste collection contractor;
- Waste collection contractor's permit number;
- Waste collection receipt;

- Vehicle registration number;
- Driver's details;
- Destination of waste; and
- Waste Permit / Licence number of destination facility.

Other written records of the waste arisings will be maintained as per Section 7.0 of this RWMP.

6.4 Management of Wastes & Resources

6.4.1 Resources / Waste

Type of materials/wastes identified below are based on an assessment for development of this nature, scale and timeline. Estimated of waste quantities are provided in Table 4. Waste amounts will also be dependent on whether construction components are arriving on Site prefabricated or require fabrication with raw materials on site which results in higher residual wastes being generated. These quantities will be tracked and assessed for improvement opportunities throughout the course of the build.

6.5 Management of Stockpiles

Segregation and storage of wastes generated during works will be segregated and temporarily stored onsite (pending removal or for re-use on site) in accordance with a pre-determined segregation and storage strategy. While waste classification and acceptance at a waste facility is pending, materials for recovery / disposal shall be stockpiled as follows:

- Stockpile number;
- Origin (i.e., location and depth of excavation);
- Approximate volume of stockpile;
- Date of creation;
- Description and Classification of material;
- Date sampled;
- Date removed from site;
- Disposal / recovery destination; and
- Photographed.

Waste storage, fuel storage and stockpiling and movement are to be undertaken with a view to protecting any essential services (electricity, water, etc.) and to protect any existing surface and new water drains. Non-waste soil stockpiles will be stored on site, in such a manner as to:

- Prevent environmental pollution, minimize noise generation and implement dust / odour control measures, as may be required); and
- Maximise waste segregation minimise potential cross contamination of waste streams and facilitate subsequent re-use, recycling and recovery.

6.5.1 Metals

Scrap Metals will be segregated in appropriate skips or other receptacles in accordance with the authorized waste collectors' requirements. The Main Contractor shall liaise with SGMI to inform the metal waste contractor as to the segregation streams relevant to their site. The majority of metal waste will be recycled.

6.5.2 Geosynthetic Materials

Scrap, damaged and offcuts from geosynthetic materials that are not of sufficient size for reuse, will be collected at work area and placed in the appropriate recycling area at the Main Contractor Compound.

It is anticipated that the majority of limited wastes generated will be suitable for reuse, recovery or recycling and will therefore be segregated to facilitate the reuse, recovery and/or recycling, wherever possible.

6.5.3 Waste Wood

Uncontaminated timber and wood products will be segregated accordingly. The Main Contractor shall ensure that appropriate segregation is maintained to exclude materials containing glues, preservatives, paints, varnishes, etc. waste timber production will vary during the course of the proposed Development.

6.5.4 Plastic

Appropriate waste and 'off-cut' construction plastic (hard plastic) will be segregated appropriately in accordance with the waste contractor's requirements and recycled appropriately. Soft plastics and plastic wrapping shall be segregated for offsite recycling.

6.5.5 Wastes from Construction Site Offices and Staff

During the course of the construction phase waste will be generated from employees on the site. These will encompass general refuse, mixed dry recyclables, food wastes and wastes from onsite porta-loos.

These wastes will be managed by appropriately licensed and specialized waste contractors. These wastes will be collected and stored separately from the C&D wastes generated through construction activities.

6.5.6 Other Wastes

As required and depending on the stage of the proposed Development, the Main Contractor will determine if other waste streams need appropriate segregation. These streams may include glass, paper, and cardboard.

These needs will be periodically assessed and evaluated by the Main Contractor. These waste streams will be segregated for reuse, recovery and/or recycling.

6.5.7 Hazardous Wastes

The management of all hazardous waste streams will be coordinated in conjunction with the Main Contractor's Site Health and Safety Manager. Hazardous waste arisings are not largely anticipated other than the asbestos sources identified in the houses scheduled for demolition. However, the appropriate waste management practices will be employed.

Hazardous wastes (anticipated to be limited to, waste oils/lubricants, oily rags and batteries) will be segregated securely, collected by an approved licensed waste collection permit holder and disposed of / recycled by an authorized waste license or waste facility permit holder.

6.6 Costs of Waste Management

Re-iterating the Waste Hierarchy (Figure 1) it is clear that cost of waste management reflects this top-down pyramid. Therefore incentivising this Development to first prevent waste from being created as is outlined above will reduce the cost of waste management and overall construction costs.

Reuse of material is also beneficial to cost, as virgin material that is manufactured or mined and subsequently transported to Site may well be in excess of reuse costs. This Development will reuse appropriate, non-hazardous waste topsoil for landscaping purposes.

Scrap metal, wood, plastics, and other wastes will be assessed by the main contractor/resource manager. Metal salvage waste costs can be offset by rebates. Acceptable plastic and wood will also be from the site.

Disposal costs for landfill are typically (est.) €150.00 per tonne including the landfill levy (*Waste Management (Landfill Levy) Regulations 2015 (S.I. No. 189 of 2015)*). This price is non-inclusive of skip hire and collection costs which can widely vary. Thus, this Development will endeavour to accord with the Waste Hierarchy to prevent, reuse and recycle before disposal of waste where appropriate.

7.0 SITE MANAGEMENT

Site Management will ultimately be the responsibility of the Main Contractor(s) for the various stages of the proposed Development.

Control of the Site including waste management will be transferred to the Main Contractor at commencement of the various stages / phases in the life of the proposed Development.

The Design Team or SGMI may set recommended tasks for the Main Contractor to follow in the works specification.

7.1 Resource Manager Responsibility

- Agree and revise as necessary any commitments or targets included in the RWMP developed at design/planning with SGMI for acceptance and adoption in the RWMP for construction;
- Allocate responsibility for resource management to one or more individuals of sufficient seniority to put the relevant procedures into practice. Nominate a suitably qualified Resource Manager (RM) with expertise in waste and resource management to implement the RWMP;
- The RM will be required to update the plan as required to reflect new resource streams, work practices, suppliers or resource management options as required;
- The RM will be responsible for delivery of all training and induction in relation to resource management;
- The RM will be responsible for ensuring site infrastructure is supplied and maintained as fit for purpose;
- The RM will be responsible for conducting all relevant internal site audits including audits of subcontractor operations;
- The RM will be available as required for any Local Authority or other audits undertaken;
- The RM will be responsible for maintaining site records for waste and resources exported offsite and ensuring these are undertaken by suitably authorised operators to suitably authorised sites; and
- The RM will be engaged with relevant individuals who have access to ordering and stock-control records to ensure supply chain initiatives have been adopted.

7.2 Authorised Waste Collection & Receiving Facilities

All waste removed from site must be carried out by a waste contractor with a current waste collection permit for the waste codes to be collected.

All residual resources legally classified as a ‘waste’ taken from site must be sent to suitably authorised waste facilities for disposal or recovery. The following authorisations are applicable:

- Certificate of Registration (CoR) from the Local Authority (issued to private sector);
- Waste Facility Permit (WFP) from the Local Authority; and

- Licenced Landfill.

7.3 Record Keeping and Reporting

Prior to commencement on site the Main Contractor(s) will update the RWMP with the authorized waste contractors' details for each waste type (name, permit numbers, authorized waste sites etc.). Waste handling and all documentation will be monitored in accordance with the procedures outlined.

The Site Manager will maintain a copy of all waste collection permits. A waste docket must be issued to the collector. If being transported to another site, a copy of the waste permit or EPA Waste License for that site must be provided to SGMI (as the dispatcher of waste) and also copied to the Main Contractor.

As well as a waste collection docket, a receipt from the destination of the material will be kept as part of the on-site waste management records. All information will be entered in a waste management system to be maintained on-site.

Note: *Waste contractors have not been appointed at this stage of the project and will likely be procured, coordinated and managed by the Main Contractor(s) during the various stages of the life of the proposed Development.*

7.4 Waste Training

Hard copies of waste management plans will be maintained on-site in the main project office, (and in other applicable locations) so that it is available to all relevant personnel on site.

Arrangements will be put in place for all project personnel and sub-contractors to be instructed on the objectives of waste plans and materials management. These instructions shall be incorporated into the project induction and refreshed during regular toolbox talks throughout the project.

The Resource Manager (RM) shall ensure that all personnel are aware of their specific responsibilities under the plan, including appropriate storage and handling of waste materials, reusable materials and recyclables.

7.5 Procedures for Audits

The waste audit procedures represent a systematic study of the site's waste management practices. The purpose of the waste auditing is to identify any problems with the site's waste procedures and also the benefits of prevention and minimization that is in place.

The audit will be a 'self-audit' process carried out by the Resource Manager and/or appointed team member/contractor. The RM will create an Audit Plan and identify the appropriate frequency at which the audits are to be conducted over the various stages of the proposed Development. The waste audit will document details of the quantity, type and composition of all waste removed from the site.

The audit process will identify appropriate performance and waste output or re-use targets. As appropriate, corrective actions will be identified if targets have not been met.

The audit findings will highlight any corrective actions that may need to be taken in relation to waste management procedures or site practices. These corrective actions will be tracked in order to identify root- causes as appropriate.

7.6 Communication with Local Authority and Other Stakeholders

The results of the audits will be documented in a periodic summary report which will outline the types, quantities of waste arisings and their final treatment method. These audit reports should be retained and where requested, be sent to the appropriate persons in the local authority's Waste or Environment Department where requested.

8.0 REFERENCES

- Connaught-Ulster Waste Management Plan (CUWMP), May 2015.
- DECC 2021, Department of the Environment, Climate and Communications, Waste Action Plan for a Circular Economy, 2020, last updated on 16 September 2021.
- DEHLG 2006, Department of the Environment, Heritage and Local Government, 2006. Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects.
- EPA 2021, Environmental Protection Agency (EPA), Best practice guidelines for the preparation of resource & waste management plans for construction & demolition projects, 2021.
- Monaghan County Development Plan, 2019 – 2025, March 2019.

Signature Page

Golder-WSP Ireland Consulting Ltd

Rab Kassie - Sheeran
Environmental Consultant

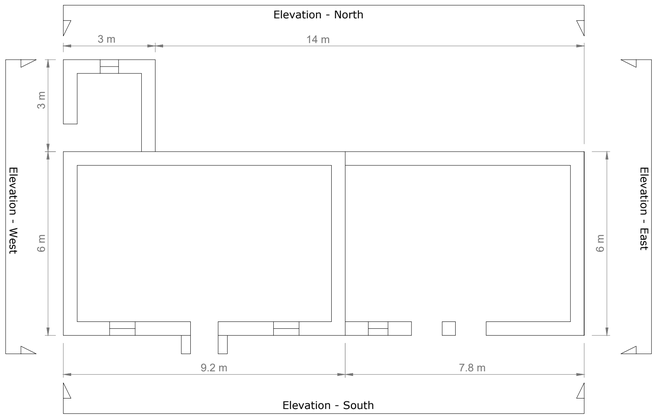
Brian Keenan
Associate Director, Geotechnical Engineer

RK/BK/ld

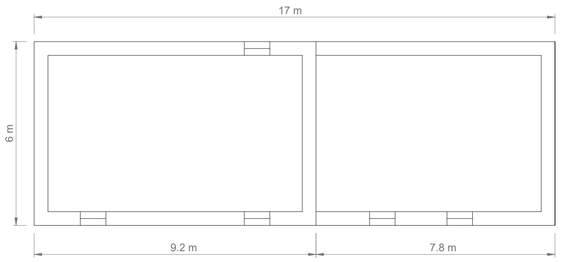
Registered in Ireland
Registration No.302231
At Trinity House, Charleston Road, Ranelagh, Dublin 6 D06C8X4, Ireland
VAT No. 6322231R

APPENDIX A

House Drawings



GROUND FLOOR PLAN



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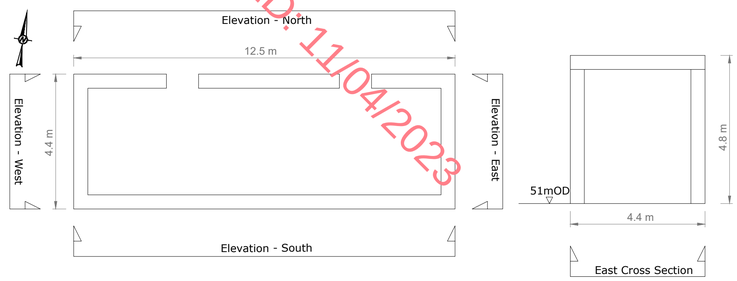

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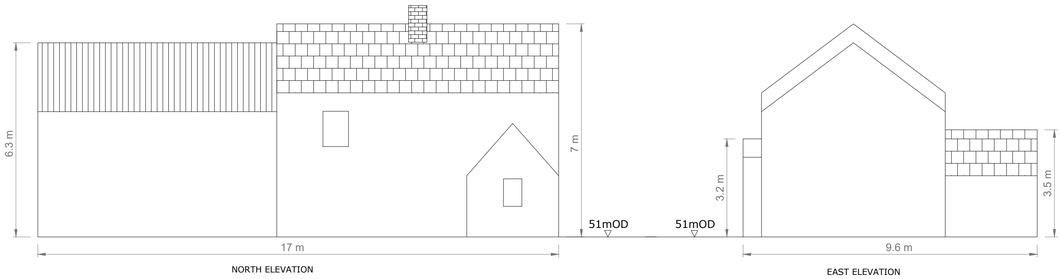
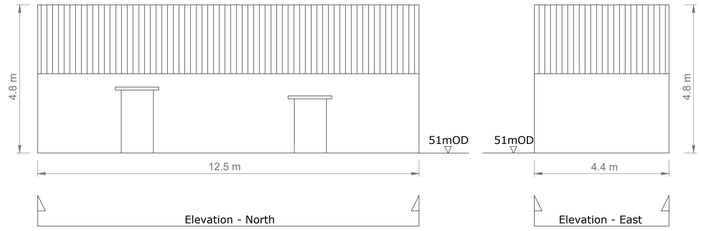
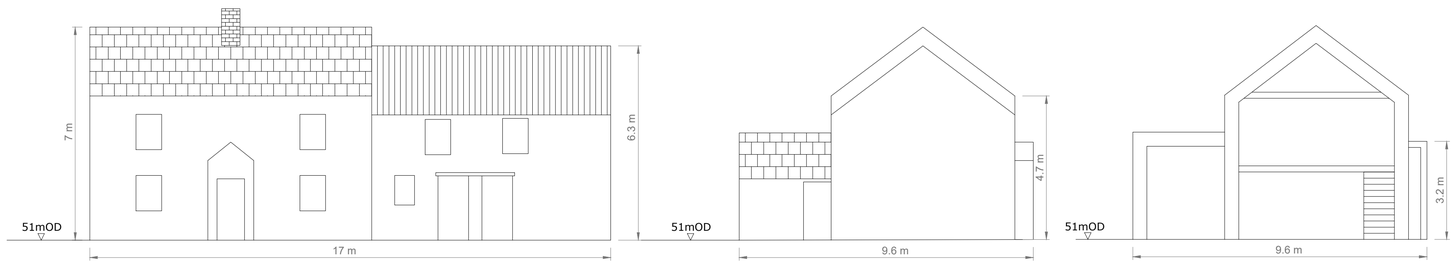


NORTH ELEVATION

EAST ELEVATION

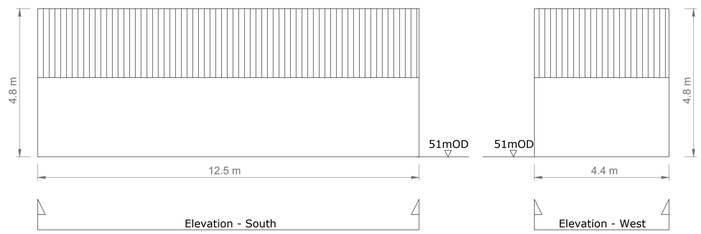




SOUTH ELEVATION

WEST ELEVATION

WEST CROSS SECTION



NOTES:

LEVELS ARE IN METRES
& TO O.S. DATUM.

DIMENSIONS ARE IN METRES.

CLIENT

SAINT-GOBAIN MINING (IRELAND) LTD.

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-Jan
PREPARED	JD
DESIGN	JD
REVIEW	BB
APPROVED	BB

PROJECT

KNOCKNACRAN WEST OPEN-CAST MINE AND COMMUNITY SPORTS COMPLEX

TITLE

EXISTING HOUSE NO. 1 (UNOCCUPIED) AND SHED - TO BE DEMOLISHED

PROJECT No.	DRAWING No.	Rev.	SCALE
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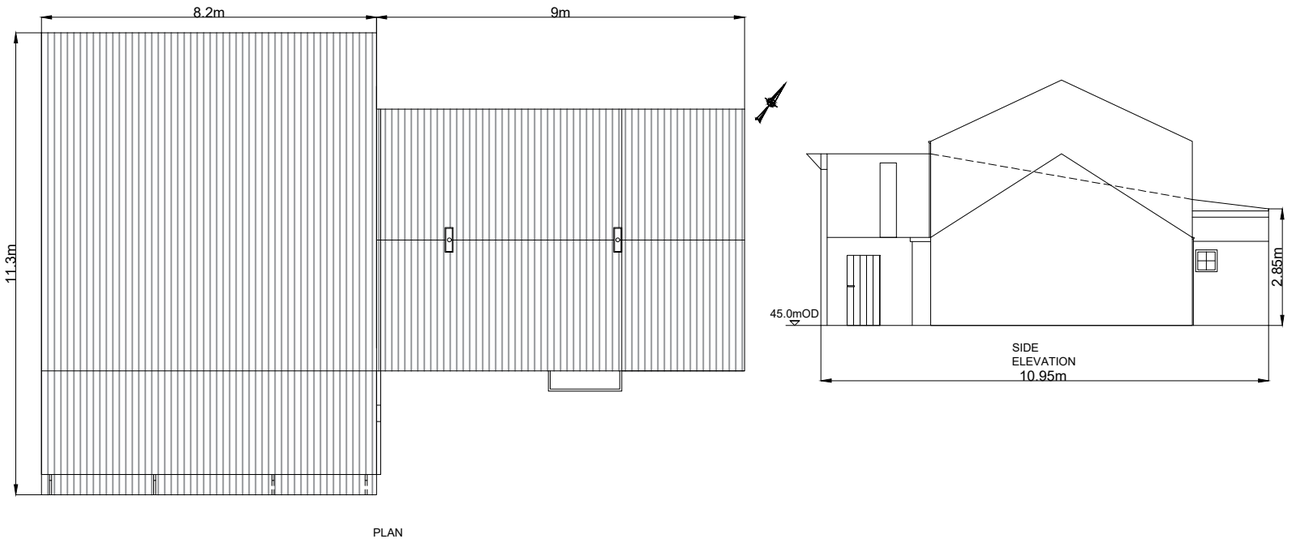
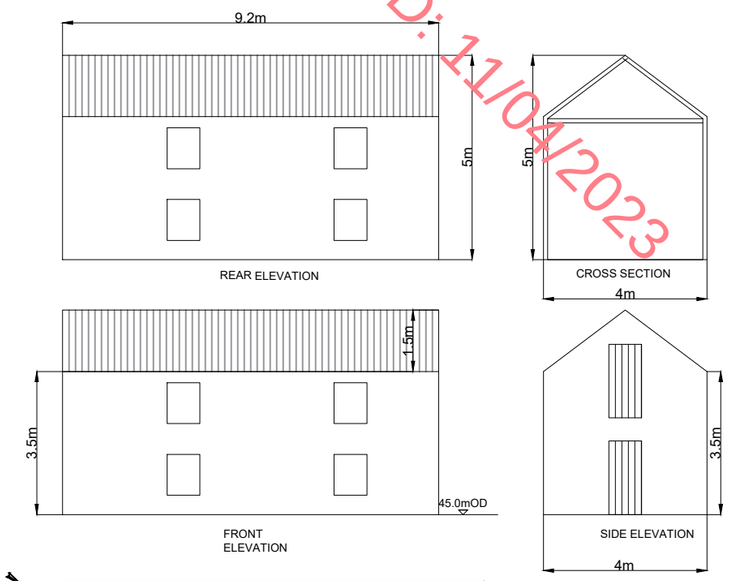
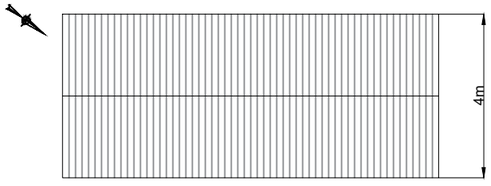
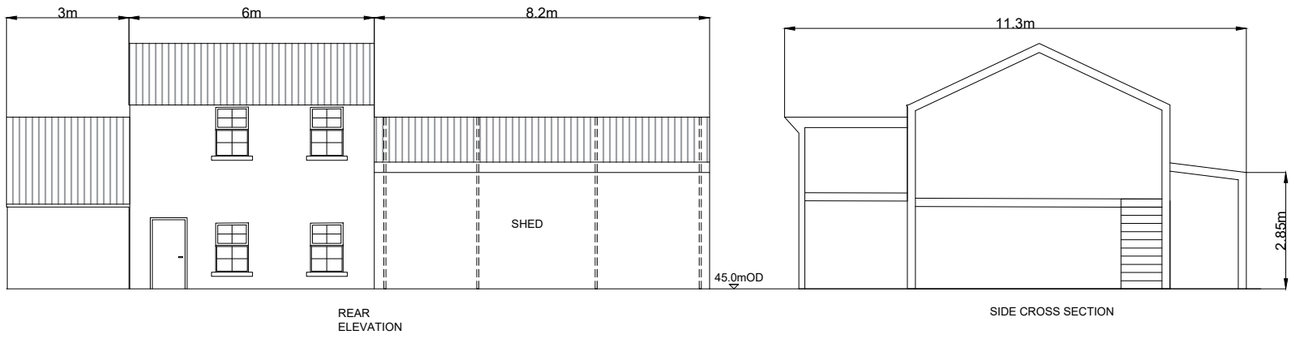






SHED DETAILS



UNOCCUPIED HOUSE NO. 2 DETAILS

NOTES:

LEVELS ARE IN METRES
& TO O.S. DATUM.

DIMENSIONS ARE IN METRES.

CLIENT

SAINT-GOBAIN MINING (IRELAND) LTD.

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-Jan
PREPARED	JD
DESIGN	JD
REVIEW	BB
APPROVED	BB

PROJECT

KNOCKNACRAN WEST OPEN-CAST MINE AND COMMUNITY SPORTS COMPLEX

TITLE

EXISTING HOUSE NO. 2 (UNOCCUPIED) AND SHEDS - TO BE DEMOLISHED

PROJECT No.	DRAWING No.	Rev.	SCALE
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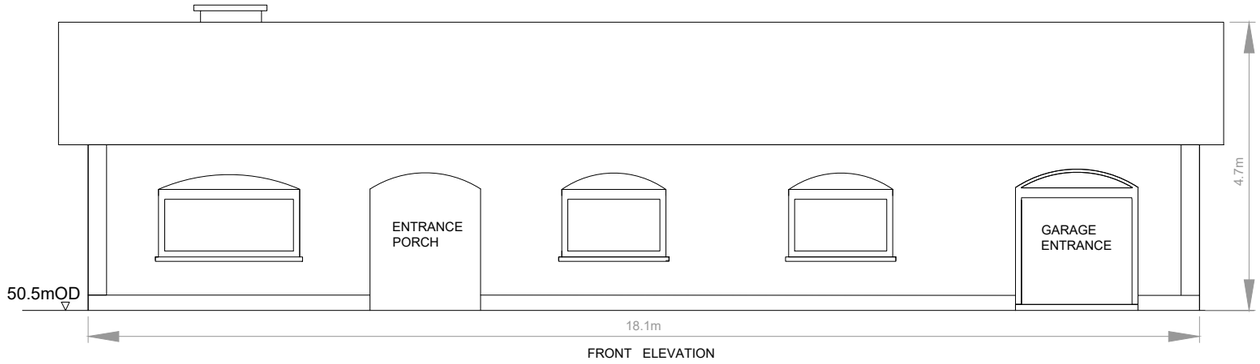

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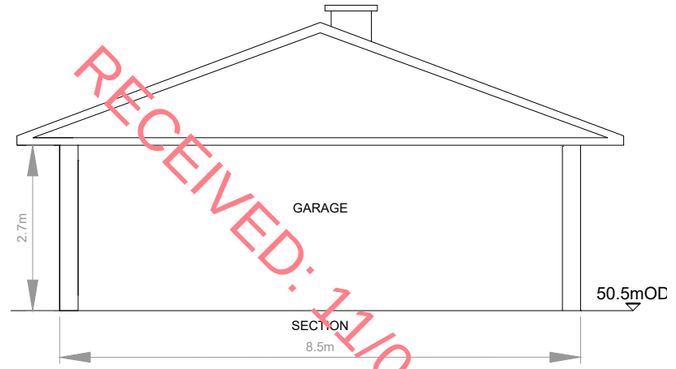

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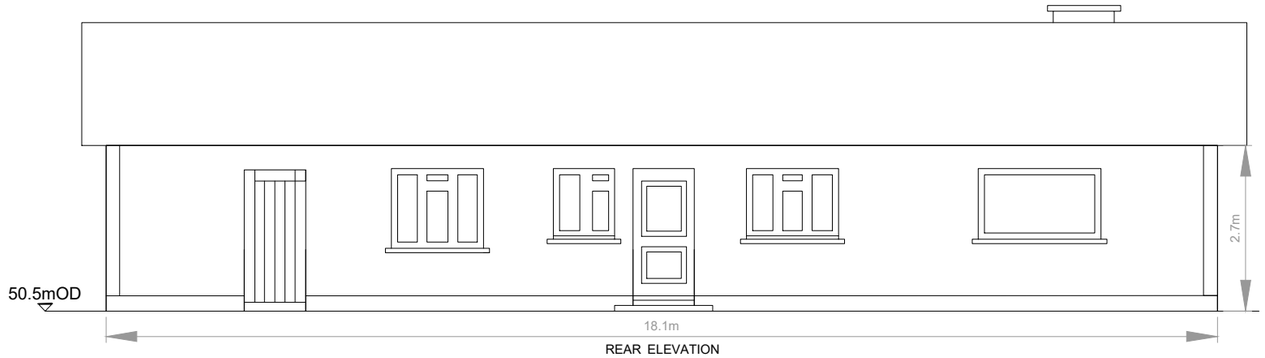

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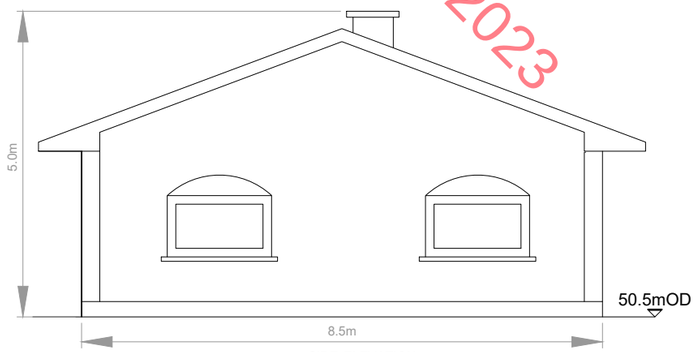
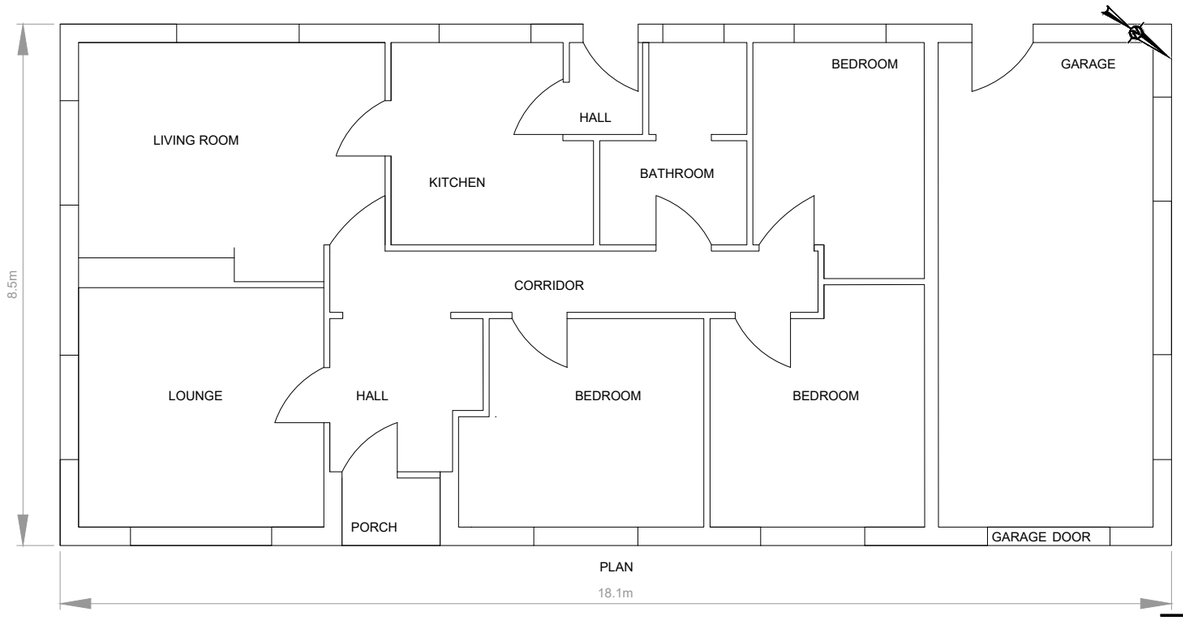
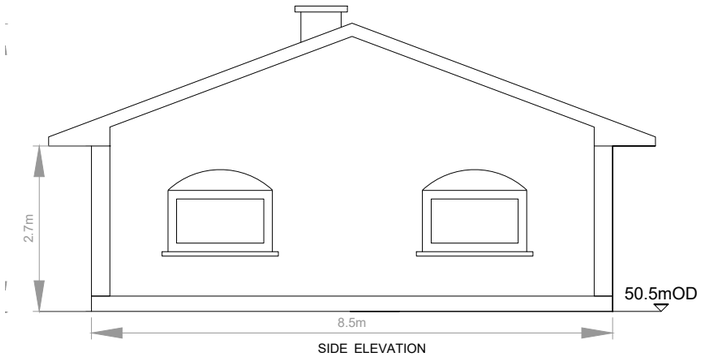


SIDE ELEVATION



PLAN



SIDE ELEVATION

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1:100

NOTES:

LEVELS ARE IN METRES
& TO O.S. DATUM.

DIMENSIONS ARE IN METRES.

CLIENT

SAINT-GOBAIN MINING (IRELAND) LTD.

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-Jan
PREPARED	HMc
DESIGN	HMc
REVIEW	BB
APPROVED	BB

PROJECT

KNOCKNACRAN WEST OPEN-CAST MINE AND COMMUNITY SPORTS COMPLEX

TITLE

EXISTING HOUSE NO. 3 - TO BE DEMOLISHED

PROJECT No.	DRAWING No.	Rev.	SCALE
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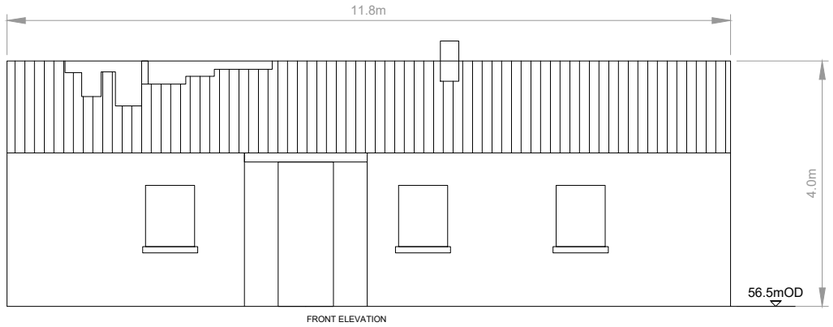

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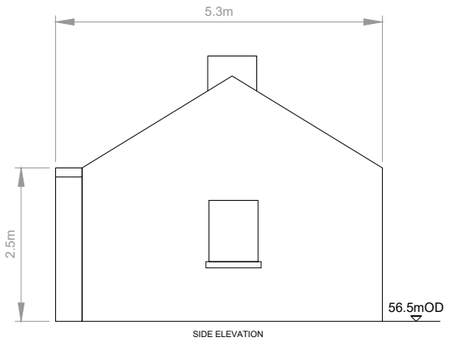

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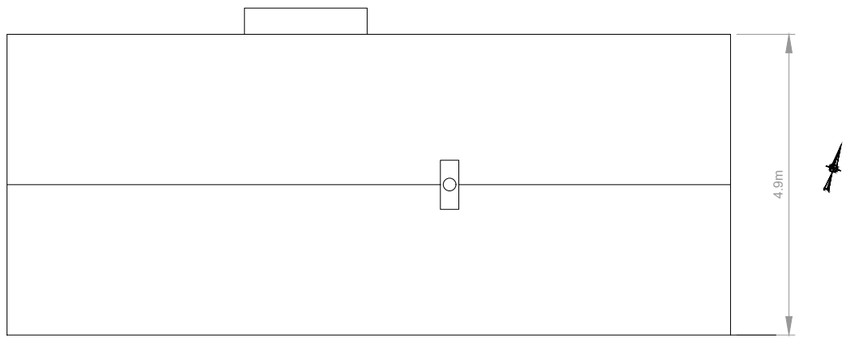

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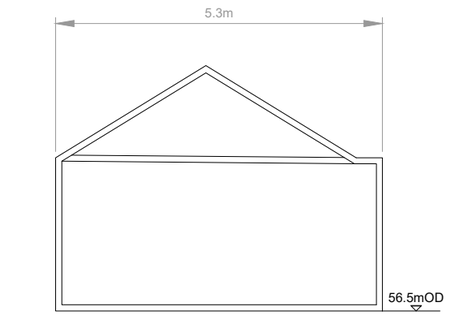

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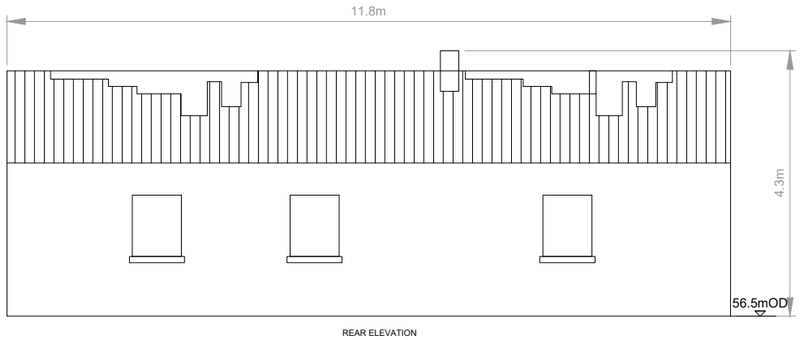

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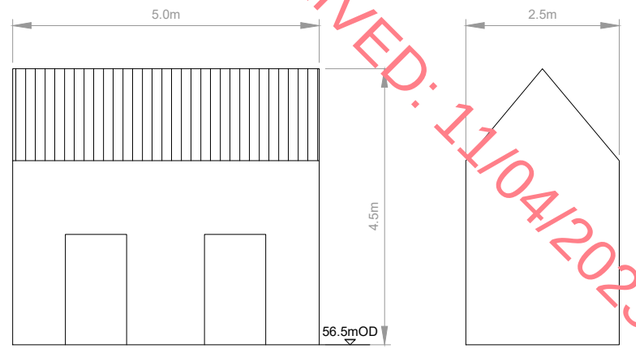
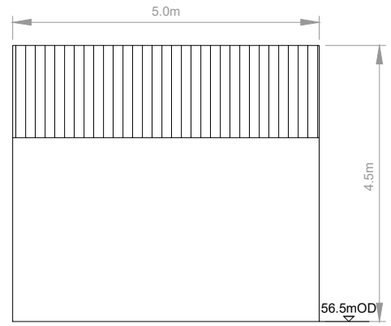


FRONT ELEVATION

SIDE ELEVATION

PLAN



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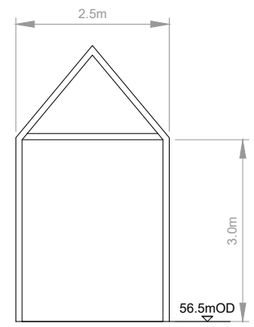

SIDE SECTION

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NOTES:

LEVELS ARE IN METRES
& TO O.S. DATUM.

DIMENSIONS ARE IN METRES.

CLIENT

SAINT-GOBAIN MINING (IRELAND) LTD.

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-Jan
PREPARED	JD
DESIGN	JD
REVIEW	BB
APPROVED	BB

PROJECT

KNOCKNACRAN WEST OPEN-CAST MINE AND COMMUNITY SPORTS COMPLEX

TITLE

EXISTING HOUSE NO. 4 (UNOCCUPIED) AND SHED - TO BE DEMOLISHED

PROJECT No.	DRAWING No.	Rev.	SCALE
19121210	34	A	1:100 A3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3

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APPENDIX B

Refurbishment & Demolition Asbestos Survey

ABOUT SAFETY LTD.

ASBESTOS | LEAD BASED PAINT | MOULD | SILICA DUST | HAZMAT
SURVEYING & TESTING
RISK MANAGEMENT | PROJECT MANAGEMENT

Refurbishment & Demolition Asbestos Survey

Site Address	**Knocknacran West Building Surveys** **Magheracloone** **Monaghan** **Co. Monaghan**
Site Location	
Client	**Name:** **WSP Golder** **Town Centre House** **Dublin Road, Naas** **Co. Kildare** **W91 TD0P** **Contact:** **Brian Keenan**
Survey Dates	**16th August, 2022**
Issue Date	**17th August, 2022**
Surveyor(s)	**John Kelleher, About Safety Ltd.**

Table of Contents

Executive Summary

Ref:	Confirmed Asbestos [Requires removal and disposal as asbestos waste by a competent or specialist asbestos contractor prior to work likely to cause disturbance.]
1, 4	House No. 3. Asbestos containing slate strips on the gable ends over the facia boards on the main house and the outhouse to the rear. 28 linear meters approximately.
2	House No. 3. Asbestos insulation board to the ceiling in the garage. Unsealed. Removal and disposal as asbestos waste by a ***SPECIALIST*** asbestos contractor under fully controlled conditions prior to work likely to cause disturbance. Statutory notification of 14 days is required to be given by the appointed specialist asbestos contractor. 28 square meters approximately.
10	House No. 2. Flat asbestos containing gaskets to the brass fittings on the copper cylinder. Small amount.
14	House No. 2. Asbestos containing soil pipe and cowl to the wall on the bathroom extension. 3 Linear meters approximately.
24, 25, 28	House No. 4. Single skin asbestos cement corrugated roof sheeting and gutter. Circa 60 square meters and 12 linear meters of gutter. Associated debris from damage internally and externally around walls.

Ref:	Presumed/Strongly Presumed Asbestos [Requires dismantling and/or investigation by the competent or specialist asbestos contractor prior to work likely to cause disturbance.]
3	House No. 3. Integral areas of the external cased in boiler are presumed to contain asbestos gaskets.
	House No. 3. Internal areas of the residence were not accessible and will require further investigation. The owner confirmed that some ceilings have textured coatings which were known to contain asbestos.
15	House No. 2. Integral areas of the external cased in boiler are presumed to contain asbestos gaskets.

NB: The extent of asbestos containing materials identified in this report are only approximate and should not be relied upon as a basis for tendering removal works. Contractors tendering works are expected to satisfy themselves by site visit and measurement the exact nature and extent of any works which is proposed.

Introduction

About Safety Ltd. was instructed to carry out a Refurbishment and Demolition Asbestos Survey of the above property. The survey and sampling was carried out taking cognizance of the requirements of the Health and Safety Executive (UK) document, *HSG 264, Asbestos: The Survey Guide.*

Objectives

The objectives of this survey were to:

To carry out a survey to ascertain the presence of asbestos based materials.
To carry out a survey to locate and describe, as far as reasonably practicable, all asbestos containing materials prior to refurbishment/demolition.
To gain access to all areas, as necessary, to determine the extent of any asbestos that may be present.
To sample and estimate the extent and volume of any asbestos materials that may be present.
To generate asbestos material assessments where the period between the survey and event is significant i.e. more that 3 months.
To produce a report identifying areas containing asbestos to be used as a basis for tendering their removal.
To instigate asbestos removal works prior to refurbishment/demolition.

Scope of Works & Site Description

General Information

Scope of Works:	**Proposed demolition of 4 properties.**
Structural Details:	**3 buildings are of original stone construction with pitched roofs. Buildings are derelict generally with limited access in some areas.** **House No. 3 is a bungalow constructed in the early 1980's and has a pitched roof with concrete tiles.**

	Coordinates
House No.1	**53.94286230043669, -6.771962921820947**
House No.2	**53.94568687917337, -6.768889575477286**
House No.3	**53.94484390780139, -6.768487530078527**
House No.4	**53.94847474377047, -6.774511389534516**

Survey Limitations

All areas accessed for proposed refurbishment works were subjected to a survey taking cognisance of the requirements of HSG 264, Asbestos: The Survey Guide. The investigation consisted of an inspection of each room and area to be impacted by the works.
No report has been made on any concealed spaces, which may exist within the fabric of the building where the extent and presence of these is not evident due to inaccessibility, lack of building drawings or insufficient knowledge of the structure of the building at the time of the survey. Original and permanent finishes or areas of the building subject to protection orders were not disturbed where requested by the client.

Inaccessible Areas: Electrical equipment such as, boiler units, water heaters, storage heaters, fuse or switch boards. Within floor or wall structures, behind wall or ceiling cladding or within blocked up chimneys. Within internal areas of fire doors unless asbestos observed from keyhole or other damaged areas. Care should always be exercised when working on any electrical equipment in particular the older styles as asbestos-containing materials may be present.

Special considerations for old boilers and plant containing asbestos gaskets:
Some old plant may have gaskets and seals which could contain asbestos. During normal maintenance operations these gaskets or seals may have to be opened, which would not normally be notifiable. If, however the gasket was in a friable condition or had to broken up for removal or examination, the work could become notifiable. An assessment would need to be made and the work notified with the H.S.A. if necessary. Dismantling of boilers and plant is a specialist task requiring specialist tools and is considered demolition.

Asbestos Refurbishment & Demolition Survey: Definition

A refurbishment and demolition survey is needed before any refurbishment or demolition works is carried out. This type of survey is used to locate and describe, as far as reasonably practicable, all ACM's in the area where the refurbishment works will take place or in the whole building if demolition is planned. The survey will be fully intrusive and involve destructive inspection, as necessary, to gain access to all areas, including those that may be difficult to reach. A refurbishment and demolition survey may also be required in other circumstances, e.g. when more intrusive and maintenance and repair work will be carried out or for plant removal and dismantling.
Where the refurbishment or demolition works may not take place for a significant period after the survey (e.g. three months), then the information required for a management survey should be obtained.

Asbestos Contaminated Soils (ACS)

The first point of contact with soil or ground contaminated with asbestos will be during site investigations and exploratory ground works. This may be defined as asbestos operative related work and applies where there is a potential for sporadic or low intensity exposure. People directly involved in these preliminary works, geotechnical engineers and ground workers, should receive formal training enabling them to work safely where asbestos could be present in the ground as a consequence of legacy use issues with the land. In principle, the general tiered approach to the assessment and management of potential risks posed by ACS is the same as that for any other contaminant. However, the unique nature of asbestos means that different methods of analysis, exposure estimation and risk estimation are required. Importantly, soil and air analysis methods need to be more detailed than those currently and commonly used to demonstrate compliance with the Asbestos Regulations.

Material Assessment

No condition assessment is normally necessary for refurbishment and demolition surveys but, where the period between survey and the event is significant, e.g. more than 3 months, then a material assessment should be conducted and interim management arrangements put in place.

Material Assessment Algorithm

In the material assessment process, the main factors influencing fiber release are given a score which can then be added together to obtain a material assessment rating. The four main parameters which determine the amount of fiber released from an ACM when subject to disturbance are:

- **Product Type**
- **Extent of damage or deterioration**
- **Surface Treatment; and**
- **Asbestos type**

Each parameter is scored between 1 and 3. A score of 1 equivalent to a low potential for fiber release, 2 = medium and 3 = high. Two parameters can also be given a nil score (equivalent to a very low potential for fiber release). The value assigned to each of the four parameters is added together to give a total score of between 2 and 12. Presumed or strongly presumed ACM's are scored as Crocidolite (i.e. score = 3) unless there is strong evidence to show otherwise.

Materials with assessment scores of 10 or more are rated as having a high potential to release fibers, if disturbed. Scores of between 7 and 9 are regarded as having a medium potential, and between 5 and 6 a low potential. Scores of 4 or less have a very low potential to release fibers.

Analytical Techniques

Asbestos Bulk Sample Analysis is conducted by using Polarised Light and Dispersion Staining Techniques. Dispersion Staining is used to describe the colour effects produced when a transparent colourless particle or fiber is immersed in a liquid having a refractive index near to that of the particle or fiber, and is viewed under a microscope using transmitted white light (based on HSE Publication, HSG 248).

Samples were returned to About Safety Ltd. Laboratory for Analysis. Photographs were taken at all of the sample locations (unless otherwise stated). The commitment to quality is independently assured through membership of the Asbestos in Materials scheme (AIMS), HSL(UK).
Materials of a similar type were only occasionally sampled and it was assumed that other materials visually inspected to where the sample was taken, were of a similar composition.
Each area was viewed for suspect materials thought or known to contain asbestos and samples taken where it was considered necessary.

General Caveat

This report is based on a Refurbishment & Demolition survey of 3 unoccupied houses. One property occupied with limited access due to Covid-19.

During the course of the survey all reasonable efforts were made to identify the physical presence of materials containing asbestos. It is known that asbestos materials are frequently concealed within the fabric of buildings or within sealed building voids so that it is not possible to regard the findings of any survey as being definite. It must remain a possibility that asbestos containing materials may be found during demolition activities. For reasons set out in this report, the results cannot give an assurance that all asbestos materials have been found and must not be thought to do so.

This report has been written with reference to the various Guidance Notes etc., issued, and current at the date of this report and describes circumstances at the site on the date the survey took place.

Specific Notes

Legislation and Codes of Practice

The Safety, Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 to 2010, apply to work where there is or may be asbestos fibers present. These regulations apply in particular to any person or employer working with or removing asbestos.

In addition, Safety, Health and Welfare at Work (Construction) Regulations 2013 (SI 291 of 2013) also apply to any building, installation, repair, demolition and asbestos removal work.

Information about working with material containing asbestos cement is containing in Health and Safety Authority's document "Asbestos-containing materials (ACM's) in Workplaces – Practical Guidelines on ACM Management and Abatement".

Provision of information

It is recommended that this report is brought to the attention of any person likely to be involved in refurbishment/demolition works.
Once asbestos materials have been identified it is essential that appropriate remedial measures be introduced prior to any structural alterations, refurbishment or demolition works commencing. All the asbestos removal works should be carried out by a competent asbestos removal contractor in accordance with Asbestos at Work Regulations 2006 to 2010. Statutory notification requirements of 14 days are required under the provisions of the Asbestos Regulations for certain works involving asbestos. The contractor appointed for removal works is responsible for deciding if a 14-day notification is required and for drawing up a plan of work for any removal works.

Appendix A – Asbestos Bulk Identification Report

ASBESTOS BULK IDENTIFICATION REPORT

Report on:
Identification of asbestos content of suspected asbestos containing materials (ACM's) sampled from the following location/site:

Knocknacran West Properties

TEST RESULT

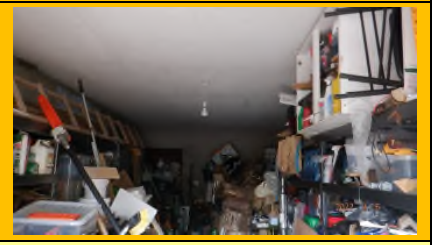
SAMPLE NO	LAB. REF.	SAMPLE LOCATION	MATERIAL DESCRIPTION	ASBESTOS TYPE IDENTIFIEID
Jkb16082201	**2222701**	**House No. 4 - roof**	**AC sheeting**	**Chrysotile**

Glossary

*NADIS = No Asbestos Detected in Sample Chrysotile (white asbestos) Amosite (brown asbestos) Crocidolite (blue asbestos)
VFT = Vinyl Floor Tile

Analyst: John Kelleher

Appendix B – Schedule of Survey Sheets

Ref No.	Building or Area of Site	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
1.	Existing House No. 3	Roof Gable ends		Slate strip over facia board	Circa 20 LM	Chrysotile	1	0	1	1	3	Removal and disposal as asbestos waste by a competent asbestos contractor prior to work likely to cause disturbance.	
2.	Existing House No. 3	Garage ceiling		AIB fireboard. Unsealed with fibrous edges.	Circa 28 SM	Amosite	2	2	2	2	8	Removal and disposal as asbestos waste by a ***SPECIALIST*** asbestos contractor under fully controlled conditions prior to work likely to cause disturbance.	
3.	Existing House No. 3	External boiler		Integral areas of boiler		Presumed asbestos						Investigation by a competent asbestos contractor prior to work likely to cause disturbance.	
4.	Existing House No. 3	Outhouse		Slate strip over facia board	Circa 8 LM	Chrysotile	1	0	1	1	3	Removal and disposal as asbestos waste by a competent asbestos contractor prior to work likely to cause disturbance.	

Key
NAD = No asbestos detected
AIB = Asbestos insulation board
AC = Asbestos cement
VFT = vinyl floor tile
NQ = Not Quantified/Quantifiable
SM = Square Meters
LM = Linear Meters

Confirmed Asbestos
Presumed/Strongly presumed ACM Or Non Accessed Area

Material Assessment Score	Risk
≤ 4	Very Low
5 - 6	Low
7 - 9	Medium
≥ 10	High

No condition assessment is normally necessary for refurbishment and demolition surveys but, where the period between survey and the event is significant, e.g. more than 3 months, then a material assessment should be conducted and interim management arrangements put in place.

Ref No.	Building or Area of Site	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
5.	Existing House No. 3	Internal areas of house		No access. Occupants have Covid-19.		Presumed asbestos						Investigation prior to work likely to cause disturbance.	No photo
6.	Existing House No. 2	Roofs		Natural quarry slates and galvanized sheeting		NAD							
7.	Existing House No. 2	Ground floor room 1				NAD							
8.	Existing House No. 2	Ground floor room 2				NAD							

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Ref No.	Building or Area of Site	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
9.	Existing House No. 2	Ground floor room 3				NAD							
10.	Existing House No. 2	Ground floor Hotpress		Brass gaskets on tank fittings	Circa 4 – 5	Chrysotile	1	0	0	1	2	Removal and disposal as asbestos waste by a competent asbestos contractor prior to work likely to cause disturbance.	
11.	Existing House No. 2	1st floor Bedroom 1				NAD							
12.	Existing House No. 2	1st floor Hallway		Timber cladding to ceilings		NAD							

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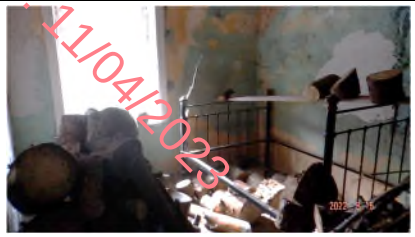
13.	Existing House No. 2	1st floor Bedroom 2				NAD							
14.	Existing House No. 2	External Bathroom wall		AC soil pipe and cowl on corner of extension	Circa 3 LM	Chrysotile	1	1	1	1	4	4Removal and disposal as asbestos waste by a competent asbestos contractor prior to work likely to cause disturbance.	
15.	Existing House No. 2	External boiler		Integral areas of boiler		Presumed asbestos.						Investigation by a competent asbestos contractor prior to work likely to cause disturbance.	
16.	Existing House No. 2	Shed to side of house		Modern extension		NAD							

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Ref No.	Building or Area of Site	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
17.	Existing House No. 2	Outhouses		Galvanized sheeting on roof		NAD							
18.	Existing House No. 2	Outhouses Internal areas				NAD							
19.	Existing House No. 2	Outhouses Internal areas				NAD							
20.	Existing House No. 1	Main house roof		Natural quarry slates Galvanized sheeting on lean-to building		NAD							

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Ref No.	Building or Area of Site	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
21.	Existing House No. 1	Kitchen				NAD							
22.	Existing House No. 1	Bedroom				NAD							
23.	Existing House No. 1	Back porch				NAD							
24.	Existing House No. 4	Roof	2222701	AC sheeting	Circa 60 SM	Chrysotile	1	2	1	1	5	Removal and disposal as asbestos waste by a competent asbestos contractor prior to work likely to cause disturbance.	

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Ref No.	Building or Area of Site	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
25.	Existing House No. 4	Roof		AC gutters. Broken in areas		Chrysotile	1	2	1	1	5	Removal and disposal as asbestos waste by a competent asbestos contractor prior to work likely to cause disturbance. Visual sweep of the ground on both sides and overgrowth for debris.	
26.	Existing House No. 4	Internal rooms		Timber lats to ceilings.		NAD							
27.	Existing House No. 4	Internal rooms		Polystyrene tiles on hardboard sheeting		NAD							
28.	Existing House No. 4	Internal areas		Misc. sections of AC sheeting around floors.		Misc. AC debris from damaged roof	1	2	1	1	5	Removal and disposal as asbestos waste by a competent asbestos contractor prior to work likely to cause disturbance. Visual sweep of the rooms and contents for debris.	

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Ref No.	Building or Area of Site	Location or Functional Space	Sample No.	Material Description, surface treatment and condition	Extent	Asbestos identified (presumed, strongly presumed or identified)	Product type	Condition	Surface treatment	Asbestos type	Material assessment score	Recommendations	Photo
29.	Existing House No. 4	Outhouses		Galvanized sheeting on roof.		NAD							
30.	Existing House No. 4	Outhouses internally				NAD							

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APPENDIX C

SGMI Contractor's Safety and Environmental Handbook

Zero Work Related Accidents, Zero Occupational Illnesses, Zero Environmental Accidents and minimum impact of our activities.

Contractors' Safety Handbook

SAINT-GOBAIN

Kingscourt • Knocknacran • Kilcarbery • Ireland
Website: www.Saint-Gobain.ie
Kingscourt - Tel: 00353 42 969 8100
Kilcarbery - Tel: 00353 1 629 8400

Gyproc SAINT-GOBAIN

ISOVER SAINT-GOBAIN

Contractor's Safety Handbook

SAINT-GOBAIN

IMPORTANT

PLEASE COMPLETE

In an emergency, contact one of the following:

Security on	**Internal Ext 042 96 98 241**
On-site supervisor	_____
Your Saint-Gobain contact	_____
Any employee	_____

Saint-Gobain Contact

Name	_____
Title	_____
Extension Number	_____

Issued to:

Contractors Name:	_____
Contractor's Company Name:	_____

Date of issue:

Fire evacuation point:

Tick A, B or C

- **Process site Kingscourt** A ☐ B ☐ C ☐
- **Mine site Knocknacran / Drummond**
- **Unit 4 Kilcarbery**

Notes: _____

_____

_____

_____

CONTENTS

Gyproc SAINT-GOBAIN ISOVER SAINT-GOBAIN SAINT-GOBAIN

CONTENTS

DEFINITIONS:

Saint-Gobain Contact:
Saint-Gobain Gyproc / Isover (hence known as Saint-Gobain) employee who is responsible for employing and supervising a contractor.

Contractors:
Contractor means a firm or company retained on a temporary and /or contractual basis by Saint-Gobain to carry out a job, task or assignment for the company either directly or indirectly.

Subcontractors:
A company, business, etc. that has been contracted by an Approved Saint-Gobain contractor to carry out a job, tasks or assignment for the company.

Material Safety Data Sheet (MSDS):
A written description of the hazards and precautions associated with chemicals.

CONTRACTORS' SAFETY INFORMATION

This information booklet is provided to ensure that all contractors to Saint-Gobain are aware of the environmental, health and safety requirements while working on site. It is important that everyone understands their responsibilities in the area of health & safety and the environment.

It is the policy of Saint-Gobain that the working environment is safe, clean and healthy. Every one working here has a duty to themselves, their family, fellow workers, employees, visitors and other contractors to ensure that they work safely and prevent incidents.

Preventing incidents requires each person to be constantly alert. It also requires the company, it's employees, contractors and visitors to ensure facilities, material supplies and processes are safe. All contractors must follow proper working practices and procedures.

Non-adherence to safety rules and practices may result in disciplinary action, up to and including being barred from future work on our sites.

Each contractor must work with his/ her site contact in Saint-Gobain in relation to advice on the site's emergency evacuation procedures and in relation to health & safety and environmental requirements to a particular contract.

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YOUR RESPONSIBILITIES

At Kingscourt Gypsum Industries manufactures plaster and plaster boards for the construction industries. Gypsum is mined in an underground mine, at Knocknacran which is located 4.5km southwest of Carrickmacross.

Our Dublin head office site and Technical Academy is located at Unit 4, Kilcarbery Business Park, Dublin 22. The Managing Director, Finance Sales & Marketing, Technical Support and Customer Service departments are located on the 2nd floor and the Technical Academy is located on the ground floor.

Gypsum is a non metallic mineral, which is found in rock form in the Cavan area. It is composed of Calcium Sulphate di-hydrate. After mining at Knocknacran/Drummond, gypsum is crushed and transported by road to the processing facility where it is calcined and then converted to gypsum plaster boards or builders plaster.

All work carried out in Saint-Gobain is subject to strict safety, hygiene, environmental and quality control regulations.

Therefore, please read and follow the guidelines carefully. If you have any questions please advise your site contact who will assist.

Please note any Contractor working in Saint-Gobain has a site contact, who is responsible for approving the Contractor on site. This person is your site contact. Please ensure you know this person(s) and liaise with them with any queries or problems that you encounter. It is your responsibility to do this.

[WARNING]
ANY INDIVIDUAL OR CONTRACTOR WHO VIOLATES THESE GUIDELINES MAY BE DISMISSED FROM THE SITE

REMEMBER: The law requires you to comply with prescribed safety standards as regulated by the

- Safety, Health and Welfare at Work Act 2005 and associated Regulations,
- Factories Act 1955,
- Safety in Industry Act 1980,
- Safety, Health and Welfare at Work (Construction) Regulations 2013,
- Where the work involves 'construction' as defined by the construction regulation additional duties as identified by your site contact may be required. These duties will be dependent on the type and scope of the construction project.
- Internal Saint-Gobain EHS Standards

Removal of material must be documented and agreed by your site contact prior to removal. Copies of signed documentation where applicable should be given to your site contact at Security (Kingscourt) Reception (Kilcarbery) Main Office at Knocknacran / Drummond mine.

Inspection:
You and your vehicle may be subject to discretionary search on entry to and departure from the sites.

Personal Protective Equipment.
High visibility work wear with a reflective strip is required at all times when leaving main office at Kingscourt. On exit from Knocknacran office into the Mine/Quarry site and on entry into Kilcarbery Technical Academy.

Occupational Exposures
Contractor work, which by it's nature, is likely to result in exposure to environmental factors such as dust, fumes, mists, gases etc. must be protected against by the contractor. The protection must cover both the contractor and the company employees who may be exposed to these factors.

Additionally, the site contact will ensure that the contractor is not exposed to other environmental factors particular to the work on the premises.

Walkways & Handrails
Contractors must use designated walkways and underpasses on site, which are identified. The only exception is where detours are required in the context of the work in hand. Follow specific safety signage in these areas. When entering an operating area ensure to obtain eye contact / hand signals from vehicle operators to alert and verify that they have acknowledged your presence. Proceed only if it's safe to do so. Please use handrails at all times when using the stairs.

At the mine site follow mine pedestrian site rules, which are explained during mine induction.

Lone Working
The company operates a lone worker alarm system for all lone work. Consult your site contact in order to determine suitable control measures where lone working is required. Do not work alone outside normal working hours unless the lone working alarm system is in use. Confine yourself to your job site as specified. Do not wander onto other parts of the site or adjacent lands.

Running and Boisterous play
Running or boisterous play is not permitted on the site.

Housekeeping
Contractors are required to consistently maintain a clean and tidy workplace. Waste receptacles are present on all sites and shall be used for the correct disposal of waste. REMEMBER: IF IN DOUBT, ASK!

Mobile Phones
Mobile phones can be a source of distraction. The use of mobile phones is permitted on site, however please adhere to the following site rules.

Please do not walk and talk. Move to a safe area (away from FLT's etc) to receive calls. The use of mobile phones while driving on site is not permitted unless a hands free kit is used.

Fire Alarms and Evacuations
The general on site fire alarm at Kingscourt provides 4 messages, based on the alarm level; all personnel will be advised through a voice enhancement of the following alarm conditions.

1. An intermittent bleep with a voice message *'An alarm has been activated stand by and await further instructions'* On hearing this contractors shall continue in their work whilst the alarm activation is being verified following this check you will be requested to either *'please leave the building'* or an *'all-clear'* message will be transmitted.
2. An intermittent bleep with the message to advise you *'All clear no action required'*
3. A 2 second continuous tone with a voice message *" Fire, Fire, please leave the building"* On hearing this contractors should make their work area safe and proceed to their designated assembly point as demonstrated during induction.
4. Is used when a planned test of the system is being undertaken and in this case the intermittent bleep will be followed by the message *'This is an alarm test no action required'*.

In areas of high noise this alarm system also utilises a flashing white beacon to advise persons in the area that an alarm has been activated and in this situation you are required to make your way to the nearest control room in order to hear the message and comply with its requirements.
The on site emergency response team or local emergency services will deal with the emergency.

At Knocknacran/Drummond the alarm has a 2 second continuous tone which will be demonstrated at Knocknacran/Drummond Induction. Additional evacuation requirements for the mine are detailed under a site specific Mine Induction.
At Kilcarbery the alarm has a 2 second continuous tone.

Scaffold erection,
Roof and Wall Cladding,
Crane operation,
Safe pass training,
Manual handling,
Fork Lift Truck operation,
Pallet truck operation
Use of lifting equipment
This is a non-exhaustive list and additional records may be requested from your site contact based on the identified nature of the task.
Do not carry out any work activity for which you are not suitably trained.

SPECIFIC TASK SAFETY RULES

For certain specified activities/ operations, Standard Operating Procedures exist. These will be brought to your attention by your site contact and must be adhered to.

Workplace Vehicles:
Be aware that Heavy plant and equipment, Lorries, Pallet and Forklift trucks operate throughout the site. Do not assume that you have right of way, both pedestrian and driver must stop, make eye contact and signal when they come into contact with each other and proceed when they have established it is safe to do so.

Controls for pedestrians
- Be aware of workplace vehicles in your area.
- Use mirrors to see oncoming vehicles.
- Wear a high visibility work wear with reflective strip in designated areas. Signs are posted to identify these designated areas.
- Use pedestrian walkways where provided.
- Do not take shortcuts through hazardous areas.

Controls for drivers
- Drivers of any vehicles must hold a full driving license and be over 18.
- Be aware of pedestrians in your area. Stop, get eye contact / hand signal before proceeding.
- Use mirrors to see oncoming pedestrians and vehicles.
- Observe site speed limits: Kilcarbery 8 (KPH), Kingscourt (10 KPH), and Knocknacran 15 (KPH). [note at Knocknacran quarry speed is dictated in accordance with ground conditions]
- Obey all traffic signs and road markings.
- Slow down and sound horn, when entering doorways and blind spots.
- Give way to pedestrians on walkways.
- Park in designated areas.

- Do not reverse any vehicle on site unless you have a clear view to the rear or are being directed by a competent person.
- Follow the instructions of the person in the loading bays or collection points.
- Complete pre-start checks as required when working at the mine site. Your site contact will explain this pre start check.
- Use of mobile phone is not permitted while driving on site unless a hands free kit is used.
- Report vehicle defects to your employer.
- Pallet and Forklift trucks can only be operated by appropriately trained Saint-Gobain employees.
- No one, other than the operator, shall ride on a fork/lift truck/tractor.
- Fork/Lift trucks should not be used for lifting personnel to gain access to elevated positions, unless the equipment is designed for this.
- Where use of own fork trucks is required, only certified drivers and equipment should be used. Additional company requirements will be explained during induction; this includes use of a safety belt, flashing beacon and roll over protection.

Mobile Plant and Vehicle Safety
- All mobile plant vehicles must have a safety cab fitted and be ROPS and FOPS compliant.
- Carrying of passengers is forbidden.
- In the case of tractors and equipment using tow bar equipment, under no circumstances must a person ride on the draw bar of a trailer on site.
- All operators must wear a safety belt.
- Tractor must have a flashing beacon and roll over protection.
- All safety guards and equipment must be operational, this includes the PTO shaft.

Compressed Air
- Compressed air must never be used to clean dust or debris from the person. It can penetrate the skin or cause debris to penetrate the skin, with potentially fatal results.
- Never horse play with compressed air.
- Never crimp, couple or uncouple a pressurised hose. Shut off valves and bleed off pressure.
- Hoses and leads must not be laid across walkways. Where possible they should be strung overhead at a height of 2 meters or more. In exceptional cases where hoses do have to cross walkways, a tripping hazard sign must be placed on either side of the hazard.
- Check hoses and couplings daily before use. Only use hose designed to handle compressed air. Provide all hose couplings with a positive lock device. (e.g. safety clips)

Compressed Gases

Compressed gas cylinders hold gas under pressure. The cylinder can become a dangerous missile if it is damaged in any way. Also the gas itself can be hazardous.

- All compressed gas cylinders must be properly secured in an upright position for both storage and use. In particular mobile trolleys must have a proper means of securing cylinders and should also be accompanied by a fire extinguisher.
- Gas cylinders may not be stored inside buildings. When not in use all cylinders must be stored out doors in an approved location adjacent to rock intake area and mine workshop.
- Oil or grease plus oxygen may explode or catch fire. Be sure your hands and tools are very clean when handling Oxygen cylinder valves, regulators, gauges or fittings.
- Finally use a proper hand truck to move cylinders. Do not drag or roll, and do not drop or bang cylinders.
- Proper codes and labels should be affixed to the cylinders.
- All oxy acetylene equipment should be equipped with flash back arrestors and non return valves at the hose end. This equipment must be serviced and maintained as per statutory requirements.

Site Emergency Equipment

- Company emergency equipment (extinguishers, hoses, hydrants and spill kits etc.) must not be moved, blocked, or otherwise rendered unavailable. They should only be used in emergency situations.
- First aid equipment, fire blankets etc should not be moved or blocked in any way.
- In the event of a minor fire, there are various fire points located throughout the plant. The types of fire extinguishers on site are recommended in the table below:
- Contractor must supply extinguishers, fire blankets and screens for use when carrying out Hot Work. (Full measures are identified on the Hot Work permit.)
- Please ensure that you are familiar with all fire protection equipment at your disposal. Should you need to use a company fire extinguisher this must be reported to your site contact ASAP to ensure re-servicing and investigation of the incident.

Extinguisher type	Suitability
Dry powder	Powder is suitable for fires involving flammable liquids, gases, electrical equipment, motor vehicles and fuel oils
Carbon Dioxide Liquid	CO2 is suitable for any indoor area involving flammable liquid or electrical equipment and is ideal for use in laboratories. It is not suitable for outdoor use.
Foam	Foam is suitable for liquid fires (petrol, oil, fat)
Water	Water is suitable for wood, paper, furniture, etc. Never use water extinguishers or fire hose reels on electrical fires or burning liquids.
ABC Multipurpose	Suitable for all fire types

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First-Aid or Medical Treatment

Contractors are obliged to provide adequate numbers of trained first-aiders as required by the Safety, Health and Welfare at Work (General Application) Regulations 2007. First aid facilities including access to an on-site First Aider is available at all sites.
Contact your supervisor/ Saint-Gobain contact if you require first-aid or medical treatment.

Chemicals and Material Safety Data Sheets (MSDS)

- Contractors bringing chemicals onto the site must provide the relevant MSDS in soft copy.
- All chemicals must be stored in suitable containers in a bunded container / area. This must be sent to your site contact in advance of any work commencing.
- Do not store flammable liquids in construction trailers or cabins. They should only be stored in appropriate storage containers.
- Small volumes may be stored in approved safety containers.
- Storage is limited to 100 litres, if placed in an outside room or approved cabinet. Storage may reach a maximum of 250 litres if liquids are stored in separate, approved cabinets.
- Cabinets must meet recognised standards of approval e.g. UL, FM, I.S. etc. and all cabinets must be earthed.
- The Contractor must supply a suitable fire extinguisher directly outside the storage room.

Engine powered equipment

- Where petrol, diesel or LPG engine powered equipment is to be used (specialised vehicles, pumps, builders or cleaning equipment etc.), arrangements must be made to ensure adequate containment/ ventilation of exhaust fumes or dusts.
- If noise is likely to be excessive, special arrangements must be agreed in advance.
- The equipment must be in good repair.
- Fuel for equipment must be stored in an approved manner and place. Liquid fuel (diesel or petrol) must be stored on a bunded container.
- There may be specific hazards in designated areas, such as the presence of potentially explosive atmospheres. Consult your site contact regarding the suitability of the equipment for these areas.

Cranes, Hoists and Lifting Equipment

- Notify the Engineering Department before rigging a crane over any cable routes and pipe racks.
- Operators must be certified by an approved body for use of cranes and insurance certificates must be provided to your site contact prior to use.
- Cranes, hoists and other material lifting equipment used on the premises must be in good repair. Current statutory inspection certificates must be available on request.
- Only trained employees may use mechanical lifting devices. If contractors have not received the necessary training, the equipment must not be used.
- No one is allowed to work or pass under a suspended load.
- The swing radius of a rotating crane must be placarded and barricaded to prevent employees and others from being struck by the body of the crane.
- The safe working load must be marked and never exceeded.

- The operator must not attempt any lift for which they feel conditions are inadequate. In this situation the site supervisor and the site contact must be consulted.
- Work within 15m of electric power lines is not permitted unless special arrangements have been made.

Lifting Gear

Lifting gear or tackle is defined as chain blocks, chain slings, rope slings (or similar), rings, links, hooks, plate clamps, shackles, swivels and eyebolts.

- Always use the right kind of sling for the job in hand.
- Lifting tackle is subject to statutory inspections and certification must be made available on request.
- Check the safe working load marked on the sling against the load to be lifted.
- Never exceed the safe working load.
- Check the condition of the lifting gear.
- Do not tie knots in chains or wire ropes.
- Avoid sharp edges.
- Make sure the safety catch on the hook is working and in good condition.
- When placing items on the ground make sure they do not obstruct general walkways.
- Use and fit plate clamps properly.
- When using hand gantries do not use the pendant control to pull the gantry along.
- Do not jerk or swing the load with violent action.

Wall and Floor Penetrations

Many of the walls and roofs of on site buildings are asbestos cement based.

- If a contractor's job requires making holes in floors or roofs, permission must be obtained from the Saint-Gobain contact in advance.
- Floor and wall penetrations must be fully filled when work is completed.

SAFE WORK PERMITS

The company operate a SAFE WORK PERMIT system on site in order to protect its employees, other people and its property.

The following Permits apply to the company activities:

- Hot Work Permit System [Rec 235]
- Lock Out Tag out System
- Confined Space Permit System [Rec 234]
- Working at Heights Permit system [Rec 226]
- Excavation Permit system [Rec343]
- Safe System Work Plan (non –routine tasks [Rec 319])
- Electrical Permit to Work [Rec 344]

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The permit will be issued to the Contractors Supervisor or designated "Person-in-Charge" by the Engineering Department/ Site contact after checking for safe conditions.

A permit is valid only if it contains all relevant signatures, i.e. that of:

- Issuer
- User (Contractor)
- Others as specified by the permit system.

The permit shall be available at all times during the permitted activities. The permit must be returned to the Engineering Department/ Site contact on completion of work.

Permits are valid only for the specific job and time period (24 hours maximum) Permits shall be reviewed and amended as the task changes.

Appropriate P.P.E must be worn by contractors and safe systems should be in place at all times.

The company personnel may cancel a permit at any stage if unsafe conditions exist. In this case all work must cease immediately.
Further information on SAFE WORK PERMITS is available from your site contact in the plant or the Engineering Department.
The relevant 'Permits to work' MUST be completed prior to use on site.

Hot Work Permits

Hot work is any activity, which produces sparks, fire or molten slag or has the potential to cause a fire or explosion. Hot work includes but is not limited to welding, cutting, brazing, soldering, grinding, torch applied materials and hot air welding. Hot Work Permits are required for these activities when they are conducted outside the workshop area.

Do not use a naked flame or electric tools anywhere near combustible materials or flammable liquids chemicals or gasses.
It is the contractors' responsibility to assess any changes in the working area to ensure the hot work permit remains safe to use.

The hot work permit will specify minimum conditions, which must be fulfilled. These conditions may include availability of fire extinguishers, fire blankets or other precautionary equipment. Fire watch checks must be completed as detailed in the hot work permit after the hot work has been completed.

Remember for each task you complete or carry out, you must constantly review the working environment around to ensure no new hazards are created.

Lockout and Tag Out Procedure:
Lockout and Tag procedures are employed to isolate equipment prior to servicing, maintaining, repairing or testing equipment in order to protect all persons, from potentially hazardous sources of energy. All safety and operational isolation will be the subject of a "lock-out" procedure. This procedure will be co-ordinated by the company.

Contractors must use "Lockout / Tag-out "procedures to indicate that work is being carried out or incomplete to prevent interference with plant, equipment and employees.

As part of the Lock Out Tag Out procedures, contractors will be issued with ISO-locks. All locks are assigned a unique ID number which is recorded against the user. This lock must be placed on the isolated equipment prior to checking, servicing or maintaining the equipment. Test all equipment for energy prior to commencing work. All locks must be removed and the equipment returned to safe condition on completion of work.

Contractors are reminded that multiple energy sources may be present including electrical, gas, pneumatic or stored energy, and energy sources which may have an impact on the task may be upstream or downstream of the task.

Confined Space Permits:
A confined space means any place, including any vessel, tank, container, silo, hopper, pit, bund, trench, pipe, sewer or other similar space which, because of its enclosed nature, creates the conditions where an incident, harm or injury is likely to require emergency action due to:

1. The presence or reasonable foreseeable presence of:
   - Flammable or explosive atmospheres
   - Harmful gas, fume or vapour,
   - Free flowing solid or an increasing level of liquid,
   - Excess of oxygen,
   - Excessively high temperatures.
2. A lack of oxygen or reasonably foreseeable lack of oxygen.

A Confined Space permit issued by the company must be adhered to by all contractors. All persons involved in confined space work should be competent to carry out their role. To achieve this adequate training is necessary. Persons entering a confined space must be fully informed of the hazards of the work and work permit (safety) requirements and have a complete understanding of the potential hazards. Experience in working in confined spaces is also an advantage. The Confined Space Programme is provided to the Contractor and it is their responsibility to ensure any confined space entries are carried out as per this programme.

All Tanks, Vessels, Pits, Stills will require permits initiated by the company management. ***Never enter a confined space without the appropriate training, emergency equipment and a completed work permit.***

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The work permit clearly highlights all areas to check and relevant tests to complete prior to entry these include:

- Isolation from hazardous substances
- Isolation from energy sources
- Cleaning, purging and ventilation
- Atmospheric testing
- Hot Work requirements
- Emergency and Rescue procedures
- PPE
- Precautions to be taken

Authorisation is required and this highlighted on the work permit.

NOTE

- Both the Persons entering a confined space (entrants) as well as the Confined Space Attendant must sign the confined space work permit
- Both the Persons entering a confined space (entrants) as well as the Confined Space Attendant must be trained in confined space and rescue procedures.
- Ensure personal protective equipment is in place and worn. (e.g. Safety Harness, Helmets, Goggles, etc.)
- Ensure oxygen tests, Explosimeter Tests, (flammable gases or vapours) and CO Test are completed and that the environment safe.

Working at heights:
Working at heights applies to all work activities where there is a need to control a risk of falling a distance liable to cause a personal injury. It includes access and egress from a place of work. It would for example include:

- Working on a scaffold or from a mobile elevated work platform (MEWP)
- Working on the back of a flat bed trailer/ curtain sided trailer
- Using cradles or ropes to access parts of the building
- Climbing permanent structures such as gantries, silo's etc.
- Working close to an excavation or opening
- Using a ladder, step ladder, window cleaning or other maintenance tasks

Roof Work (Existing Roofs) and Heights

- Assess the work to be completed and identify the required safety measures including P.P.E. i.e. harnesses, life lines, anchor points, etc... required to complete the job safely
- Cover and protect any openings or penetrations.
- Do not leave any debris on the roof and ensure any materials stored there are securely anchored.
- Do not pour any liquids or debris into roof drains. Do not throw anything off a roof.
- Do not leave tools or materials lying about at height or throw them down.
- Keep away from exhaust fans, which may have fumes.

Scaffolds

- Erection, dismantling, alteration and certification of scaffolding must be carried out by qualified personnel.
- Signs must be erected on the scaffold certifying that it is safe for use and indicating the Safe Working Load. Warning signs must be displayed on the scaffold during its assembly, dismantling or alteration indicating it is not safe for use.
- Always inspect scaffolding before starting work on it and also after wet, windy or frosty weather.
- Never start work on scaffolding unless it is safe. If in doubt consult the appropriate person, your site supervisor, site contact, safety officer or scaffolder.
- Scaffolds and work platforms must have guard rails and toe boards.
- If other employees will pass underneath the scaffold, it must have a screen between the top rail and toe board to prevent objects from falling on those below.
- Use the access ladders - never jump up on or climb down scaffold bracing or poles. Hoist materials up and down - don't throw them.
- All scaffolds must be provided with an access ladder or other safe means of access.
- If work is being carried out on elevated work platforms (e.g. roof's) or scaffolds where there is no edge protection, the fall protection system incorporating a suitable anchor point, safety harness and lanyard must be worn.
- Never overload a scaffold – if in doubt, find out what the safe load is. Make sure stacked materials cannot fall off – get wire mesh frames between the guardrails and toe-board.
- Keep scaffolds tidy. Provide unobstructed passageways for people and materials.

Mobile Scaffolds

- Erection, dismantling, alteration and certification of mobile scaffolding must be carried out by qualified personnel.
- The maximum height of a mobile scaffold must not be more than 3 times the minimum base width for outside use.
- When height is more than 6 meters the scaffold must be tied to the building or base weights must be used.
- Guardrails and toe boards must be fixed.
- Never try to increase the height – e.g. by working off a pair of steps on top of a scaffold – this will raise the centre of gravity and the entire scaffold may topple
- Use only a firm level ground. Prevent movement when in use by locking or choking wheels, and ensure that the wheels are firmly fixed to the uprights.
- Move a mobile work scaffold only by pushing at the base, but never when somebody is on it. Look out for overhead electric cables when moving.
- Lightweight mobile scaffolds must always have outriggers and be tied to the building for outside use.

Mobile Elevated Work Platforms (e.g. Scissors Lift, Boom Lift, etc)

- Contractors using any type of mobile elevated work platforms such as scissors lifts or boom lifts must be able to demonstrate before work commences that the operators of such machines must have the necessary training records to meet the legislative requirements for such machines. These training records must be provided when requested.
- Contractors should use their own access equipment. They are not permitted to use this equipment unless approved in advance by their site contact.
- Equipment must be appropriate for the job in hand and must be in good condition. Certification must be available if requested.
- Fall protection equipment and hard hats are required at all times when in MEWP.

Floor Openings

- All floor openings must be protected to prevent persons or equipment from accidentally falling or tripping into them.
- When contractors are not working on floor openings, they must be covered with a suitable material of adequate strength to support any foreseeable load. Coverings must be posted with signs reading "Floor Opening – Do not remove"
- Fixed guardrails and toe boards may be used in place of planking when it is impractical to cover an opening capable of taking weight. These must be substantial and not susceptible to accidental damage or displacement. Tape, cord, or chains with anchor posts are not acceptable.

Fall Protection

- If working at heights where there is a risk of falling and subsequent injury, adequate guardrails should be used. If this is not possible the approved fall protection equipment must be used. This includes approved safety harnesses, anchor lines and lifelines.
- Contractors must satisfy the company that proper training has been given in the use of such equipment and that its use is properly understood and implemented.

Ladders

Ladders, stepladders and mobile steps or approved scaffolding must be used for elevated work. Standing on chairs etc. is prohibited. All ladders must be properly secured at the top or bottom. All company ladders, stepladders and mobile steps have a unique identification mark or tag and are included on a planned maintenance schedule.

Selection of Ladders, Step Ladders and Mobile Steps

- Select the most suitable equipment for the task. Avoid working off ladders where possible. Use mobile elevated platforms, stepladders or mobile steps as a safer alternative for elevated work.
- Do not use metal ladders or steps for electrical work. Use fibreglass, wooden or insulated ladders.

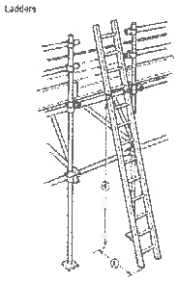
Inspection of Ladders, Step Ladders and Mobile Steps

- Before use, inspect the equipment for wear or damage. Recheck after use.
- Report damaged or worn equipment to your supervisor/ site contact.
- Do not use damaged or worn equipment. Take defective equipment out of service and report to the Site contact or the Safety Officer immediately.

Use of Portable Ladders

- Wear safety footwear provided with heels. This will prevent slipping off the rungs.
- Follow any instruction or safety notices supplied with the ladder.
- Place ladder on a firm and level surface. **Do not** place ladders on a platform e.g. box for extra height, planks etc...
- Position the ladder the right way up and the right way round. Ladders with wire reinforced stiles or rungs should have wire on the underside when in use and any mud/grease, etc should be cleaned off before the ladder is used.
- Set the ladder at the correct angle, ideally 75 degrees (4 vertical to one horizontal).
- Rest the top of the ladder against a solid surface. Do not rest it against plastic guttering, windows or fragile structure.
- Assess the environment you will be working in before carrying out the task. **Never** place the ladder where there is danger from moving vehicles, overhead crane or electric power lines.
- Extend the ladder at least 1 metre above the landing place.
- Tie the ladder off or get someone to foot it to prevent it slipping. A second person must foot the ladder while the other is climbing it to tie it off (the person 'footing the ladder' must face the ladder and keep one hand on each stile and a foot on the bottom rung).
- Sections of extension ladders should overlap as follows:

Ladder Closed Length	Minimum Overlap
Up to 5m	1 rung
5m – 6m	2 rungs
Over 6m	3 rungs



- Do not work from or climb to the top rung of the ladder or extension ladder.
- Assess the need to cordon off the area (in order to alert people in the area to overhead work) if using a ladder close to a doorway, walkway or where vehicles operate.
- Keep a secure grip and face inwards when ascending and descending ladders. Grip the sides or rungs.
- When working from a ladder:
  - ❑ Do not over reach.
  - ❑ Keep your body in line with the ladder and bothfeet on the rungs.
  - ❑ Grip the ladder with one hand where possible.
  - ❑ Use a tool belt, pocket, or shoulder sling to carry tools.
- Do not walk or work underneath a ladder.
- Only one person at a time is allowed on a ladder. If a second person is required, they must use another ladder.
- Exercise caution when carrying a ladder. Get help if needed. When approaching a corner keep the front end above head height and take a wide turn.
- Return the ladder to it's designated storage area immediately on completion of the work / job.
- Never leave an extended ladder unattended, this is very dangerous for other personnel who do not know how to use the equipment properly.
- Do not climb or work off a ladder unless you can keep three points of contact with the ladder at all times.

Use of Step Ladders and Mobile Steps

- Follow any instruction or safety notices supplied with the steps.
- When using folding steps, extend it fully before use, placing it on level ground and at a right angle to the work.
- Do not work from the top step of steps unless it is designed for this purpose.
- Only one person should use a stepladder at a time.
- Do not over reach from steps. Move the steps to the required location.
- Where handrails are provided, keep your body inside the rails and use handrails when ascending and descending steps.
- Do not use the handrail as a support to lean against.
- Ladders should not be left lying against a wall after use, they should be returned to their designated storage area.
- All onsite mobile steps and ladders are supplied with a ladder tag and are identified. Operators should ensure that this ladder tag is in place indicating that ladders are fit for use.

Excavations:

An excavation is any work that involves penetrating the ground at or below surface level, including the use of core drills, con-saws and road-saws. This includes all such work associated with new or existing buildings and such work carried out on roadways, internal roadways, footpaths and other external areas where there is a foreseeable likelihood of buried underground services. These services include all underground pipes, cables and equipment associated with the electricity, gas, water (including piped sewage), telecommunications and computer cabling.

DIG WITH CAUTION!

Before commencing excavations ascertain the existence and the routes of all electric cables, drains and water mains. Consult with the Civil/Facilities and Engineering Department.

- Complete Excavation permit as part of the review of the plans on the area to be excavated. A confined space permit may be required to enter the trench.
- Review of the plans of the area to be excavated
- Plan the excavation work - if excavation is required. For trenches less than 1.2 meters deep shoring and protection may be required if the work requires bending or kneeling. This will be identified during risk assessment.
- Identify and mark underground services (using cable detecting devices and tape/ paint)
- Apply Safe digging practices (Task Dependant)
- You must expose cables and pipes manually.

- Ensure excavations do not affect the footings of scaffolds or the foundations of nearby structures. Walls may have very shallow foundations that can be undermined by even small trenches.
- To prevent cave-ins, shore and protect all excavations 1.2m (4 ft.) deep or greater.
- All excavations must be inspected by a competent person at least once in every day during which persons are at work in the excavations. A thorough examination of the excavation must be carried out at least every 7 days. This must be recorded on an AF3 form. A record of the examinations must be kept and provided to the company on request.
- Do not store any excavated material closer than 0.6m (2 ft.) to the edge of the excavation.
- Do not enter any excavation over 1.2 meters deep unless it is shored to a safe slope.
- Debris and earth from excavations must be removed to a designated area.
- Inform Saint-Gobain Site contact immediately if any damage is caused to underground services. *Note: Never have a person in an excavation while machinery is working over it. Where a vehicle has to tip material into the excavation, use stop blocks to prevent them from over running.*

Electrical Safety

- Contact with live electrical circuits can cause serious injury or death.
- All work on electrical equipment or use of electrical equipment must comply with statutory regulations in conjunction with the requirements of the Electrical Permit to Work [Rec 344]
- Operate all electrical equipment responsibly to avoid danger.
- Report all potentially dangerous defects to your site contact.
- Only persons authorised by the company may install, inspect, test, maintain, design, modify or approve electrical equipment or installations.
- Where a machine or appliance cannot be physically disconnected (e.g. unplugged from the supply) there is a lockout procedure, which must be implemented before commencing work on the machine.
- Assume that any electrical wire or device is live until proven otherwise. Before any repair or adjustment is made always switch off and isolate.
- Screwdrivers incorporating a neon light (Phase tester) must not be used on site. Only approved test meters must be used for fault finding.
- Approved Voltage indicators must be used for verifying that a circuit is dead.
- Unguarded, energised parts cannot be left unattended even momentarily.
- All energised parts, panels, junctions etc must be properly barricaded at all times to alert people to the hazards.
- Electrical equipment must be properly grounded or be of the double insulated type.
- Portable equipment up to 2 KvA rating must be 110V. 110V transformers for cord connected tools must be centre tapped to earth.
- Hand lamps must be less than 25V AC or 50V DC. All 380V and 220V sockets must be protected by Residual Circuit Breakers.
- All installations and equipment must comply with the Safety, Health and Welfare at Work (General Applications) Regulations Electricity and ATEX regulations (where appropriate).

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- Where temporary lighting is required it must be protected and have an adequate clearance off the floor level.

Extension leads

- Extension leads must be three-wire type and must not have any cuts, frayed insulation or splices.
- 380V and 220V extension leads must be of screened type.
- Extension leads must not run through doorways where the door could cut or damage them.
- Plugs must be in good working order.
- Inspect equipment before and after use, do not use defective equipment, report defective equipment to your supervisor or site contact.

Noise

- Where contractor operations are likely to involve excessive noise (exceeding 80 dBA) special arrangements may be necessary to protect other people in the vicinity (muffling, evacuation, rescheduling, timing etc.)
- Adequate hearing protection must be worn by everyone in the area.
- Designated Mandatory hearing areas exist within the site and these are identified by the appropriate signage.

Floors and Walkways

- Running is not permitted on the company sites.
- Floor markings are used throughout the plant to identify walkways and areas of special significance.
- Traffic and Pedestrian routes are marked out and must be used.
- Red and white marking tape or chain and posts should be used to indicate hazards such as possible traps, trips, slips, spillages, maintenance work in progress etc.
- Floor surfaces and pedestrian routes must be kept clear of water, oil or any substance, which could cause a slip hazard. If the hazard cannot be immediately removed, then an adequate barricade or proper secondary containment measure must be provided.
- When moving through various departments keep to the designated walkways until the work area or destination is reached. Do not take shortcuts off walkways.
- Exercise caution around hazardous areas such as wet floors or trailing cables.
- When moving through doorways, which are used by vehicles, always use the marked pedestrian route.
- Hold onto handrails provided on staircases or steps when ascending and descending stairs.
- Be aware of other pedestrians and vehicles. Use mirrors provided in hazardous areas to see oncoming pedestrians and traffic.
- Do not leave obstructions or spillages in walkways or on floor areas especially on emergency escape routes, stairs and steps or at doorways. Remove or Report to your site contact any unauthorised obstructions or spillages on walkways or floors.

Spillages
Where practical, spillages that result in hazardous conditions must be cleaned up and /or the area restricted until the hazard has been removed, At Kingscourt and the Knocknacran site the designated Response team will also be available. A flow chart is provided inside spill kits located at Kingscourt & Knocnacran.

Safety Signage:
There are five main categories:

- Prohibition – red and white
- Mandatory – blue and white
- Warning – yellow and black
- Safe conditions – green
- Information – black and white

Hazardous Work Activities
Warning, safety and security signs, notices and barriers are all posted for protection. Hazardous work activities must be cordoned off. The purpose of cordoning off is to:

- Identify and isolate a hazardous area or activity.
- Limit the number of people exposed to the hazard.
- Prevent unsuspecting personnel from being exposed to the hazard.

Cordoning off must be planned, based on risk assessment in consultation with your site contact. This must be observed and followed:

- When work may expose employees or others to hazards, warning signs, barriers or barricades must be provided.
- Where the signs and barricades do not provide adequate protection, particularly along a roadway or pavement, flag persons or other additional protection must be used.
- Work areas must be cordoned off by warning tape or chain and posts. These must be provided by the contractor.

The general Contractor will post caution signs where needed (e.g. "Hard Hat Area", "Caution Excavation in Progress" etc.)

- Examples of hazards and activities that may need to be identified and with a general cordon are:
- Maintenance work on overhead equipment and roofs where there is a risk of objects falling.
- Work in trafficked areas where there is a risk of collisions.
- When using hoists or other lifting equipment where there is a risk of objects falling.
- During major clean downs and product changes.
- Excavations and construction work.
- Trip hazards, spillages, slippery surfaces and wet floors.
- Machinery under test.

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Dust Protection
Take extra care when working in "EX" rated zones (ATEX regulated), all spillages must be cleaned up immediately and always ensure you monitor the working environment and recognize where new hazards may be introduced to the area.

Please make note to ATEX regulated areas which are recognized by the "EX" sign posted on the entrance to the ex rated zones. Before any work is carried out in "EX" (ATEX regulated) areas (namely Board Plant additives area) permission must be received from the Technical Manager and the required permits completed.
Please consult your site contact before commencing this type of work.

Reporting Requirements
All accidents, injuries, incidents and hazardous occurrences must be reported immediately. It is important that all accidents, incidents and hazardous occurrences are reported so that:

- Appropriate action must be taken to rectify the situation as quickly as possible.
- An incident investigation can be carried out.
- We may fulfil any legal responsibilities with regard to notification of statutory authorities and the company incident reporting procedures.

These include:

- Using the dedicated emergency number (Internal extension 042 96 98 241)
- Incidents and injuries such as fire, property damage, flood, spillages, hazardous conditions or other unusual occurrences.
- Illnesses resulting from work on the site;
- Near misses, dangerous occurrences, safety obstructions, unsafe acts/ conditions (e.g. trips, slips, falls, scaffold fall, trench collapse, fork truck overturning, etc.)

Notify the Site contact, if unavailable contact security using the dedicated emergency number (Ext 042 96 98 241) immediately.

NOTE: See last page of booklet for emergency contact details, phone numbers. etc.

The site contact must be informed immediately of such incidents in order to prevent them happening again and causing serious injury.

Inspections and Auditing

- Individuals carrying out contract work on all sites must be competent to do so and all equipment, machinery, tools etc. must be appropriate for the job.
- The company reserves the right to inspect certification of skills competency or equipment condition.
- Safety and environmental audits are regularly carried out by company personnel on work places and work practices on site. These are designed to encourage continuous improvement in health, safety and environmental standards for all personnel working on site. Contractor operations will be audited in the same way as regular company audits.

- Good working practices will be noted and encouraged, and equally, shortcomings will require corrective actions to be implemented.
- Persistent or Serious offenders will be excluded from the site.

CONDUCT

The use of alcohol and illegal drugs is strictly forbidden on site. Anybody deemed to be under the influence will be removed from the site, and will not be allowed to return. The company should be advised if contractors are on prescribed drugs that could affect your ability to work safely so that a suitable risk assessment may be undertaken.

Horseplay can lead to serious accidents and will not be tolerated.

Please be courteous. This includes no offensive language, no rowdy behaviour, no loud radios or other disturbances.

To protect your safety, full and proper attire must be worn at all times as required.

The Company views the theft of its products, property or employee's property as extremely serious. Any individual caught or suspected of stealing such property will be escorted off site and banned from re-entering the premises. Such an occurrence may also result in the contract being suspended and the contracting Company being withdrawn from the site permanently. The Garda Siochana may be requested on site to carry out a full investigation.

USING Gyproc /Isover Saint-Gobain facilities at Kingscourt/Knocknacran & Kilcarbery.

Canteen Facilities

Canteen facilities are available throughout the site. Your site contact will inform you where the nearest canteen facilities are available. It is the responsibility of all canteen users (including contractors) to ensure that the area is left clean and tidy after use. Failure of contractors to observe this rule may result in canteen use being suspended.

Toilet Facilities

The company toilets and wash facilities are available to contract employees.

Telephones

The Contractor must provide a job phone, if required. The use of internal phones is permitted with prior permission of your site contact. The use of mobile phones is not permitted on site while operating mobile plant and equipment.

When walking onsite or working at a work station if you receive a call **STOP** what you are doing, make your work area safe and move to a safe area if necessary to take the call.

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PROTECTING THE ENVIRONMENT

ISO 14001 Environmental Management System

Saint-Gobain Gyproc/Isover operates to ISO14001. The system ensures that all aspects of the environment are managed through documented procedures, work practices and the keeping of records to demonstrate compliance.

Health & Safety, Environmental and Quality Policy

The Health & Safety, Environmental and Quality Policy is displayed in the following locations:

- Reception in Kingscourt, Knocknacran/Drummond and Kilcarbery
- Boardroom at Kingscourt,
- Board Plant and
- Plaster Mill

Integrated Pollution Prevention and Control (IPPC) Licence

The IPPC Licence covers all aspects of our environmental performance and details all the requirements under law in relation to our air, water, noise and waste emissions. The Environmental Protection Agency (EPA) may arrive on site at any time to inspect our activities and to take samples, to enforce our compliance with this licence.

Effluent/Storm water

The company has its own effluent treatment plant at the process site. This treatment plant deals with all sewage waste from the processing site at Kingscourt.

There are two sets of drains on-site:
Storm water drains which run directly to the river – Rain/Surface water run off
Foul water drains which go to the effluent treatment plant – Sewerage
Never pour oil, chemicals, waste chemicals or any other hazardous material down a surface or foul drain.
This could directly affect treatment of our effluent and the discharges to the river. If you are in doubt, or see anything entering the foul or storm drain system, contact your supervisor / site contact immediately.

Storage of Chemicals

All hazardous materials (chemicals, oils) used on all sites must be stored on chemstores or in bunded areas (lubrication store, board plant additive area, oil storage areas). In this way spillages can be contained and present no risk to the environment.
Spill kits which hold absorbent material are available in the board plant, plaster mill, yard, garage (at the mine and factory) and in the emergency response compound. In the

event of a spill, report the incident to your site contact or the company representative and use the absorbent materials to contain the spillage. An on site emergency response team is available to assist with spill clean up. Contact security using the dedicated emergency number (Internal extension 042 96 98 241) to alert the emergency response at the Kingscourt site. 042 96 98 241 can be used if calling from the mine site also.

Waste Disposal

All waste disposal is carefully controlled at Saint-Gobain. The procedures for disposal/ recovery of non-hazardous and hazardous waste are outlined in the environmental manual, respectively, detail how waste is to be disposed of and who is responsible for its correct disposal.

General waste is collected in black wheelie bins throughout our site. Green wheelie bins are used to store recyclable materials such as paper, cardboard, plastic bottles, milk cartons and aluminium cans.

All waste oils and chemicals must be stored in clearly identifiable and suitable containers while awaiting disposal. Liquid waste/ chemicals must be stored in a bunded container/ area.

Other items that require special attention are waste oils, scrap metals, light bulbs, batteries , refrigerants etc.

If in doubt about waste disposal of any material ask your supervisor/ Saint-Gobain contact.

Communications
Environmental communications can be reported using the "Communications" form (KC ENV 06). Report all environmental incidents or near misses to your site contact immediately.

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Contractors Safety Handbook

Acknowledgement Slip

This is to confirm that I have received, read and understood the contents of this contractor's safety handbook.

I agree to follow the rules outlined in this contractor's safety handbook.

First Name (Print) _____

Surname (Print) _____

Signed: _____

Company: _____

Sub-contracting: _____

Occupation: _____

Inducted at:
- ☐ Process site Kingscourt
- ☐ Mine site Knocknacran
- ☐ Unit 4 Kilcarbery

Inducted by: _____

Date: _____

EMERGENCY CONTACT DETAILS

Contact Kingscourt security on ext 0429698241 from the factory and mob. 0879980754 (i.e. between 5:00pm and 8:00pm) from the mine site to initiate emergency response procedures. A list of emergency contact details are available at numerous locations at each site and should be consulted in an emergency.

The attached are for reference.

Doctors		
Dr Owen V Clarke	046 902 1186	
Dr D lynch	01 057 3080	Clondalkin
Dr Ollinger	01 459 2956	Monastery Road
NEDOC	1850 777 911	Outside of surgery hours (i.e. between 6:00pm and 8:00am), weekends and Bank/Public holidays

Hospitals	999/11		
Navan Hospital	046 902 1210	Cavan Hospital	049 4361399
Monaghan Hospital	047 81811	Drogheda Hospital	041 9837601
Tallaght Hospital	01 414 2000		
St James' Hospital	01 453 7941		

Fire Brigade	999/112	
Garda	999/112	(For all emergencies)

Garda confidential line	1800 666 111		
Kingscourt	042 966 7292	Carrickmacross	042 9690190
Bailieborough	042 969 4570	Ballyfermot	01 6264559

Sharon Lynch	087 900 1353	Kilcarbery Management
Maeve O'Reilly	01 268 0100	EPA
Head Office	053 916 0600	
Rilta (emergencies clean up)	01 401 8000	

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Appendix 3.7

Interpretative Geotechnical Report - Temporary Road Diversion & Cut-and-Cover Tunnel

REPORT

Geotechnical Interpretative Report: Temporary Diversion Road and Tunnel

Saint-Gobain Mining (Ireland) Limited

Submitted to:

Monaghan County Council (MCC)
on behalf of
Saint-Gobain Mining (Ireland) Limited
Gyproc Ireland
Kingscourt
Co. Cavan
A82 PF99

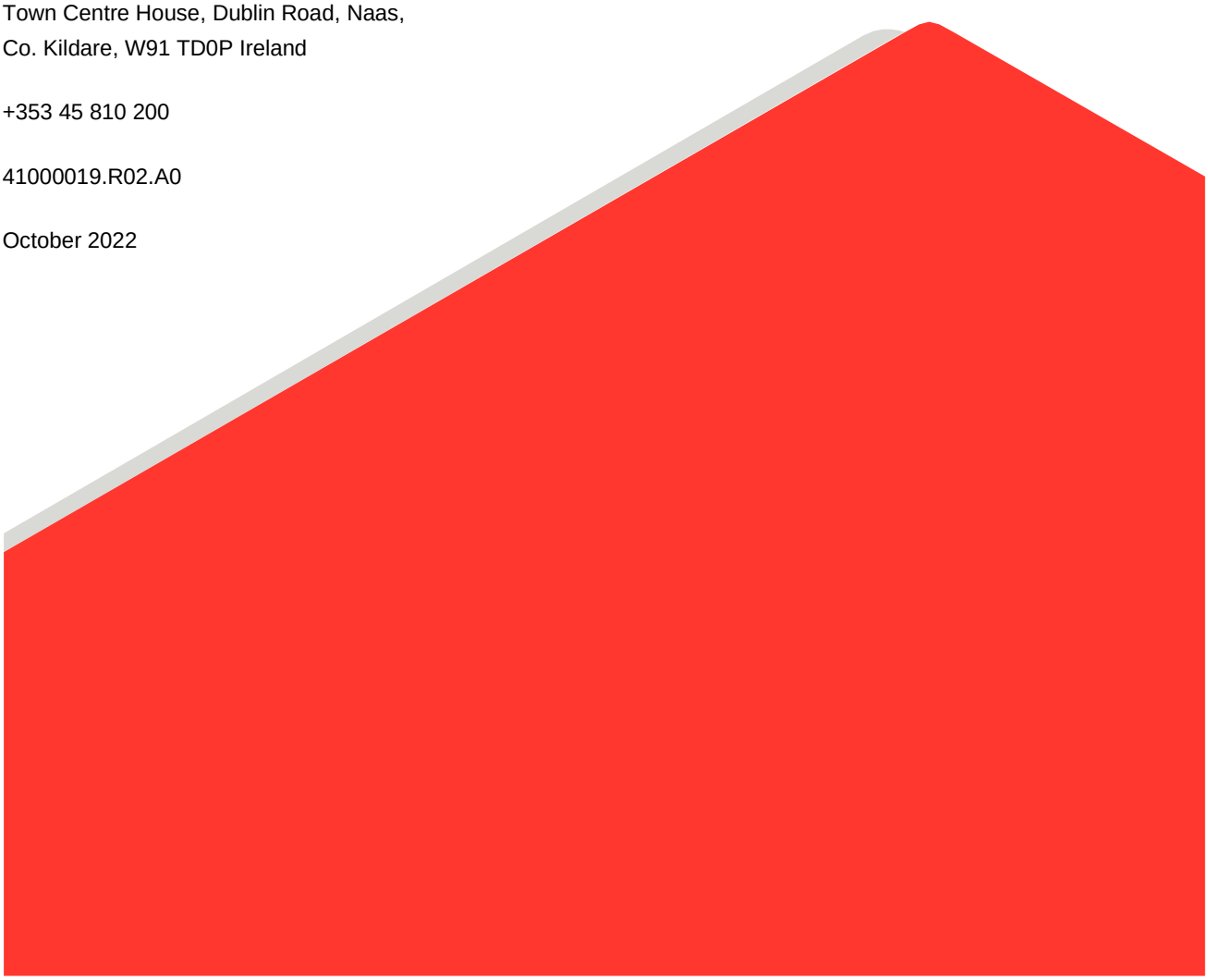
Submitted by:

Golder-WSP Ireland Consulting Ltd
Town Centre House, Dublin Road, Naas,
Co. Kildare, W91 TD0P Ireland

+353 45 810 200

41000019.R02.A0

October 2022



Distribution List

Golder-WSP Ireland Consulting Ltd - 1 copy (PDF)

MCC - 1 copy (PDF)

SGMI - 1 copy (PDF)

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SI Report - Causeway

1.0 INTRODUCTION

Golder-WSP Ireland Consulting Ltd (Golder-WSP) has been commissioned to prepare this Geotechnical Interpretative Report to support the design of the proposed Temporary Diversion Road and proposed Tunnel below the R179, which are components in the Construction Stage – Enabling Works for the proposed Development, on behalf of Saint-Gobain Mining (Ireland) Limited (SGMI) for submittal to Monaghan County Council (MCC).

This report has been prepared to provide a response to the following additional information items requested by MCC for Planning Ref. 22/34:

- **RFI. 20.I.** To substantiate the proposed design of the R-170 temporary design, the following design reports are required:

  (i) A geotechnical report outlining the current ground conditions, the load-bearing capacity and confirmation that the proposed road diversion has been designed taking account of a detailed Site Investigation Report.

  (v) Structural design report for the proposed tunnel under the R-179. The report shall include:

  ii. A geotechnical report outlining the current ground conditions, the load-bearing capacity and confirmation that the proposed structured has been designed taking account of a Site Investigation Report.

Golder-WSP prepared a 'Pit Slope Stability Preliminary Assessment' (Golder 2019, Report Ref. 19121210.R01.B0) as part of the submittal for the EIAR which provided an assessment of the ground conditions for Knocknacran West based on previous site investigation and design reports for the Knocknacran Pit, SGMI borehole logs for Knocknacran West and borehole logs from the Golder 2018-2019 ground investigation / monitoring well drilling programmes at Knocknacran West (see Table 1).

Table 1: List of Previous Site Investigation and Design Reports

Works	Author
Original Design of the Knocknacran Pit	(Geoffrey Walton, 1982)
Geotechnical Assessment Knocknacran Open Pit Mine Ireland	(Golder, 2003)
Design of Knocknacran Pit extension to northern boundary.	(Atkins, 2006)
Design of Knocknacran Pit extension to south-eastern boundary	(Golder, 2017)
Drumgoosat Subsidence event – Technical report	(SRK, 2018)
Investigation of the collapse of working at Drumgoosat – An independent review of the works completed by SRK	(Wardell Armstrong, 2018)
Knocknacran West, Ground Investigation and Monitoring Well Drilling Programme	(Golder, 2019)
Knocknacran Open Pit Geotechnical Assessment	(Golder, 2019)

Chapter 7.0 of the EIAR provides comprehensive details of the Land, Soils and Geology for the proposed Development.

A specific site investigation was conducted along the route of the proposed Temporary Diversion Road and Tunnel in September 2022, comprising 3 x Trial Pits, 3 x Plate Load Tests and 5 x Boreholes with SPT testing, and the factual report is provided in Appendix C.

2.0 PROPOSED DEVELOPMENT

The mine workings at the former Drumgoosat Underground Mine (closed in 1989) exist under the proposed Knocknacran West open-cast mine. SGMI proposes to extract the remaining pillars, overlying roof beams, underlying floor beams and previously un-mined areas from both the Upper and the Lower Gypsum Units using open pit mining methods. The proposed Knocknacran West Open-Cast Mine site is ca. 54.3 ha, of this ca. 47.5 ha comprises the extraction area. The depths range from ca. 70m to 80m from the current ground elevation to the base of the lower gypsum unit. It is proposed to continue to use the existing processing facility on the existing Knocknacran Mine site for the processing of the extracted gypsum from Knocknacran West Mine.

2.1 Development Activities

The elements of the proposed Development that are relevant to this geotechnical interpretative report are described below and shown in Figure 1 and Figure 2.

- Development will include the construction of a Cut-and-Cover Tunnel under the Carrickmacross to Kingscourt regional road (R179) for the transport of gypsum (by haulage truck and covered conveyor) to the existing processing plant area at Knocknacran, and for the transport of overburden and interburden (by haulage truck) to the existing Knocknacran Open-Cast Mine site for ongoing restoration purposes. The construction of the proposed Tunnel will necessitate a temporary realignment of the R179 (Temporary Diversion Road) during the Tunnel construction period to allow the R179 to remain in constant use.

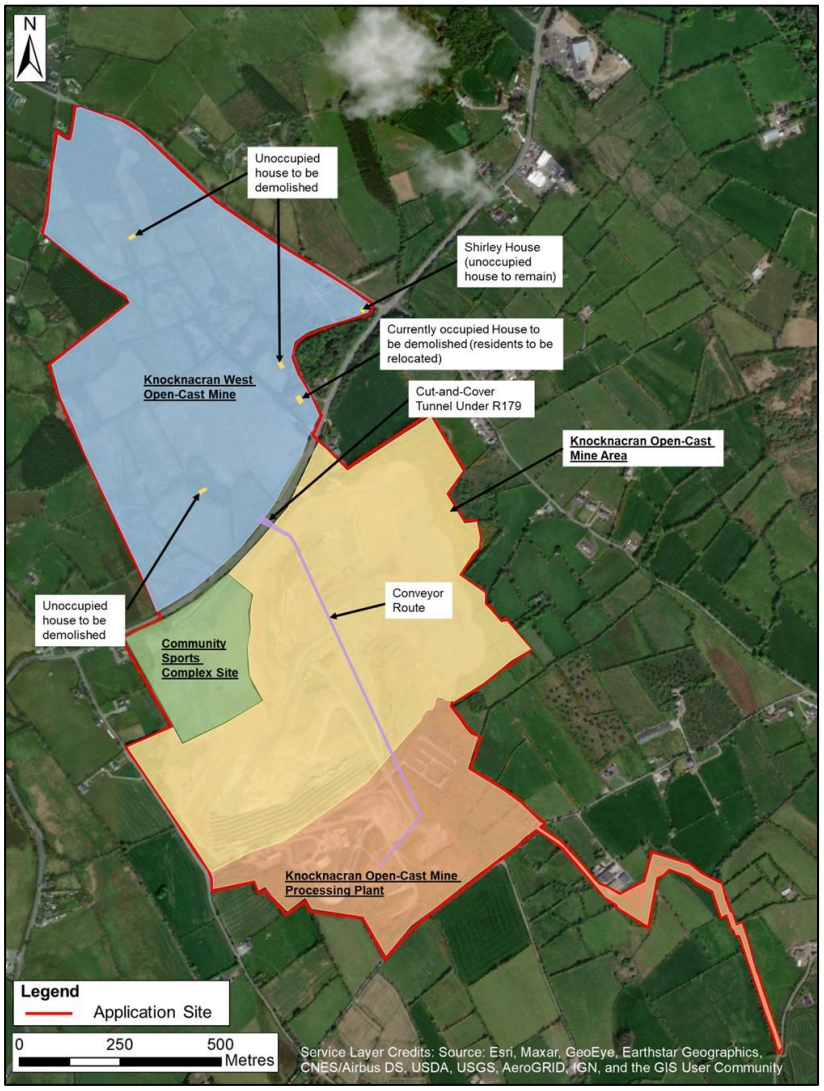


Figure 1: Proposed Development Site Layout showing Cut-and-Cover Tunnel

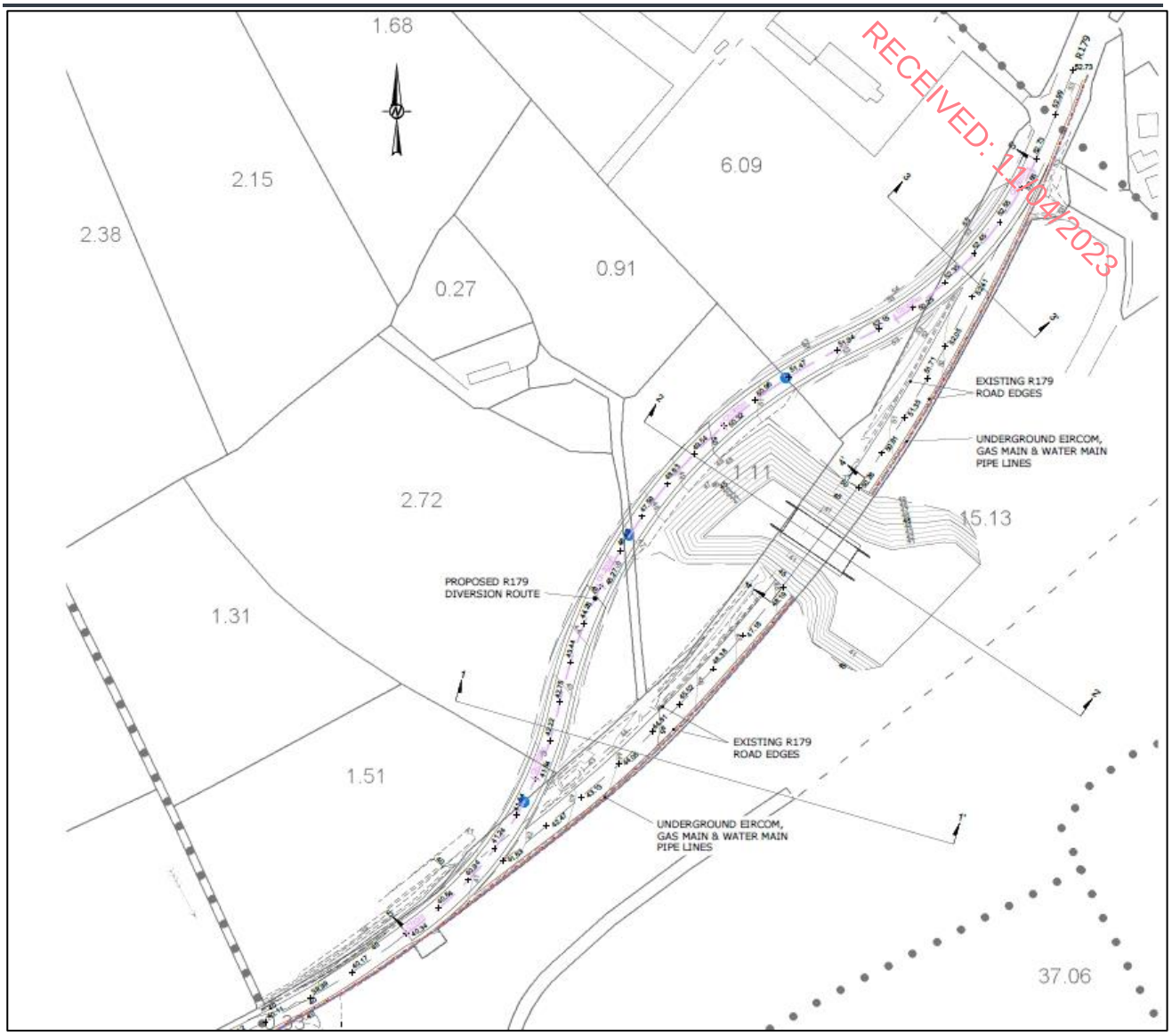


Figure 2: Routes for the proposed Temporary Diversion Road and Cut-and-Cover Tunnel

The overall Application Site area is ca. 140.4 ha[1], of which the proposed Knocknacran West Mine comprises ca. 54.3 ha, ca. 24.6 ha comprises the processing plant, ca. 8.6 ha will comprise the Community Sports Complex and ca. 51.5 ha will comprise the restoration area for the existing Knocknacran Mine.

Note: The coordinated system in use on Site is Irish National Grid (ING) and elevations are taken to Knocknacran Mine Datum (Malin Head + 1,002.6 m) (i.e. 50 mOD is equivalent to 1,052.6 mMD).

[1] The red line area encompasses a small area of the R179 (ca. 1.4 ha) which accounts for the slight discrepancy in total site area.

3.0 BACKGROUND

The proposed Knocknacran West Mine site encompasses the former Drumgoosat Mine underground workings to the north of the R179, see Figure 1 and Figure 3 below.

Prior to the initial subsidence event in September 2018 (refer to EIAR Chapter 7.0), activity on the site was mixed use. Above ground the land was previously used for pastoral farming, amenity uses (former Magheracloone Mitchell's GAA Club grounds and Community Centre) and a brownfield area to the north of the site which was the site of the former Drumgoosat Mine surface plant area which has become an area of semi-natural woodland. Below ground the majority of the site comprised (and continues to comprise) the former Drumgoosat Mine underground workings.

Former Drumgoosat Mine underground workings extend under the majority of the site, with some workings extending under the R179 and L4900 and under the footprints for the proposed Temporary Diversion Road and Tunnel (see Figure 3 below). The gypsum associated with the underground workings to the south of the R179 has been excavated during mining of the Knocknacran Open-Cast Mine.

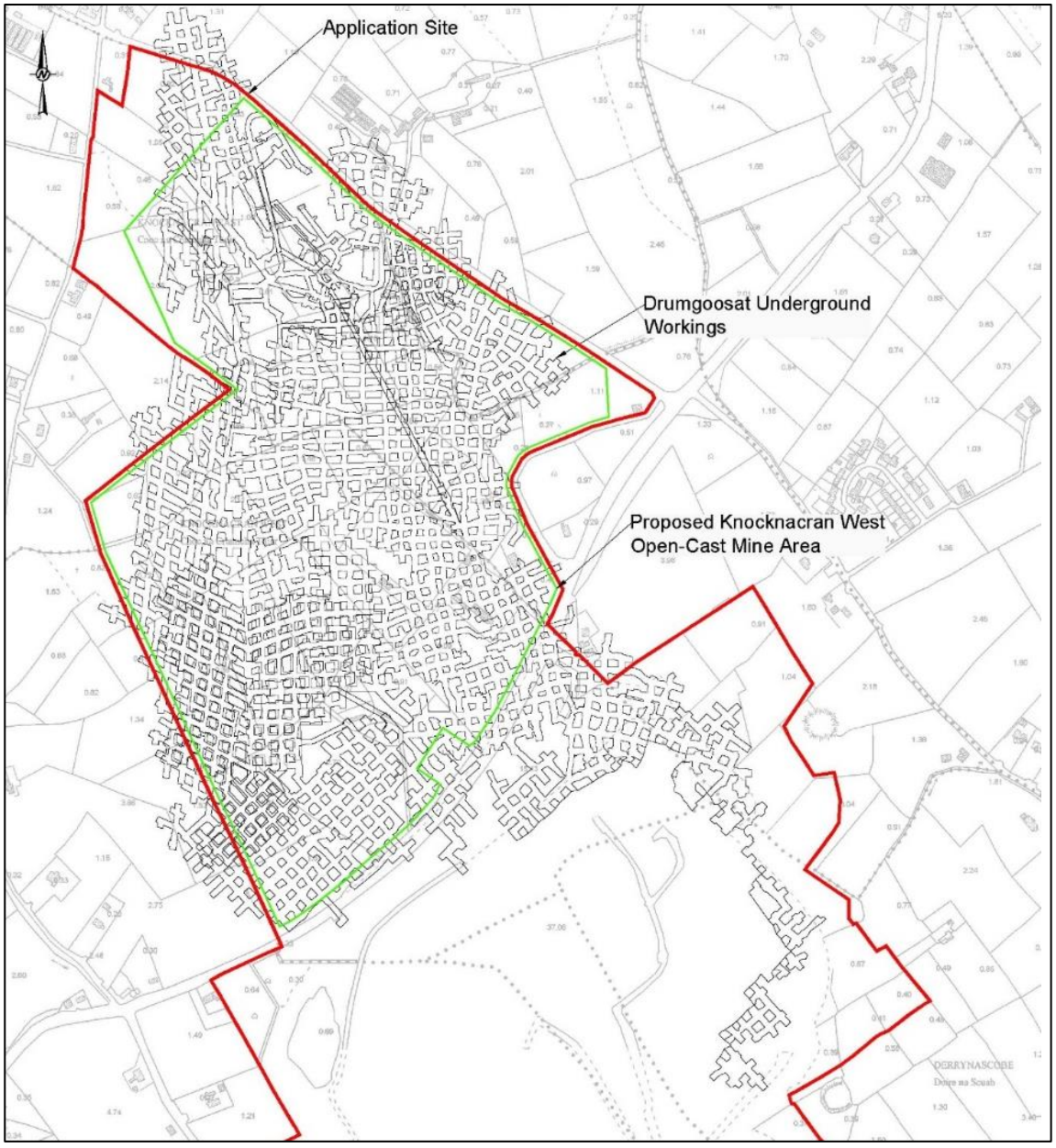


Figure 3: Plan showing extent of the former Drumgoosat Mine underground workings

Since the subsidence event in September 2018, work has been undertaken by SRK (with review by Wardell Armstrong for the Department of the Environment, Climate and Communications) to assess the causes and current, and future, stability of the existing underground workings beneath the site (refer to EIAR Chapter 7.0 and Appendices, and Item 22 of the RFI response document).

The only activities which have taken place on the Site since the subsidence event have related to remediation; through the removal of buildings, filling of subsidence features and regrading of the site, and monitoring and management of the site. The former GGA Club Grounds, Community Centre buildings and pitches were removed as part of site remediation works. Remediation of crown-holes and fissures associated with this subsidence event have also taken place. The site of the Grounds remains not in use, as does the wider site.

Figure 4 below (and Drawing 01 in Appendix A) shows the extent of the subsidence event (dashed magenta line) as identified by the tension cracks surveyed, and the location of the crown holes that were filled (dashed cyan lines). The footprints of the proposed Temporary Diversion Road and the Tunnel were not influenced by the subsidence event and the north end of the Temporary Diversion Road is located a minimum of 50m from edge of carriageway to the southern extent of the tension cracks from the subsidence event. Figure 3 shows that there are several large blocks in this area that have no mine workings.

Figure 4: Plan showing extent of the Subsidence Event and the footprint of Temporary Diversion Road

4.0 DESKTOP ASSSESMENT

Chapter 7.0 of the EIAR provides comprehensive details of the Land, Soils and Geology for the proposed Development. The relevant sections have been extracted and are summarized below.

4.1 Subsoils

According to subsoil mapping Figure 5 compiled by Teagasc and the EPA, the Knocknacran West site consists primarily of sandstone and shale till with some undifferentiated alluvium and bedrock at surface near the village of Drumgoosat. The thickness of the superficial deposits is variable across the area. Thicker till layers are observed at the higher points of the terrain (drumlins), with overburden thickness reaching about 50 m. Away from the drumlins, the overburden can be as thin as 1 m, with areas of bedrock outcrop seen to the east of the site (i.e. there is no overburden present). The average overburden thickness is 13 m according to drill hole logs and the Geological Survey of Ireland (GSI) National Well Database.

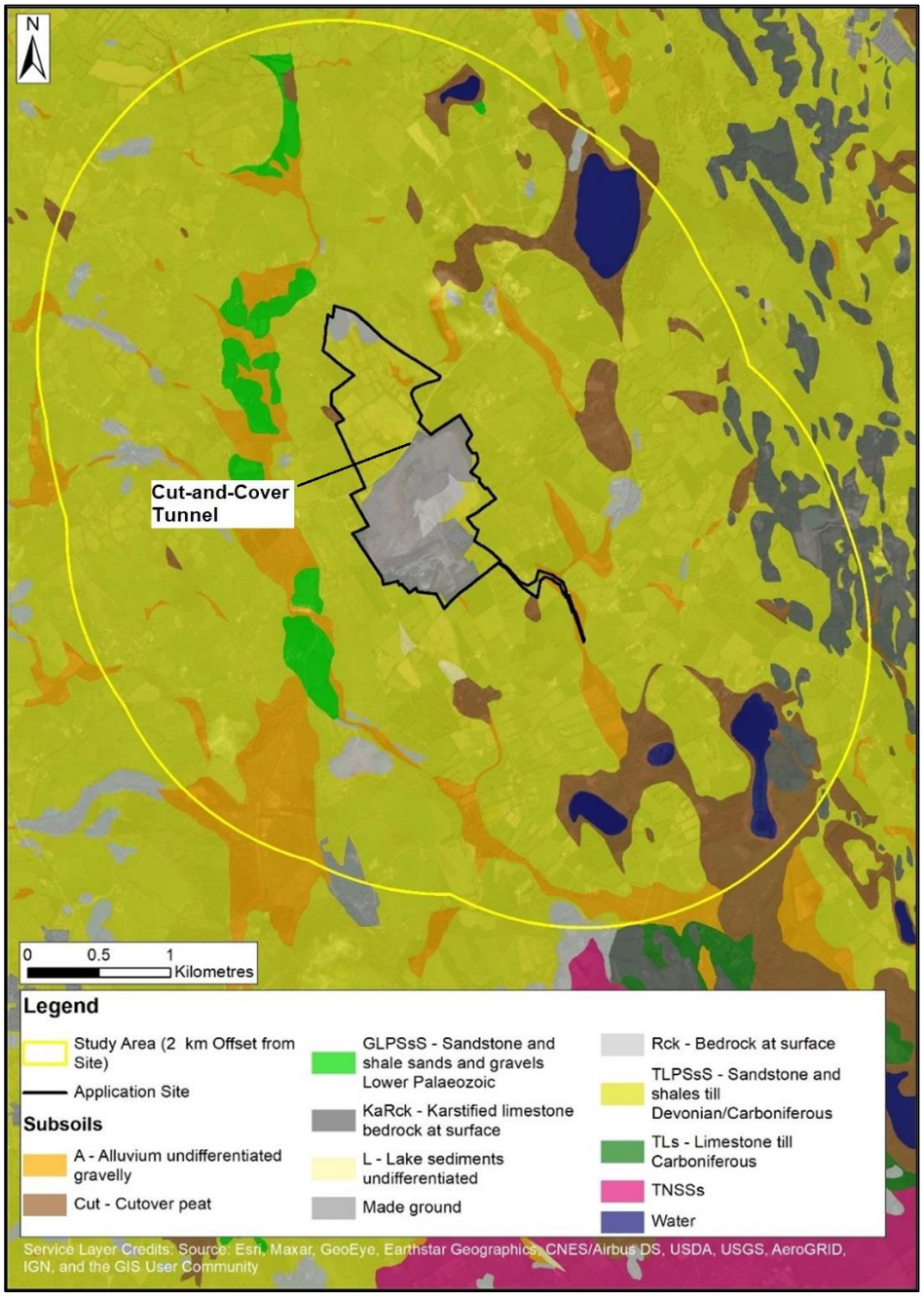


Figure 5: Subsoils Map (Teagasc and EPA)

4.2 Bedrock

Figure 6 below shows the bedrock mapping for the area. The footprint of the Temporary Diversion Road and the Tunnel are underlain by the Kingscourt Gypsum (KG) Formation. The KG Formation is underlain by undifferentiated micaceous shales, siltstones and sandstones, and occasional thin coal beds of Westphalian and Namurian (Carboniferous) age, which outcrop in small areas to the south and north of the Kingscourt Outlier.

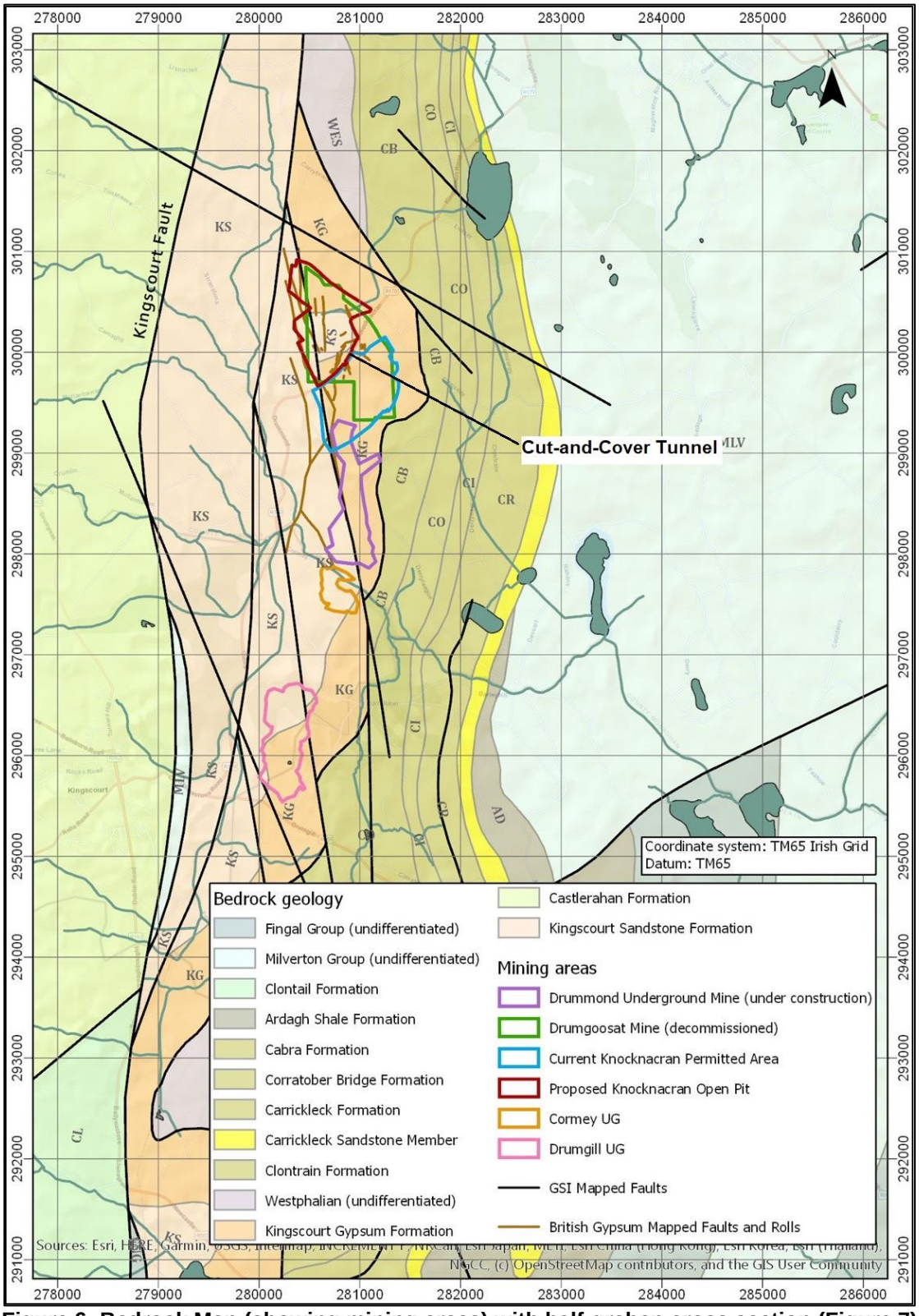


Figure 6: Bedrock Map (showing mining areas) with half-graben cross section (Figure 7)

Kingscourt Gypsum Formation: Is a mudstone unit with two distinct mineralised beds. The provenance of the gypsum suggests deposition of sediments when arid deserts were occasionally encroached upon by the sea, which then evaporated to precipitate thick deposits of evaporite minerals. Figure 7 presents the stratigraphy of the formation, which is typically divided into five units, described below from bottom to top:

- ***Lower Mudstone Member*** is a transitional mudstone which grades up into the Lower Gypsum.
- ***Lower Gypsum Member* and Anhydrite Bed** is up to 35 m in thickness and is grey in colour. Above the transition zone with the Lower Mudstone, it comprises a thickly bedded, high quality white to grey nodular gypsum that has been the target of underground mining.
- ***Middle Mudstone Member*** is a band of mudstone that separates the upper and lower gypsum members. It varies between 6 and 12 m in thickness.
- ***Upper Gypsum Member*** is a massive, fine grained, grey-brown to red pure gypsum. It is typically red and is thinner than the lower bed, ranging between 6 and 10 m in thickness.
- ***Upper Mudstone Member*** the Upper Gypsum is overlain by the Upper Mudstone, which is between 26 and 36 m in thickness.

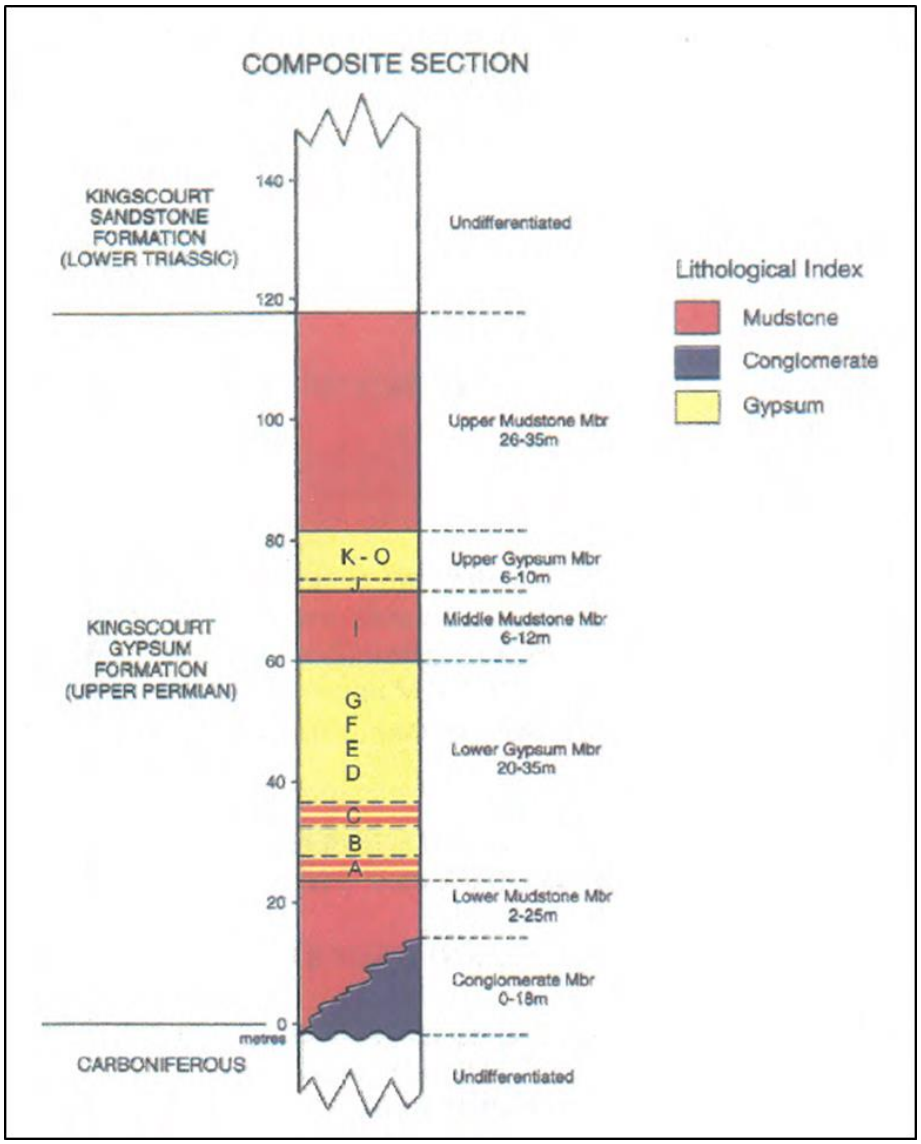


Figure 7: Kingscourt Gypsum Formation Stratigraphy (Gardiner & McArdle, 1992)

Figure 8 below shows the stratigraphy that was exposed at the south end of the proposed Tunnel (north-east sector of the Knocknacran Pit), prior to backfilling this sector of the Knocknacran Pit. The R179 is located beyond the hedge at the crest of the Pit.

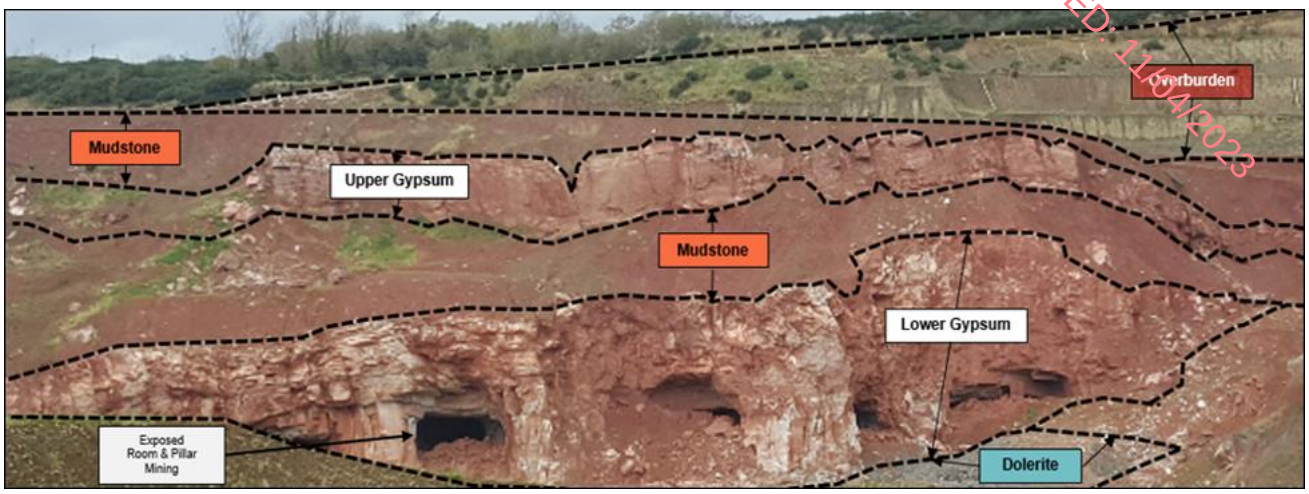


Figure 8: Stratigraphy Section showing the exposed

A similar stratigraphy extends beneath the footprint of the Temporary Diversion Road and the Tunnel. The south face of the tunnel will exit approx. 6m above the top of the Upper Seam Gypsum unit at this location.

Both the Temporary Diversion Road and the Tunnel are founded in the Overburden, which is a glacial till and/or overburden mudstone.

4.3 Borehole Data

Extensive historic resource borehole data was provided by SGMI for the Knocknacran West site, but it largely targeted the gypsum layers and provided little detail on the transitional layers. The data from these boreholes was combined with the ones showing greater detail for the stratigraphy and the borehole logs from the Golder 2018-2019 ground investigation / monitoring well drilling programmes to create a 3D sub-surface model which was utilized for the Knocknacran West resource modelling and pit design. The 'Pit Slope Stability Preliminary Assessment' (Golder 2019) cut sections through the 3D sub-surface model and the pit design for stability analyses. The overlay of this drawing with the footprints of the Temporary Diversion Road and the Tunnel is shown in Figure 9 below and in Drawing 02 in Appendix A.

Sections A-A' and B-B' cut perpendicularly across the Temporary Diversion Road and are parallel to the Tunnel (north and south of the alignment) and are considered representative for the Tunnel profile, see Figure 10 below and Drawing 03 in Appendix A. Boreholes KC18-J, KC18-K, KC18-L and KC18-N, along with Borehole #79, are located in the area of interest and their logs are provided in Appendix B. Top of Upper Seam Gypsum varied between 1032.6 mMD and 1036.4 mMD (30.0 mOD and 33.8 mOD)

Sections A-A' and B'B both show glacial till depths of 7m to 9m beneath the route of the Temporary Diversion Road and for 4.5m to 12.5m beneath the R179. Overburden mudstone then extends for 7m to 11m further beneath the route of the Temporary Diversion Road and for 2m to 12.5m beneath the R179.

The Upper Seam Gypsum lies beneath with thickness varying from 4.5m to 7m. The top of the Upper Seam Gypsum beneath the R179 at the location of the Tunnel is estimated to be at 1036.0 mMD or 33.4 mOD. The R179 elevation above the Tunnel is approx. 1051.8 mMD (49.2 mOD) and the invert of the Tunnel is at approx. 1043.1 mMD (40.5 mOD).

The Temporary Diversion Road will be founded in glacial till and the Tunnel will be founded in overburden mudstone.

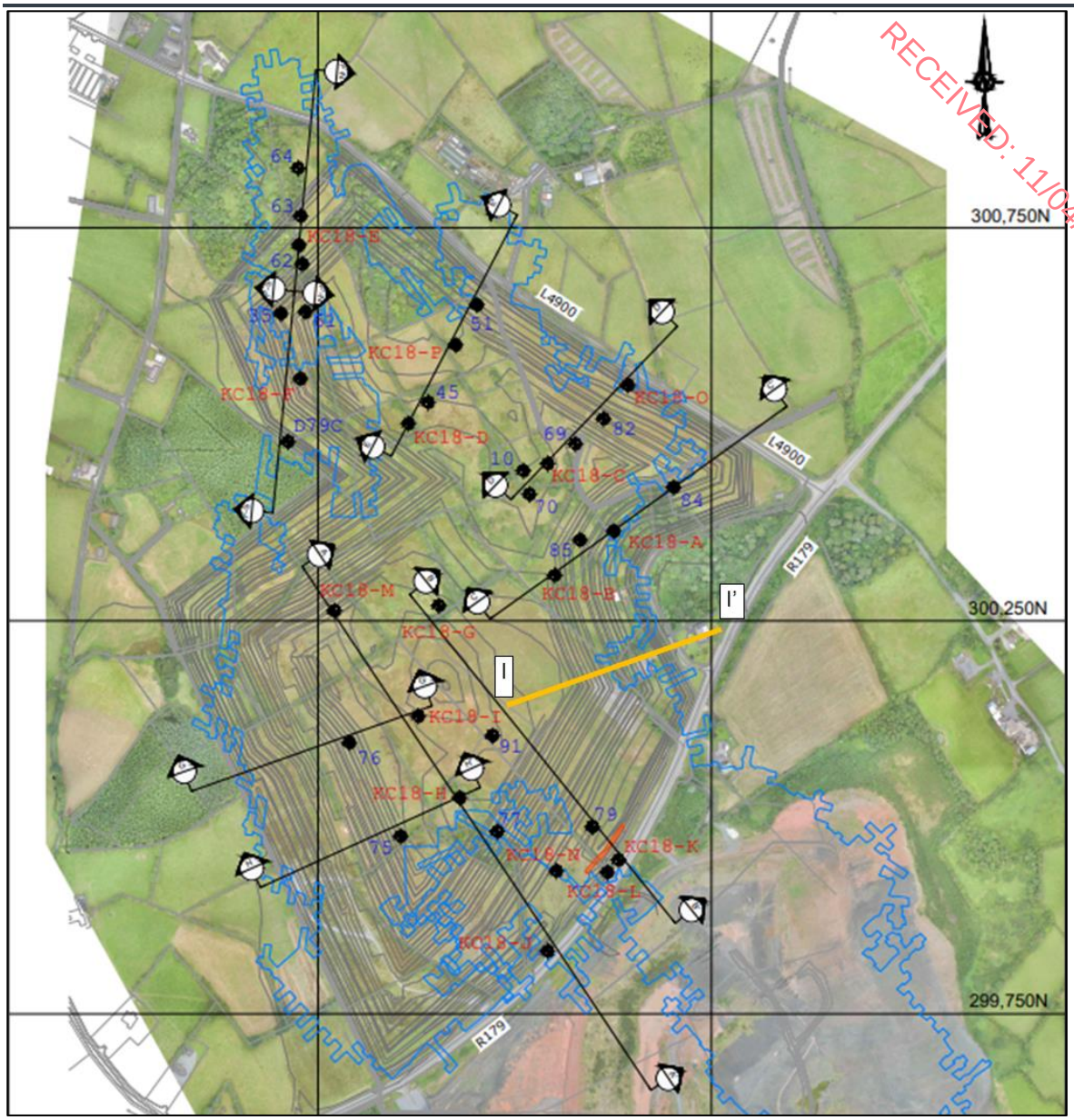


Figure 9: Map of Relevant Boreholes and Cross-Sections cut for Stability Analyses (Section I-I' added)

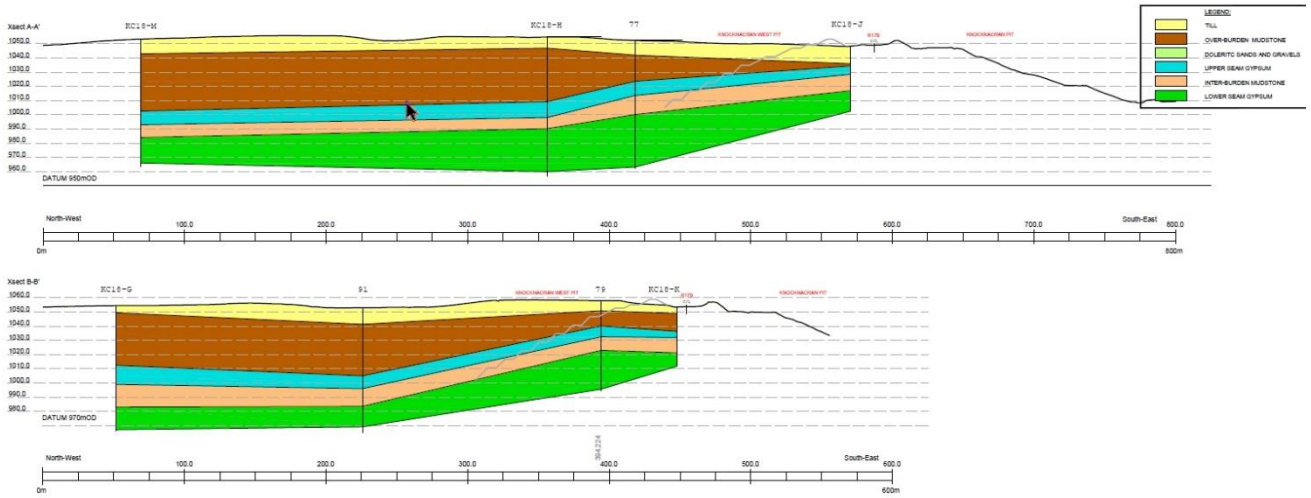


Figure 10: Cross-Sections A-A' and B-B'

4.4 Material Parameters

An Interpretative Geotechnical Report (Geoffrey Walton, 1982) was prepared for the Knocknacran Open-Cast Mine and comprised extensive site investigation, sampling and subsequent laboratory testing on the materials encountered.

Subsequent site investigations and testing have corroborated the data and the material summaries provided are validated (extracted from Table 3: General Character of Rock and Soil Materials at Knocknacran).

- ***Topsoil and Subsoil*** *– Sandy silty clays and clayey silts locally with peat and some gravel. Generally well graded of low to medium plasticity. Strength probably similar to glacial till q.v.*
- ***Glacial Till*** *– Stiff sandy, often very gravelly clay or dense very clayey gravels, with fairly even grading. Moisture content 14.7% (mean). The clays are inactive and of low plasticity. Drained shear strength is characterized by relatively high friction angles and low cohesion (ϕ' = 29.4°, c' = 19.5 kPa). Estimated C.B.R. 5%. Optimum moisture content for compaction 11.0%. Bulk density c. 2.0 Mg/m^3. Excavated without blasting and no severe handling problems.*
- ***Overburden / Interburden Mudstones*** *– heavily over consolidated reddish-brown silty, and, in places, sandy mudstones. Frequently extensively broken and highly to moderately weathered probably due to collapse brecciation. Generally found as a weak rock when slightly or moderately weathered becoming a very weak rock or a cohesive soil (soft to firm) when highly / completely weathered. Moisture content 11.9% (mean). The clays are relatively inactive, generally of medium plasticity. Shear strength differences are noted between overburden mudstones (ϕ' = 29.4°, c' = 42.9 kPa) and interburden mudstones (ϕ' = 30°, c' = 9.5 kPa). Estimated C.B.R. 15%. Optimum moisture content for compaction 8.0%. Bulk density c. 2.2 Mg/m^3. Excavated without routine blasting, generally without severe handling problems (may be sticky in places).*

5.0 SITE INVESTIGATION (SEPTEMBER 2022)

A specific site investigation was conducted along the route of the proposed Temporary Diversion Road and Tunnel in September 2022, comprising 3 x Trial Pits, 3 x Plate Load Tests and 5 x Boreholes with SPT testing, (see Figure 11 below and Drawing 04 below), and the factual report is provided in Appendix C.

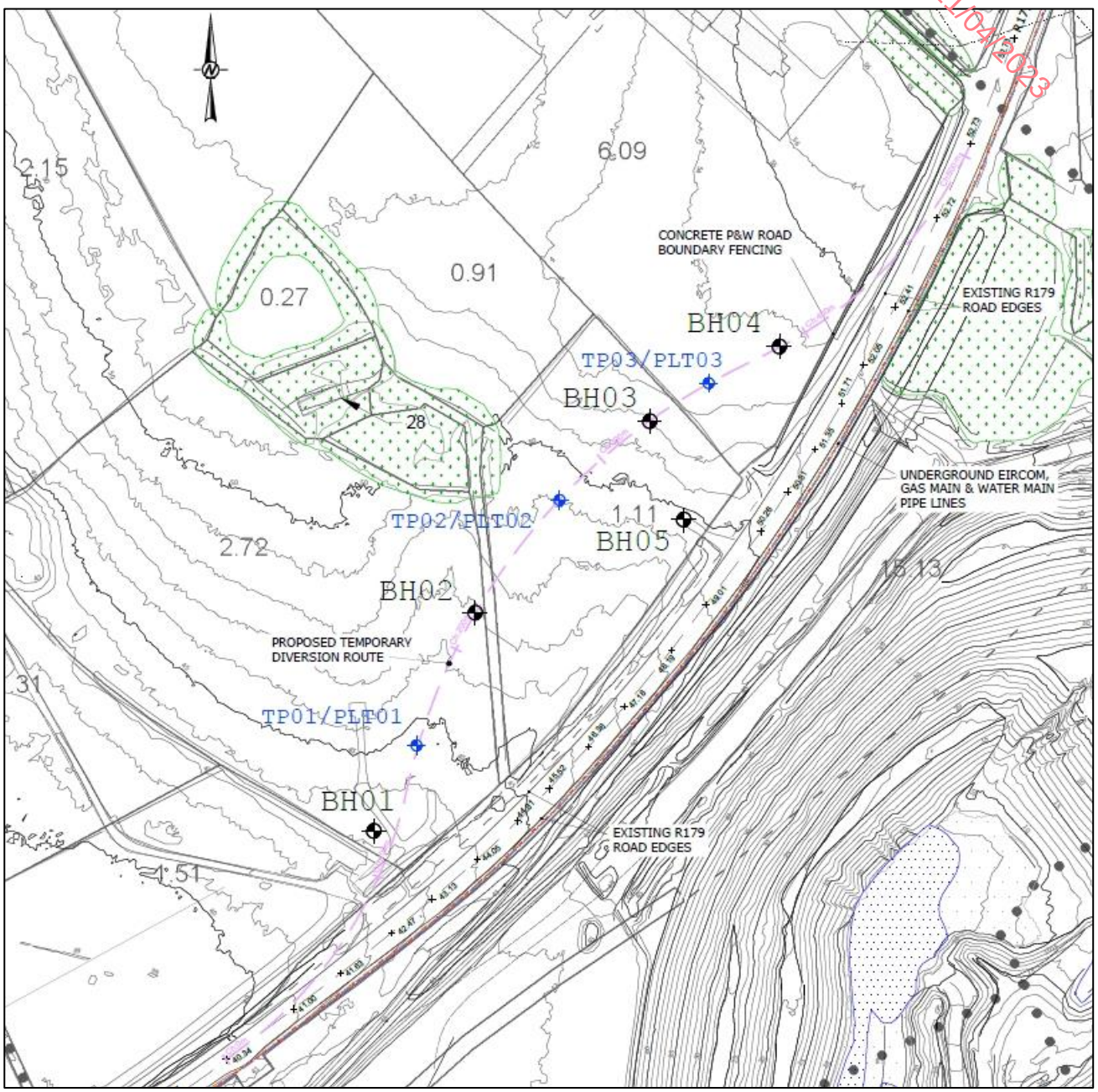


Figure 11: September 2022 - Site Investigation Locations

The 4 x Boreholes (BH01 to BH04) with SPTs were selected to be approximately located at CH-100, CH-200, CH-300 and CH-400, at 100m intervals. BH05 was selected to be on the north side of the Tunnel alignment. A summary of the borehole information is provided in Table 2 below.

Correspondingly, the 3 x Trial Pits (TP01 to TP03) and 3 x PLTs (PLT01 to PLT03) were selected to be approximately located at CH-150, CH-250 and CH-350m, also at 100m intervals. A summary of the trial pit information is provided in Table 3 below.

Table 2: Boreholes - Site Investigation Summary

ID	Location	Ground Elevation (mOD)	Overall Depth (m) [1]	Topsoil (m)	Till	Comments
BH01	CH-100	43.10	7.45	0.20	3.70	**Till: Medium Dense to Stiff** SPTs: N = 7 at 1.2m, 24 at 2m and 27 at 3m Water seeping at 1.8m (41.3 mOD) **Overburden Mudstone** SPTs: N = 36 at 4.0m, 46 at 5.0m, 50 at 6.0m and 46 at 7.0m Water seeping 4.8m (38.3 mOD)
BH02	CH-200	46.90	3.35	0.20	2.40	**Till: Firm** SPTs: N = 8 at 1.2m and 12 at 2m **Overburden Mudstone** SPTs: N = 50 at 3.0m Water seeping 3.0m (38.3 mOD)
BH03	CH-300	51.70	6.20	0.20	4.8	**Till: Medium Dense to Very Stiff** SPTs: N = 33 at 1.2m, 21 at 2m, 27 at 3m and 30 at 4m Water seeping at 2.0m (49.7 mOD) **Overburden Mudstone** SPTs: N =50 at 5.0m and 50 at 6.0m Water seeping 4.5m (47.2 mOD)
BH04	CH-400	53.62	5.70	0.20	5.70	**Till: Stiff** SPTs: N = 20 at 1.2m, 22 at 2m, 28 at 3m, 21 at 4m and 26 at 5m
BH05	Tunnel-North	50.05	5.45	0.20	5.45	**Till: Medium Dense to Very Stiff** SPTs: N = 25 at 1.2m, 35 at 2m, 23 at 3m, 36 at 4m and 28 at 5m Water seeping 2.0m (48.05mOD)

Notes:

1. ***Boreholes were advanced until chiseling for 1 hour could not progress the hole.***

Table 3: Trial Pits and Plate Load Tests - Site Investigation Summary

ID	Location	Ground Elevation (mOD)	Overall Depth (m)	Topsoil (m)	Till	Comments
TP01 PLT01	CH-150	44.46	3.60	0.20	3.60 +	Till: Soft to Firm, inflow at 1.3m (41.16 mOD) PLT: Depth = 0.4m, CBR = 1.8% (1st Cycle)
TP02 PLT02	CH-250	49.01	2.60	0.20	2.60 +	Till: Soft to Firm, inflow at 1.6m (47.41 mOD) PLT: Depth = 0.4m, CBR = 1.6% (1st Cycle)
TP03 PLT03	CH-350	53.60	3.40	0.20	3.40 +	Till: Soft to Firm PLT: Depth = 0.4m, CBR = 5.8% (1st Cycle)

The September 2022 borehole and trial pit stratigraphy indicate a lesser depth of till than that indicated by the previous borehole data with depths ranging from 2.4m to 5.7m compared to depths of 7m to 9m, thus demonstrating the undulating nature of the underlying stratigraphy.

6.0 INTERPRETATION AND RECOMMENDATIONS

The following design basis are recommended for the design of the Temporary Diversion Road and the Tunnel.

6.1 Temporary Diversion Road

The minimum expected make-up for the Temporary Diversion Road assuming a minimum C.B.R. of 4%, is 650mm, comprising a 200mm depth of Surfacing, 150mm depth of Sub-Base and 300mm of Capping, in accordance with fully flexible pavement design (TII 2010).

The design elevation of the Temporary Diversion Road increases from south to north, varying from 40.3 mOD at CH-0 to 52.8 mOD at CH-500. The elevation of the road mirrors the ground elevation less 0.3m to 0.5m.

The depth of material tested by the 1st Cycle PLTs (at 0.4m depth) will be excavated in the cut to subgrade and is considered likely that this material will meet / exceed the threshold C.B.R. of 4% once trimmed, graded and compacted. The SPTs at the 1.2m range from N=7 to N=33, and indicate a firm to very stiff till material, with an undrained strength of 25 to 200 kPa, and in the 4% to 20% range for C.B.R.

The design of the pavement on a basis of a minimum subgrade C.B.R. of 4% is proposed and inspection and testing is recommended to be undertaken on the subgrade to validate during the construction.

6.2 Tunnel

The design invert elevation for the Tunnel is at approx. 1043.1 mMD (40.5 mOD) and allowing for a 0.1m depth of decking, 0.5 thickness of precast concrete base slab, 0.05m depth of bedding and 0.1 m depth of concrete blinding, puts the subgrade at 1042.3 (39.7 mOD) which is approx. 10m below the current ground elevation and will in the overburden mudstone layer.

The SPT data for the overburden mudstone layer ranged from N = 36 to N = 50 and indicates very stiff to hard material, with an undrained strength of 100 kPa to > 200 kPa, in the 10% to > 20% range for C.B.R. and in the 200 to > 400 kPa range for bearing capacity.

The design of the Tunnel on a basis of a maximum bearing pressure of 200 kPa (including back fill over the Tunnel and live loads) for the serviceability limit state is proposed. Inspection and testing is recommended to be undertaken on the subgrade to validate during construction.

7.0 REFERENCES

Atkins 2006, Knocknacran Quarry Extension, Slope Stability Assessment.

Geoffrey Walton 1982, Geotechnical Report on a Proposed Opencast Gypsum Mine Knocknacran, Co. Monaghan.

Golder 2003, Geotechnical Assessment Knocknacran Open Pit Mine Ireland.

Golder 2017, Design of Knocknacran Pit extension to south-eastern boundary.

Golder 2019, Knocknacran Open Pit Geotechnical Assessment.

SRK 2018, Drumgoosat Subsidence event – Technical report 30238.

SRK 2019, SRK Consulting: 30238_December 2018 Crownhole Report_Final, March 2019.

TII 2010, Pavement and Foundation Design, DN-PAV-03021, TII Publications, December 2010

Wardell Armstrong. (2018). Investigation of the collapse of working at Drumgoosat – An independent review of the works completed by SRK

Signature Page

Golder-WSP Ireland Consulting Ltd

Billy Murphy
Principal, Geotechnical Engineer

Brian Keenan
Associate Director, Geotechnical Engineer

BM/BK/ld

Registered in Ireland
Registration No.302231
At Trinity House, Charleston Road, Ranelagh, Dublin 6 D06C8X4, Ireland
VAT No. 6322231R

APPENDIX A

Drawings

KNOCKNACRAN WEST
Cnoc na Crannchа Thiar

Agricultural Buildings

Dwelling House

Dwelling House

Dwelling House

R179

RECEIVED: 11/04/2023

SITE ENTRANCE (EXISTING GATES)

END OF R179 REALIGNMENT

NEW SINKHOLE APRIL 2020 (INFILLED)

PREVIOUS CROWN HOLE LOCATION

PREVIOUS SUBSIDENCE ZONE (TENSION CRACKS)

ABANDONED FARMHOUSE

ABANDONED FARM SHED

TEMPORARY DIVERSION ROAD

TUNNEL

START OF R179 REALIGNMENT

LEGEND:

- LANDS UNDER CONTROL OF APPLICANT
- BOUNDARY FENCE: POST AND WIRE
- OVERHEAD POWER LINES
- 1050 EXISTING GROUND CONTOUR (Mine Datum)
- DISTURBANCE ZONE OUTLINE
- INFILLED CROWN HOLE OUTLINES

NOTES:

GRID REFERENCES ARE IN METRES & TO IRISH NATIONAL GRID.

LEVELS ARE IN METRES & TO MINE DATUM.

DIMENSIONS ARE IN METRES.

CLIENT

SAINT-GOBAIN CONSTRUCTION PRODUCTS (IRELAND) LTD.

CONSULTANT

WSP GOLDER

YYYY-MM-DD	2022-Oct-12
PREPARED	POB
DESIGN	BK
REVIEW	DH
APPROVED	BK

PROJECT

SGMI - PROPOSED DEVELOPMENT - RESPONSE TO RFIs

TITLE

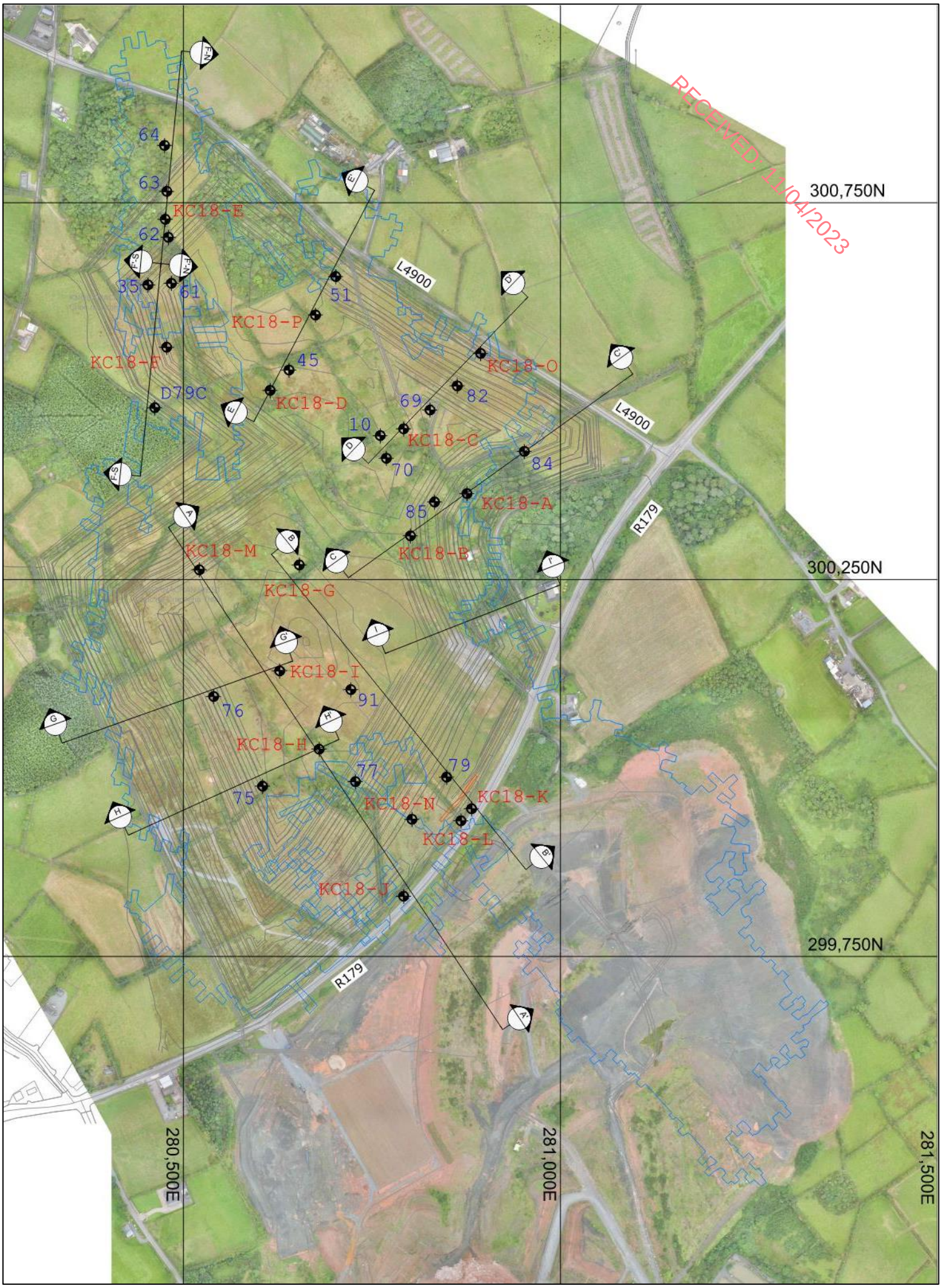
AS-BUILT CONTOURS WITH BACKGROUND AERIAL (JUNE 2020), TEMPORARY DIVERSION ROAD AND TUNNEL

PROJECT No.	DRAWING No.	Rev.	SCALE
19120130	01	A	1:1,250 A1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A1

0 25 mm

Path: C:\Users\BKeenan\OneDrive - WSP O365\Documents\Golder\Saint-Gobain_Gyproc Ireland\Magheraclone GA\1Drawings\COA Report | File Name: 108 - As Built Contours with Diversion Road and Tunnel - Oct 2022.dwg


RECEIVED: 11/04/2023
300,750N
300,250N
299,750N
280,500E
281,000E
281,500E
L4900
L4900
R179
R179
KC18-E
KC18-P
KC18-F
KC18-D
KC18-O
KC18-C
KC18-A
KC18-B
KC18-M
KC18-G
KC18-I
KC18-H
KC18-N
KC18-K
KC18-L
KC18-J
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91
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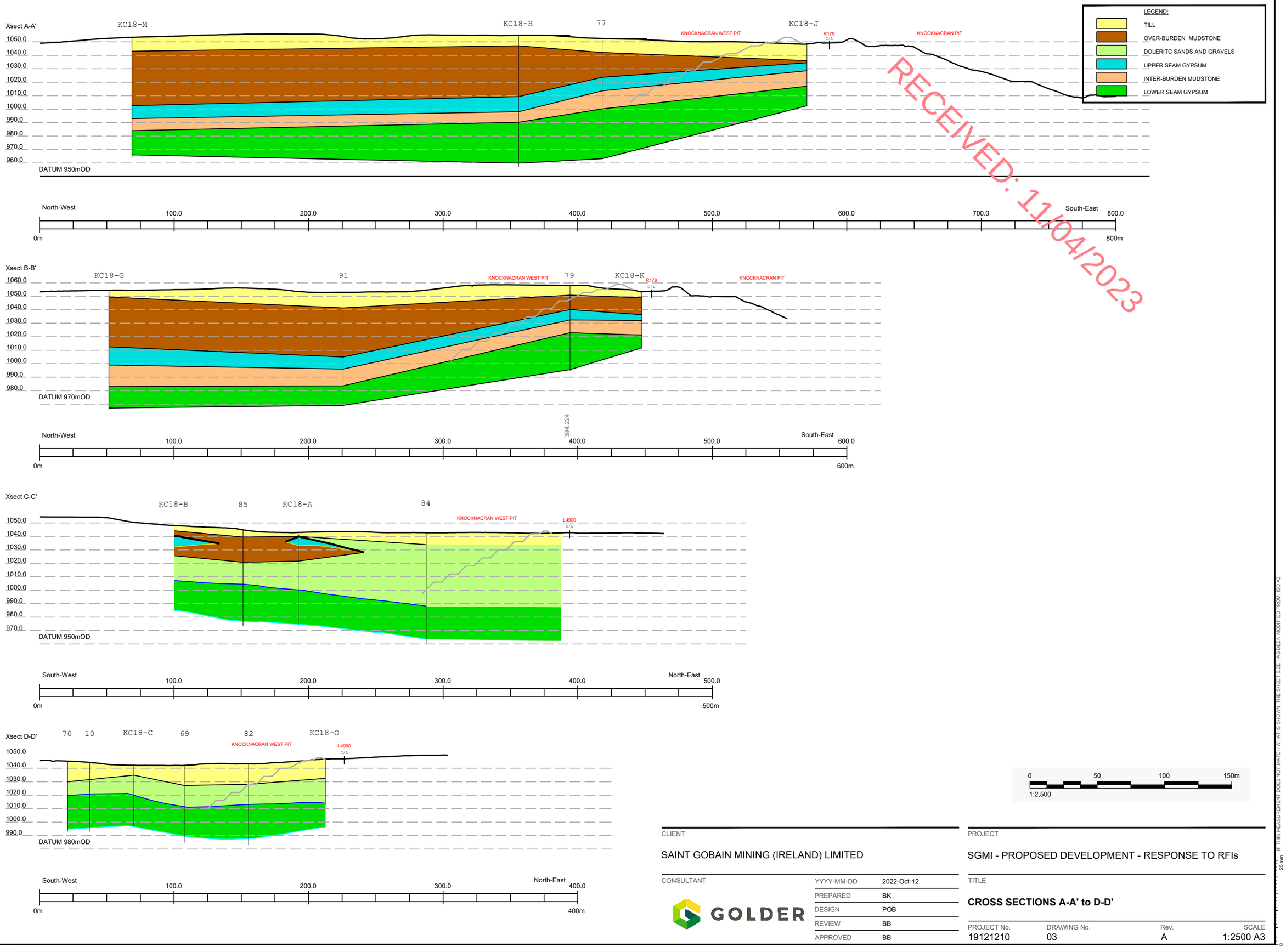
79
75



CLIENT

SAINT GOBAIN MINING (IRELAND) LIMITED

CONSULTANT

GOLDER

YYYY-MM-DD	2022-Oct-12
PREPARED	BK
DESIGN	POB
REVIEW	BB
APPROVED	BB

PROJECT

SGMI - PROPOSED DEVELOPMENT - RESPONSE TO RFIs

TITLE

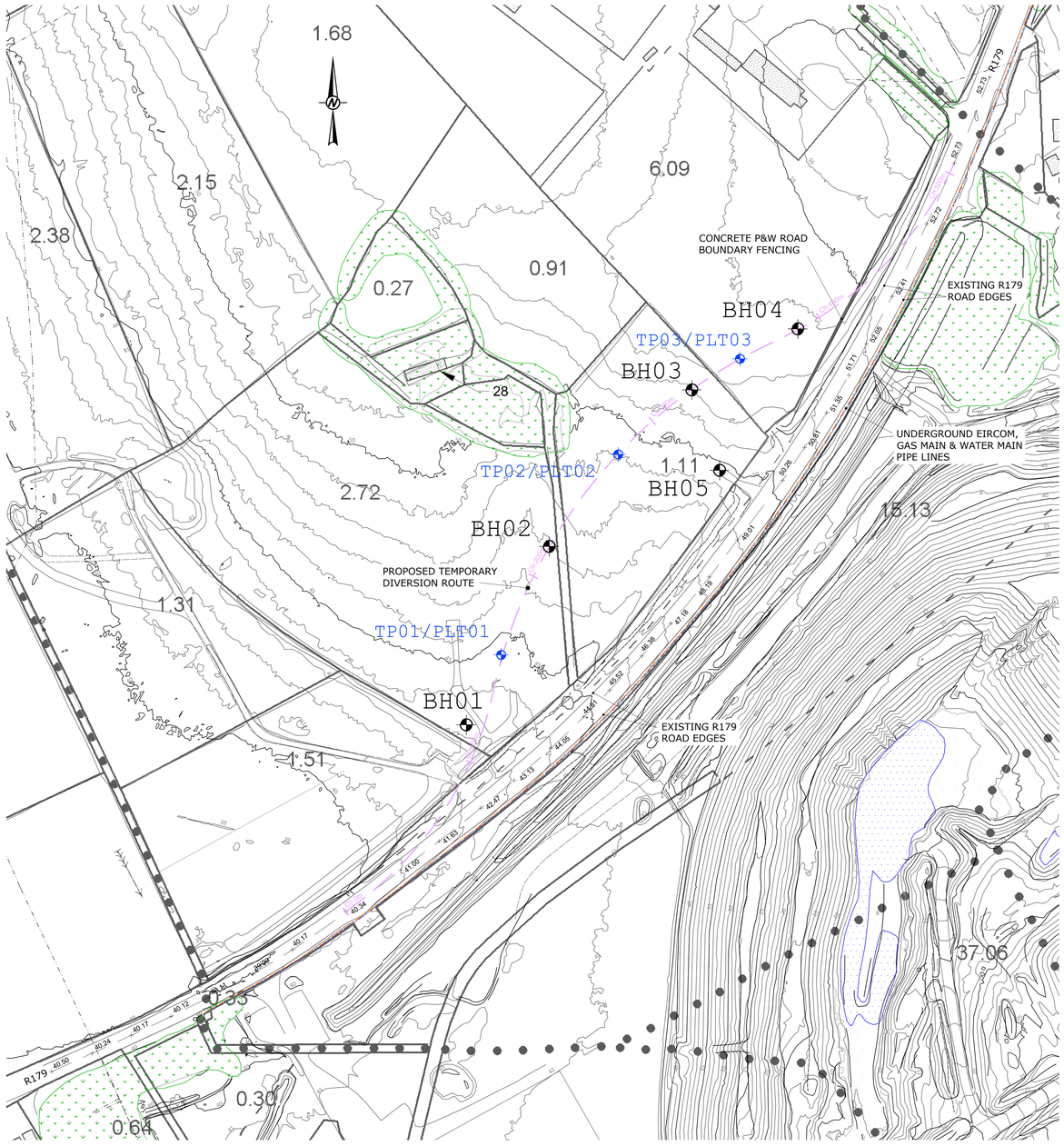
CROSS SECTIONS A-A' to D-D'

PROJECT No.	DRAWING No.	Rev.	SCALE
19121210	03	A	1:2500 A3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

0 25 mm

Path: C:\Users\bkeenan\Documents\Golder\Saint-Gobain_Gyproc Ireland\Drumgoosat\13_Bb Xsect Dwgs - 27 June 2019\ | File Name: 01 to 03 - Cross Sections - 25 Oct 2019.dwg



EXISTING R179 ROAD ALIGNMENT:

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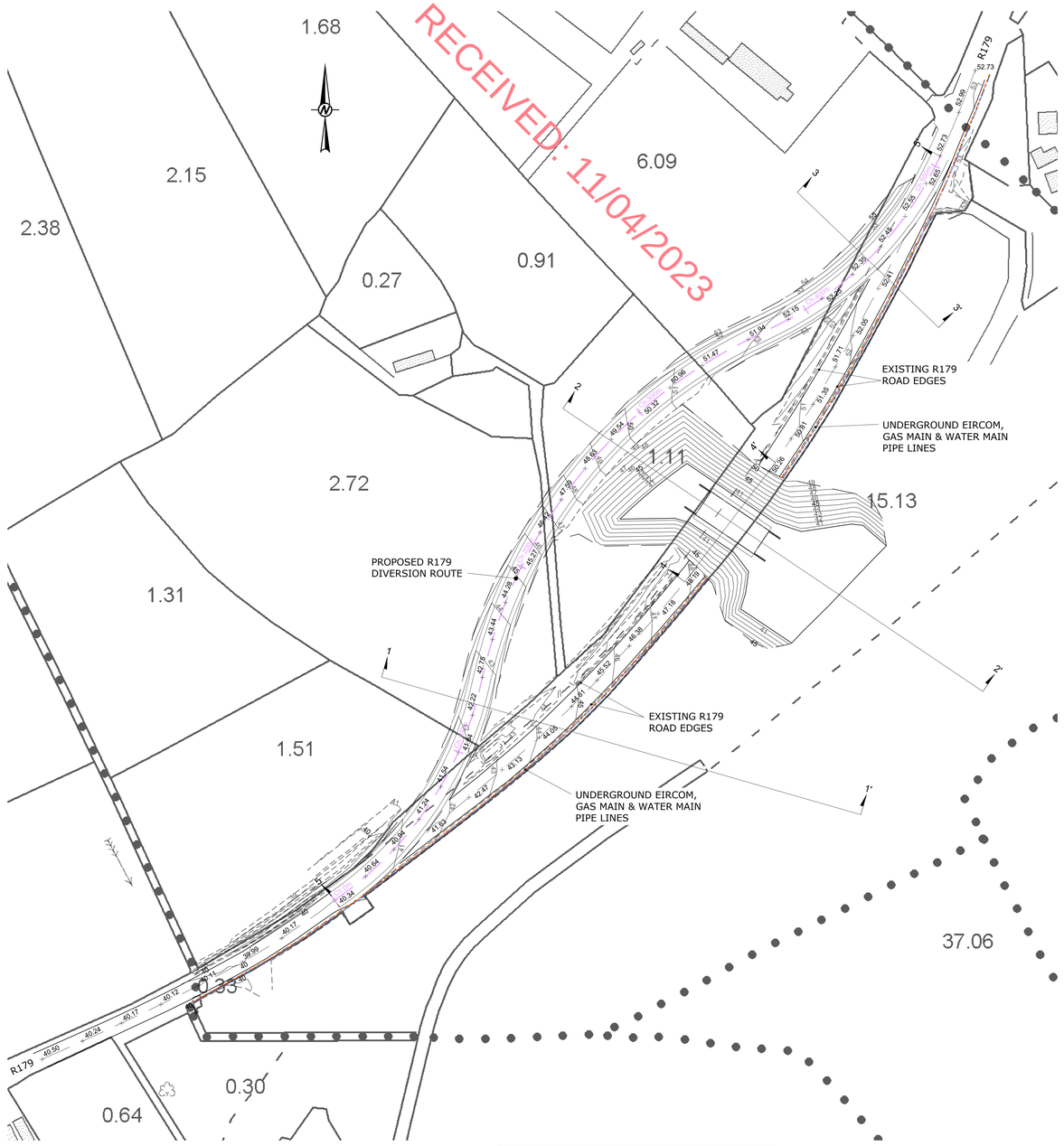
1:1,000



PROPOSED R179 ROAD DIVERSION:

0 40 80 120m
1:1,000

LEGEND:

- LANDS UNDER CONTROL OF APPLICANT
- APPLICATION SITE BOUNDARY
- 35 EXISTING GROUND CONTOUR (mOD)
- VEGETATION
- WATER
- PEDESTRIAN CROSSING
- OVERHEAD POWER LINES

NOTES:

GRID REFERENCES ARE IN METRES & TO IRISH NATIONAL GRID.

LEVELS ARE IN METRES & TO O.S. DATUM.

DIMENSIONS ARE IN METRES.

OSI Licence No.: CYAL50192220

OSI Map Series:

1:5000

1887
REVISION DATE = 14-Jun-2009
SURVEY DATE = 31-Jul-2000

1825
REVISION DATE = 14-Jan-2014
SURVEY DATE = 31-Jul-2000

1764
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1765
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1826
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1:2500

1886-B
REVISION DATE = 27-Mar-2015
SURVEY DATE = 17-Dec-2003

1887-A
REVISION DATE = 27-Mar-2015
SURVEY DATE = 13-Jan-2004

1887-B
REVISION DATE = 27-Mar-2015
SURVEY DATE = 15-Jan-2004

1887-C
REVISION DATE = 30-Mar-2016
SURVEY DATE = 31-Aug-2003

1886-D
REVISION DATE = 30-Mar-2016
SURVEY DATE = 31-Oct-2002

Projection: IG

ITM Centre Point Co-ordinate:
X,Y = 680784,798862

CLIENT
SAINT-GOBAIN MINING (IRELAND) LTD.

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-Oct-12
DESIGNED	PB
PREPARED	JD
REVIEWED	BB
APPROVED	BB

PROJECT
SGMI - KNOCKNACRAN WEST - RESPONSES TO RFIs

TITLE
SITE INVESTIGATION FOR TEMPORARY DIVERSION ROAD AND TUNNEL

PROJECT NO.	DRAWING NO.	REV.	SCALE
19121210	04	A	1:1,000 A0

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A0

0 — 25 mm

APPENDIX B

Borehole Logs

GOLDER

Client :	Hole No.
Saint Gobin	**KC 18-J**

Site : Drumgoosat, Co. Monahan

Project : Saint Gobian Drumgoosat Geotechnial Supervision

Project No : 18104447

Equipment & Methods :

Contractor : Irish Drilling Ltd

Date Started : 01/11/2011 **Completed :** 13/11/2018

Logged by : A.Crowley

Ground Level (mAOD) : 1048.00

Co-ordinates : E 280792.0 N 299830.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING				STRATA RECORD			
		Top of Core Run	TCR (%)	SCR (%)	RQD (%)	Level (mAOD)	Legend	Depth (Thickness) m	Description
								(12.00)	No Returns, inferred Mudsone
						1038.47		12.00	
		12.00	50	20	60			(1.50)	Very weak, thickly bedded, red-brown, clayey MUDSTONE, highly weathered
		13.00				1036.97		13.50	
			95	65	33				GYPSUM (Upper)
		16.00						(6.00)	
			98	76	33				
		19.00				1030.97		19.50	
									Weak, thickly bedded, dark red to brown, clayey MUDSTONE, highly to moderately weathered

Remarks :

Checked By:

Scale 1:100

GAUK - RC April 2008

GOLDER

Client : Saint Gobin

Hole No. KC 18-J

Site : Drumgoosat, Co. Monahan

Project : Saint Gobian Drumgoosat Geotechnial Supervision

Project No : 18104447

Equipment & Methods :

Contractor : Irish Drilling Ltd

Date Started : 01/11/2011 **Completed :** 13/11/2018

Logged by : A.Crowley

Ground Level (mAOD) : 1048.00

Co-ordinates : E 280792.0 N 299830.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING				STRATA RECORD			
		Top of Core Run	TCR (%)	SCR (%)	RQD (%)	Level (mAOD)	Legend	Depth (Thickness) m	Description
			63	35	17				Weak, thickly bedded, dark red to brown, clayey MUDSTONE, highly to moderately weathered
		22.00	50	40	23				
		25.00	66	43	19			(11.50)	
		28.00	73	54	32				
						1019.47		31.00	
		31.00	32	30	26				GYPSUM (Lower)
		34.00	98	70	42				
		37.00	91	61	13			(14.50)	

Remarks :

Checked By:

Scale 1:100

GAUK - RC April 2008

GOLDER

Client : Saint Gobin

Hole No. KC 18-J

Site : Drumgoosat, Co. Monahan

Project : Saint Gobian Drumgoosat Geotechnial Supervision

Project No : 18104447

Equipment & Methods :

Contractor : Irish Drilling Ltd

Date Started : 01/11/2011 **Completed :** 13/11/2018

Logged by : A.Crowley

Ground Level (mAOD) : 1048.00

Co-ordinates : E 280792.0 N 299830.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING				STRATA RECORD			
		Top of Core Run	TCR (%)	SCR (%)	RQD (%)	Level (mAOD)	Legend	Depth (Thickness) m	Description
		40.00	100	83	47				GYPSUM (Lower)
		43.00	96	85	52	1004.97		45.50	*End of Hole at 45.50m*

Remarks :

Checked By:

Scale 1:100

GAUK - RC April 2008

GOLDER

Client : Saint Gobin

Hole No. KC 18-K

Site : Drumgoosat, Co. Monahan

Project : Saint Gobian Drumgoosat Geotechnial Supervision

Project No : 18104447

Equipment & Methods :

Contractor : Irish Drilling Ltd

Date Started : 01/11/2011 **Completed :** 13/11/2018

Logged by : A.Crowley

Ground Level (mAOD) : 1053.00

Co-ordinates : E 280882.0 N 299946.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING				STRATA RECORD			
		Top of Core Run	TCR (%)	SCR (%)	RQD (%)	Level (mAOD)	Legend	Depth (Thickness) m	Description
								(16.60)	No Returns, Inferrered Mudstone
						1036.78		16.60	
		16.60	100	43	43			(1.50)	GYPSUM (Upper)
		17.60	93	72	67	1035.28		18.10	
						1034.88		18.50	Very weak, thickly bedded, dark red to brown, clayey MUDSTONE, highly to moderately weathered
		19.10						(2.50)	GYPSUM (Upper)

Remarks :

Checked By:

Scale 1:100

GAUK - RC April 2008

GOLDER

Client : Saint Gobin

Hole No. KC 18-K

Site : Drumgoosat, Co. Monahan

Project : Saint Gobian Drumgoosat Geotechnial Supervision

Project No : 18104447

Equipment & Methods :

Contractor : Irish Drilling Ltd

Date Started : 01/11/2011 **Completed :** 13/11/2018

Logged by : A.Crowley

Ground Level (mAOD) : 1053.00

Co-ordinates : E 280882.0 N 299946.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING Top of Core Run	TCR (%)	SCR (%)	RQD (%)	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
			100	88	62				GYPSUM (Upper)
		20.60	100	47	17	1032.38		21.00	
		22.10	100	0	0				Weak, thickly bedded, dark red to brown,clayey MUDSTONE, highly to moderately weathered
		23.60	100	47	30				
		25.10	100	0	0			(10.70)	
		26.60	100	0	0				
		28.10	100	0	0				
		29.60	100	87	75				
		31.10	100	93	93	1021.68		31.70	GYPSUM (Lower)
								(9.50)	

Remarks :

Checked By:

Scale 1:100

GAUK - RC April 2008

GOLDER

Client : Saint Gobin

Hole No. KC 18-K

Site : Drumgoosat, Co. Monahan

Project : Saint Gobian Drumgoosat Geotechnial Supervision

Project No : 18104447

Equipment & Methods :

Contractor : Irish Drilling Ltd

Date Started : 01/11/2011 **Completed :** 13/11/2018

Logged by : A.Crowley

Ground Level (mAOD) : 1053.00

Co-ordinates : E 280882.0 N 299946.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING				STRATA RECORD			
		Top of Core Run	TCR (%)	SCR (%)	RQD (%)	Level (mAOD)	Legend	Depth (Thickness) m	Description
						1012.18		41.20	GYPSUM (Lower)
									End of Hole at 41.20m

Remarks :

Checked By:

Scale 1:100

GAUK - RC April 2008

GOLDER

Client : Saint Gobin

Hole No. KC 18-L

Site : Drumgoosat, Co. Monahan

Project : Saint Gobian Drumgoosat Geotechnial Supervision

Project No : 18104447

Equipment & Methods :

Contractor : Irish Drilling Ltd

Date Started : 01/11/2011 **Completed :** 13/11/2018

Logged by : A.Crowley

Ground Level (mAOD) : 1053.00

Co-ordinates : E 280868.0 N 299930.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING Top of Core Run	TCR (%)	SCR (%)	RQD (%)	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
								(16.70)	No Returns, Inferred Mudstone
						1036.08		16.70	
		16.70							GYPSUM (Upper)
		17.10	96 69	93 51	82 17			(1.30)	
		17.60				1034.78		18.00	
									Very weak, thickly bedded, brown, clayey MUDSTONE, highly to moderately weathered
			100	89	45			(1.30)	
						1033.48		19.30	
									GYPSUM (Upper)

Remarks :

Checked By:

Scale 1:100

GOLDER

Client : Saint Gobin

Hole No. KC 18-L

Site : Drumgoosat, Co. Monahan

Project : Saint Gobian Drumgoosat Geotechnial Supervision

Project No : 18104447

Equipment & Methods :

Contractor : Irish Drilling Ltd

Date Started : 01/11/2011 **Completed :** 13/11/2018

Logged by : A.Crowley

Ground Level (mAOD) : 1053.00

Co-ordinates : E 280868.0 N 299930.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING				STRATA RECORD			
		Top of Core Run	TCR (%)	SCR (%)	RQD (%)	Level (mAOD)	Legend	Depth (Thickness) m	Description
								(2.00)	GYPSUM (Upper)
		20.60	100	86	75	1031.48		21.30	Extremely weak to very weak, thickly bedded, dark red to brown, clayey MUDSTONE, highly to moderately weathered
		22.10	80	40	17				
		23.60	50	21	21				
		25.10	100	69	50				
		26.70	100	86	64			(10.50)	
		28.10	37	19	8				
		29.60	87	80	87				
		31.10	100	89	71	1020.98		31.80	GYPSUM (Lower)
		32.60	100	87	87				
								(9.80)	

Remarks :

Checked By:

Scale 1:100

GAUK - RC April 2008

GOLDER

Client : Saint Gobin

Hole No. KC 18-L

Site : Drumgoosat, Co. Monahan

Project : Saint Gobian Drumgoosat Geotechnial Supervision

Project No : 18104447

Equipment & Methods :

Contractor : Irish Drilling Ltd

Date Started : 01/11/2011 **Completed :** 13/11/2018

Logged by : A.Crowley

Ground Level (mAOD) : 1053.00

Co-ordinates : E 280868.0 N 299930.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING				STRATA RECORD			
		Top of Core Run	TCR (%)	SCR (%)	RQD (%)	Level (mAOD)	Legend	Depth (Thickness) m	Description
						1011.18		41.60	GYPSUM (Lower)
									End of Hole at 41.60m

Remarks :

Checked By:

Scale 1:100

GAUK - RC April 2008

GOLDER

Client : Saint Gobin

Hole No. KC 18-N

Site : Drumgoosat, Co. Monahan

Project : Saint Gobian Drumgoosat Geotechnial Supervision

Project No : 18104447

Equipment & Methods :

Contractor : Irish Drilling Ltd

Date Started : 01/12/2018 **Completed :** 01/12/2018

Logged by : E. Sweeting

Ground Level (mAOD) : 1052.00

Co-ordinates : E 280803.0 N 299932.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING Top of Core Run	TCR (%)	SCR (%)	RQD (%)	Level (mAOD)	Legend	Depth (Thickness) m	Description
		0.00	31	0	0	1048.92		(1.50) 1.50	Inferred TILL contains cobbles
		1.50	47	0	0				Very weak, red, fine, SILTSTONE, highly weathered.
		3.00	53	0	0				
		4.50	67	0	0				
		6.00	67	0	0			(10.50)	
		7.50	100	0	0				
		9.00	80	0	0				
		10.50	80	0	0	1038.42		12.00	
		12.00	92	0	0				Very weak, thickly bedded, red-brown, fine, clayey MUDSTONE, highly weathered
		13.50	100	0	0				
		15.00	76	43	13			(7.35)	
		18.00	84	66	31				
		19.35				1031.07		19.35	GYPSUM (Upper)

Remarks :

Checked By:

Scale 1:100

GAUK - RC April 2008

GOLDER

Client : Saint Gobin

Hole No. KC 18-N

Site : Drumgoosat, Co. Monahan

Project : Saint Gobian Drumgoosat Geotechnial Supervision

Project No : 18104447

Equipment & Methods :

Contractor : Irish Drilling Ltd

Date Started : 01/12/2018 **Completed :** 01/12/2018

Logged by : E. Sweeting

Ground Level (mAOD) : 1052.00

Co-ordinates : E 280803.0 N 299932.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING				STRATA RECORD			
		Top of Core Run	TCR (%)	SCR (%)	RQD (%)	Level (mAOD)	Legend	Depth (Thickness) m	Description
			100	96	78	1029.42		(1.65) 21.00	GYPSUM (Upper)
									End of Hole at 21.00m

Remarks :

Checked By:

Scale 1:100

GAUK - RC April 2008

MR. I. A. GREENE

KINGSCOURT

DRILL HOLE RECORD

HOLE No. 2400S/Zero SERIAL No. 79

DATE COMMENCED 13/11/1962 DATE FINISHED 15/12/1962

6" O.S. MAP No. LOCATION DRUMGOOSAT

MACHINE USED Failing 1500 Reduced Level 189.50

DRILL FOREMAN M. Droney

CASING USED None

PERCENTAGE CORE RECOVERY

SIZE OF CORE 2½" 72.86 % FROM 59'6" TO 84'0"

AVERAGE WATER LEVEL 55'0" 77.27 % FROM 117'0" TO 205'0"

STRATIGRAPHICAL COLUMN

FORMATION	DESCRIPTION OF ROCK	THICKNESS FT.	THICKNESS INS.	DEPTH FT.	DEPTH INS.
	Soil	1	0	1	0
	Yellow clay and boulders	21	6	22	6
	Very hard greenstone rock	3	0	25	6
	Grey clay sand and boulders	33	0	58	6
131.00)					
105.50)	Upper bed Gypsum	25	6	84	0
	Red Marl	31	0	115	0
	LOWER BED GYPSUM			74	
74.50	Section G	4	3	119	3
	" F	13	3	132	6
	" E and F	32	0	164	6
	" D	10	0	174	6
	" C	12	6	187	0
-15-50	" B	18	0	205	0
89	Hard basalt rock	3	0	208	0
		134		58	

189 − 115 = 74

189 − 164 = 25

205 − 189 = −16

189 − 55 = 134

189 − 131 = 58

GENERAL REMARKS Lost circulation at 55'0" and at 131'0". Recovered some circulation by filling the hole with plaster. Completed the hole without circulation from 131'0" Cemented the hole ~~xxxxxxxxxxxxxxxxxxxxxxx~~ up to 113'0" when drilling was completed.

DATE 31st January, 1963. SIGNED M. DRONEY

S. 27

Appendix 3.10

Extractive Waste Management Plan

REPORT

Knocknacran West Mine

Extractive Waste Management Plan

Submitted to:

Submitted by:

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Distribution List

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1.0 INTRODUCTION

The Knocknacran West Mine is a planned open-cast gypsum mining project located in the townlands of Knocknacran (East & West) and Drumgoosat, Co. Monaghan. The project is to be developed by Saint-Gobain Mining Ireland Limited (SGMI), who operate the adjacent Knocknacran Open-Cast and Drummond Underground mines.

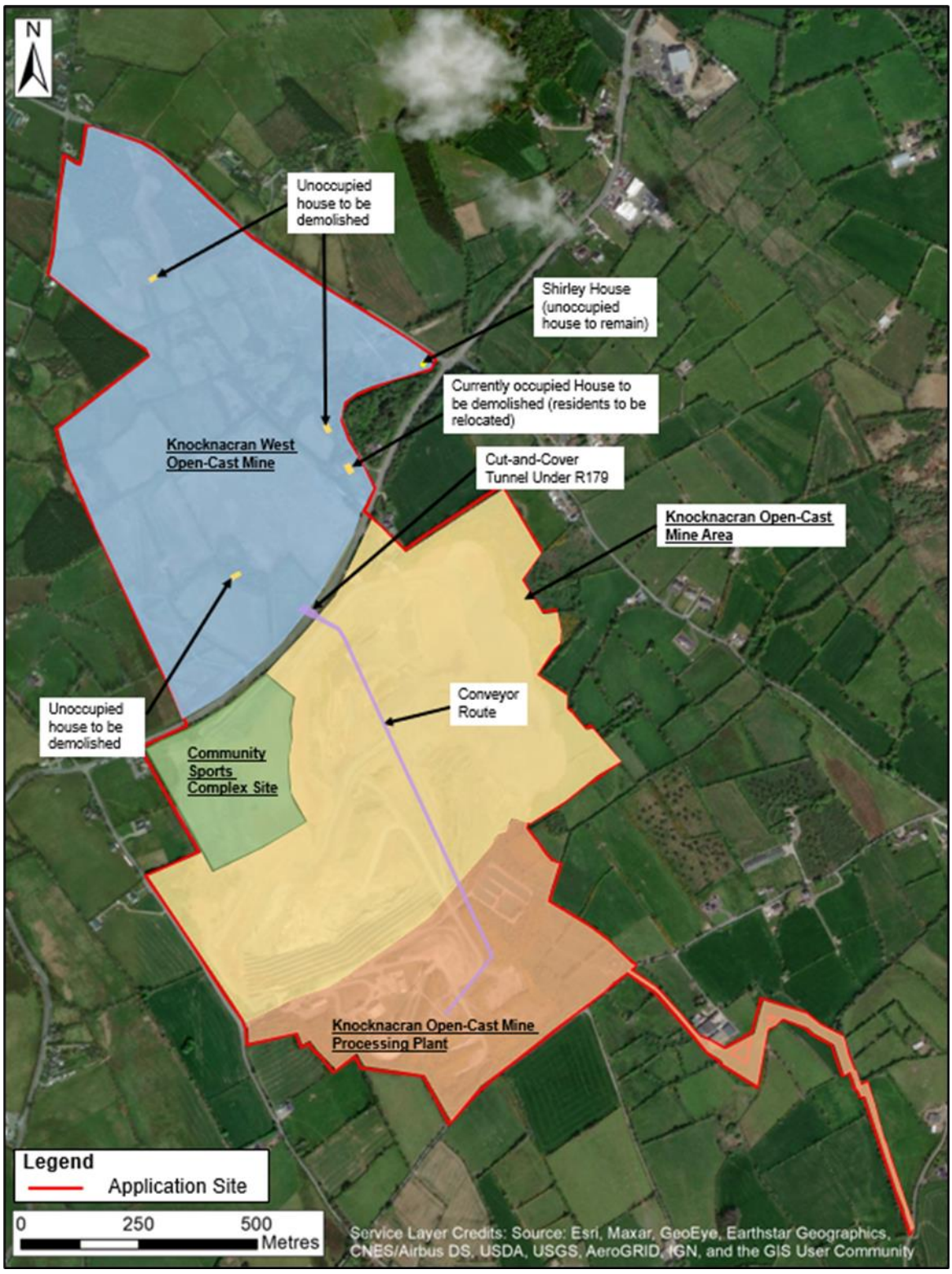

Figure 1: Knocknacran West Mining Project

The project plans for the extraction of Gypsum from the former (Drumgoosat) underground mine at Knocknacran West by open-cast mining methods, and the construction of a Cut-and-Cover Tunnel under the main Carrickmacross to Kingscourt regional road (R179) (which will necessitate in the temporary diversion of the R179) for the transport of Gypsum (by haulage truck and covered conveyor) to the existing processing plant at Knocknacran Open-Cast Mine (an existing open-cast mine), and for the transport of overburden and interburden (by haulage truck) to the Knocknacran Open-Cast Mine for restoration purposes (Figure 1). The works will also include pumping of water from the Drumgoosat workings via an existing monitoring borehole.

Extractive waste in the form of overburden and interburden materials will be produced during stripping campaigns and used initially in the restoration of the existing Knocknacran Open-Cast Mine and subsequently the Knocknacran West Open-Cast Mine.

The Knocknacran West Open-Cast Mine will be required to operate under an Industry Emissions Licence (IE), to be issued by the Irish Environmental Protection Agency (EPA). An existing IE Licence, P0519-03, exists for the Knocknacran and Drummond mines, and the processing plant at Kingscourt. This licence will need to be revised following a grant of planning permission for the proposed Knocknacran West Open-Cast Mine.

The IE Licence will contain conditions that must be complied with, and this will include conditions that relate to controls for the storage and reuse of extractive waste. The Mine will also require an extension to the existing State Mining Lease (M139) before any mining may take place, to be issued by the Department of Environment, Climate and Communications (DECC).

2.0 EXTRACTIVE WASTE

For the purposes of this document, Extractive Waste is as defined in regulation 3(2) of the Waste Management (Management of Waste from the Extractive Industries) Regulations, 2009, S.I. No. 566 of 2009.

The classification of this material will be agreed with the Competent Authority for extractive waste in Ireland (the EPA) and this classification will refer to the Regulations and the guidance on the Regulations issued by the EPA[1].

For the purposes of this document all material that has the potential to be classified as an extractive waste will be considered as an extractive waste. However, it is the intention of SGMI that materials other than Gypsum will be classified as by-products (i.e., Overburden Mudstone and Dolerite stripped prior to and during the extraction of Gypsum) and will be reused as by-products as is currently the case for the restoration of both the existing Knocknacran Site and future Knocknacran West Site.

The figure below is a decision tree from the EPA's 2020 guidance note.

[1] http://www.epa.ie/pubs/advice/waste/extractive/guidanceonthewastemanagementextractivewasteregs2012.html

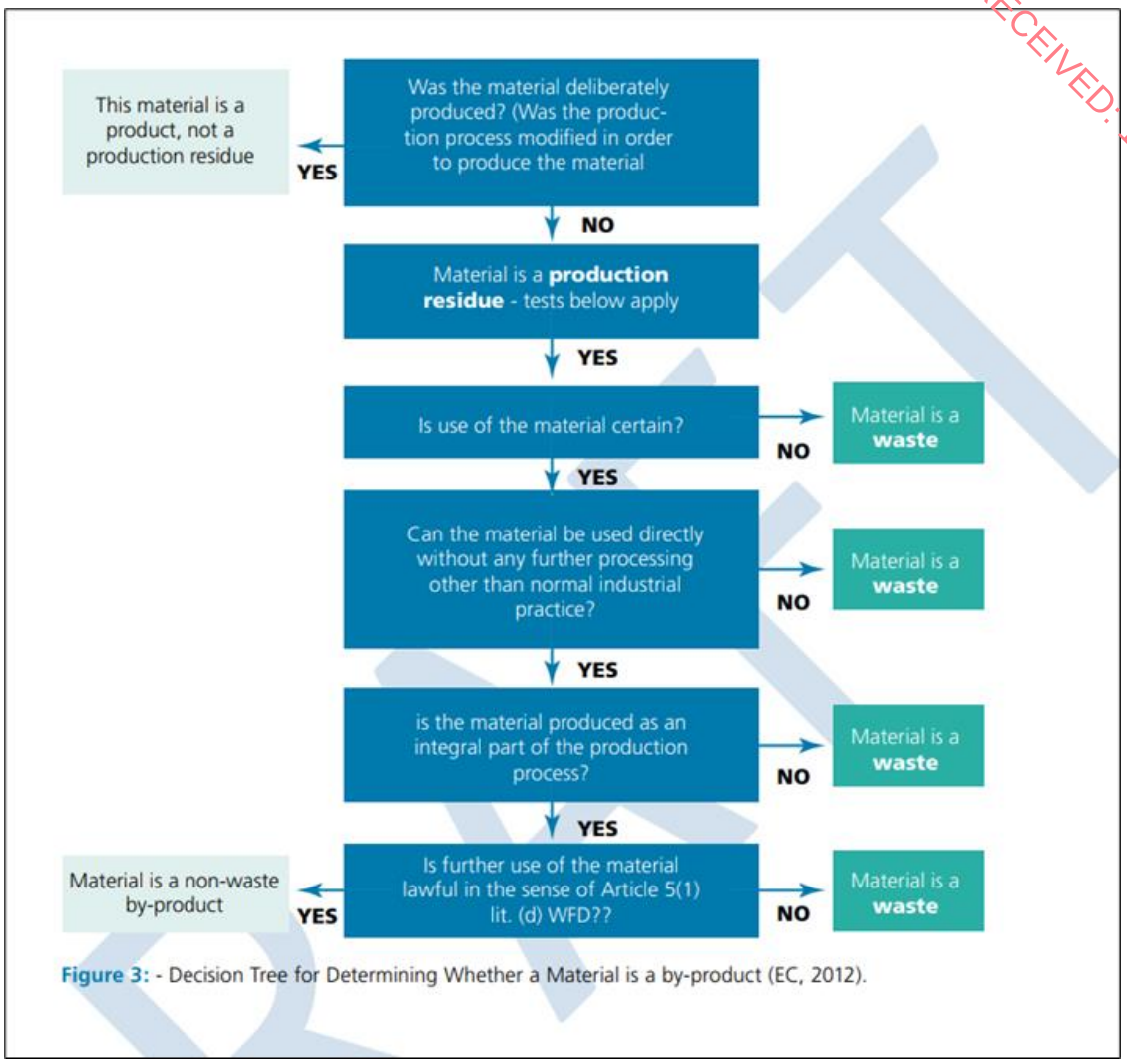

Figure 2: EPA's 2020 Guidance Note

The materials that have the potential to be considered extractive wastes at Knocknacran West are:

- Overburden;
- Interburden (Mudstone and Dolerite);
- Sediments from the Settlement Ponds; and
- Other.

2.1 Overburden

Overburden is glacial till laid down following the last ice age as the ice retreated. It consists primarily of sandstone and shale till with some undifferentiated alluvium.

2.2 Interburden

Interburden is host rock that is encountered when stripping the open-cast mine to expose the Gypsum seams (Upper and Lower seams/units/beds). The interburden will be predominantly red Mudstone and Dolerite.

2.3 Sediments from the Settlement Ponds

Water currently encountered during the mining process is treated and settled in a series of settlement ponds/lagoons prior to discharge into the River Bursk, under IE Licence P0519-03. An amendment (or review of) to the licence will be required for the development of the Knocknacran West Mine.

The sediment from the settlement is periodically 'cleaned out' and used in the ongoing restoration of the Knocknacran Site.

2.4 Other

The classification of other material as extractive waste may arise through interaction with the EPA and other Regulatory Authorities. The Extractive Waste Management Plan will be updated as necessary to reflect any such changes, should they occur.

3.0 EWMP OBJECTIVE

The objective of the EWMP is the "Minimisation, treatment, recovery and if necessary, disposal of extractive waste, taking account of the principle of sustainable development". The 2018 Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries has been reviewed to assist the preparation of this document.

The waste hierarchy as given in the 2018 BAT is:

- Prevention of solid extractive waste generation;
- Reduction of non-inert extractive waste and hazardous extractive waste generation;
- Reduction of extractive waste volumes to be deposited; and
- Recovery of extractive waste.

3.1 Prevention of Solid Extractive Waste Generation

The BAT guidance offers three methods/techniques of preventing solids waste generation and they are:

- Pre-sorting and selective handling of extractive materials that in principle qualify as by-products/products (in this case the handling of stripped Overburden, Mudstone and Dolerite);
- Placing extractive materials that qualify as by-products/products (in this case the handling of stripped Overburden, Mudstone and Dolerite) back into excavation voids (currently Knocknacran and in the future Knocknacran West); and.
- Using extractive materials that in principle qualify as by-products/products for internal or external purposes (in this case the handling of stripped Overburden, Mudstone and Dolerite, which are and will continue to be periodically used for restoration on Site throughout the life of the mining operations. No materials will be taken offsite and used for external purposes other than Gypsum).

It is SGMI's objective to classify the majority of those materials listed in Section 2.0 as by-products and as such this will prevent the generation of wastes.

3.2 Reduction of Non-Inert Extractive Waste & Hazardous Extractive Waste Generation

The BAT guidance offers two methods/techniques for the reduction of non-inert extractive waste and hazardous extractive waste generation, and they are:

- Management of extractive waste accumulated during exploration/prospecting; and
- Sorting and selective handling of extractive waste.

SGMI envisages that no non-inert extractive waste or hazardous extractive waste will be generated during the proposed mining operations at Knocknacran West.

3.3 Reduction of Extractive Waste Volumes to be Deposited

The BAT guidance offers a number of methods/techniques to reduce the volume of extracted volumes to be deposited.

The BAT guidance document includes a lot of detail on the methodologies and controls for the storage of extractive wastes (e.g., Waste Rock Dumps). These storage facilities pose a risk both during operations and post closure. The risk is both an environmental and a safety risk and unfortunately there have been many examples globally where the failure of extractive waste facilities has resulted in tragic loss of lives and significant impact on the environment.

SGMI will deposit extractive by-products (i.e., Overburden, Mudstone and Dolerite) on a phased basis across the site as part of ongoing restoration. Materials will be placed under engineered design and control.

3.4 Recovery of Extractive Waste

The BAT guidance offers a single method/technique for the recovery of extractive waste and that is reprocessing. This is not of relevance to SGMI, as extracted materials (i.e., Overburden, Mudstone and Dolerite) other than Gypsum will be placed under engineered design and control (on-site) during the restoration process.

4.0 DESCRIPTION OF THE OPERATION THAT WILL GENERATE MATERIAL THAT MAY BE CLASSIFIED AS EXTRACTIVE WASTE

Gypsum is to be extracted by blasting in an open-cast mine (sub-surface pit/void). The blasted ore will be transported from the open-cast mine following primary crushing by covered conveyor and/or truck to the existing materials handling facility on-site at Knocknacran. Here the Gypsum material will undergo secondary crushing prior to being homogenised to ensure quality of Gypsum is maintained for the manufacture of plasterboard, plaster and plaster related products at Saint-Gobain's manufacturing facility at Kingscourt ca. 7 km to the south-west. Materials other than Gypsum will be classified as by-products (i.e. Overburden Mudstone and Dolerite stripped prior to and during the extraction of Gypsum) and will be reused as by-products, as is currently the case for the restoration of both the existing Knocknacran Site and future Knocknacran West Site. In addition, sediments from the Water Settlement Ponds/Lagoons will also be used in the restoration of the sites at Knocknacran and Knocknacran West.

Therefore, no extractive waste will be generated on-site during the extraction of Gypsum. However, should material arise that could be classification as extractive waste, appropriate interaction will be undertaken with the EPA and the relevant Regulatory Authorities.

5.0 EXTRACTIVE WASTE CHARACTERISATION

The section below provides detail on those materials that may be classified as extractive waste. However, it is planned for these materials to be classified as by-products as per the EPA Guidance Note on by products[2].

5.1 Waste Rock

The waste rock will be predominantly Mudstone and Dolerite. The size particle distribution of waste rock will be dependent on blast design, natural fractures in the rock and composition of the rock face being blasted.

5.2 Sediments from the Settlement Ponds

The composition of the sediments from the Settlement Ponds / Lagoons will remain reasonably constant throughput the life of the mine, although will depend on the activities taking place on the mine floor and/or at the mine face.

The sediments will be fine grained (typically sand/silt/clay fractions) and typically consist of a mixture of Gypsum, Mudstone and / or Dolerite particles, with finer fractions also being derived from Overburden material.

5.3 Other

The characterisation of other extractive wastes will depend on the specific nature of these wastes and will be established as and when they arise.

In relation to the wastes that are expected to arise during Mine closure works, it is recognised that there is a risk of contamination, which can arise from various sources, including the use of stockpiles and simply the contamination caused by mining vehicle's tyres (despite the use of wheel washes etc). There are various standards with respect to soil contamination including those developed by the United Kingdom Environment Agency referred to as CLEA or the Dutch Guidelines. The UK CLEA guidelines have a published scientific basis. Their use is therefore often considered 'good practice' in the assessment of contaminated land. The actual success criteria values are subject to agreement with the EPA. The area or quantity of material that may be above the success criteria will not be known until such time as a site characterisation is completed (during operations and prior to closure).

Full details for any waste removed as part of the Mine closure works will be documented, recorded and reported to the EPA and will include volumes and chemical analyses.

6.0 FATE OF EXTRACTIVE WASTE

The Waste Management (Management of Waste from the Extractive Industries) Regulations, 2009, S.I. No. 566 of 2009 allows for the reuse of extractive waste (by-products).

The reuse of this extractive waste (by-products) is permitted by the EPA and typical licence conditions issued by the EPA to other Mines in Ireland is as follows:

- Unless otherwise agreed by the Agency, only extractive waste shall be placed in excavation voids.
- When placing extractive waste into excavation voids for rehabilitation and construction purposes, the licensee shall, in accordance with regulation 10 of the Waste Management (Management of Waste from the Extractive Industries) Regulations, 2009, and the Extractive Waste Management Plan:

[2] https://www.epa.ie/publications/licensing--permitting/waste/ByProduct_Guidance.pdf

i) Secure the stability of the waste;

ii) Put in place measures to prevent pollution of soil, surface water and groundwater; and

iii) Carry out monitoring of the extractive waste and excavation void.

- A full record of the volume and tonnage of material (extractive waste and/or backfill) placed shall be maintained and reported annually.

The following sections provide a high-level overview of how it is proposed to manage the by-products generated during the life of the Knocknacran West Project.

6.1 Waste Rock

Overburden and waste rock (in the form of Mudstone and Dolerite) produced during the extraction of Gypsum on-site will be placed under engineered design and control during the on-site restoration process.

6.2 Sediments from the Settlement Ponds

As referred to in Section 6.1, waste rock will be placed under engineered design and control during the on-site restoration process.

The dewatered sediments will be transported by truck where it will be mixed with Overburden (and waste rock) as part of the on-site restoration process.

A full record of all material used in this process will be retained and reported to the EPA.

6.3 Other

Opportunities may arise for the reuse of some of the material generated during Mine Restoration and Closure for geotechnical support of open-cast pit slopes and in areas where underground workings have been uncovered / intersected.

7.0 AFTERCARE MANAGEMENT PLAN

A Closure, Restoration & Aftercare Management Plan (CRAMP) has been developed for the Knocknacran West Project and this will be submitted to the EPA for approval. As there is no plan to produce extractive waste during the life of the project, the requirements of the aftercare plan with respect to extractive waste will be minimal.

8.0 RECORDS

A full record will be maintained for all aspects relating to any mine waste should it arise at Knocknacran West. These records will be submitted as required to the Regulatory Authority and will be retained by the company for an agreed period of time.

9.0 EMERGENCY RESPONSE PLAN

An Emergency Response Plan is in operation for the existing operating site, which includes Knocknacran Open-Cast Mine, Drummond Underground Mine and Knocknacran Processing/Materials Handling Plant Site. This plan is a live document and is regularly reviewed and updated by the mine management.

Clear procedures in the event of a serious incident are provided for in the plan. An emergency of any kind will normally be handled by the person discovering that emergency.

If the emergency is of such an nature that the person discovering it cannot handle it, then that person is responsible for initiating the emergency response procedure(s).

10.0 SUMMARY

Knocknacran West will be producing material that may be considered an extractive waste (by-product). Initially this material will be used in the restoration of the existing Knocknacran site to close to original ground levels, and subsequently in the restoration of Knocknacran West site itself.

The management of extractive waste at Knocknacran West will be fully controlled by an EPA licence and no action will be taken without agreement from the EPA and other relevant Authorities.

Much of the focus of the Waste Management (Management of Waste from the Extractive Industries) Regulations, 2009, S.I. No. 566 of 2009 and the BAT guidance's that have been issued are concerned with the management of tailings dams. This is an important difference when it comes to the Extractive Waste Management Plan for Knocknacran West, where this perpetual risk associated with the surface storage of extractive waste does not exist.

GOLDER
MEMBER OF WSP

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Appendix 3.11

Emergency Plan

OPERATIONS MINING – TRAINING MODULE				
Subject	**EMERGENCY RESPONSE**			
Owner	**Benson Plunkett**	**No: DTM 01B**		
Author	**Tony O'Reilly**	**Rev: 19**	**Knocknacran**	✓
Date of Issue:	**30/03/2021**		**Drummond**	✓

Introduction

Clear procedures in the event of a serious incident are required in any working environment but are of particular importance in underground & surface mining operations.

An emergency is a situation, which can escalate rapidly, and if not brought under control quickly may well result in serious injury, death or major property damage.

An emergency of any kind will normally be handled by the person discovering that emergency. If the emergency is of such a nature that the person discovering it cannot handle it, then they are responsible for initiating the emergency response procedures.

STOP!

DON'T PANIC!

FOLLOW THE EMERGENCY PROCEDURES!

SCOPE
To detail the Emergency Response arrangements and outline the associated responsibilities in the event of an emergency situation arising at the mine site, both surface and underground operations

OBJECTIVES:
The objectives in drawing up an emergency response plan can be summarised as follows:

1. To ensure that measures are in place to minimise the impact if a serious incident should occur.
2. To provide clear direction to all personnel regarding responsibilities and procedures to be followed in the event of a serious incident.

Contents:

1. TYPES OF INCIDENT, SEVERITY AND LEVEL OF RESPONSE

(1) Introduction - What to do:
Determine / Classify Incident severity and appropriate level of response; (detailed below).
Use contact list attached to activate required response (Appendix 1)

(2) Types of Major Incident
The main types of incident covered by this emergency plan are as follows:

1. Serious injury or medical emergency underground
2. Fire underground
3. Persons trapped by equipment, machinery or fall of ground underground
4. Inrush of water or fluidised material underground
5. Inrush or accumulation of gas underground
6. Ventilation failure underground
7. Unplanned explosion surface / underground
8. Serious injury or medical emergency surface
9. Fire on surface
10. Bomb threat

(3) Incident Severity and Levels of Response:
Incidents can be classified into three levels of severity, each of which has an associated response. These are described below:

a) Level 1 - Minor Incident:
A level one incident can typically be dealt with by the person identifying the problem. The supervisor should be informed **IMMEDIATELY** and the incident investigated and formally logged; this will permit assessment of the incident particularly with regard to the possibility of re-occurrence and the potential for a more serious event.

Examples: minor localised fire, minor injury

b) Level 2 - Serious Incident:
The person identifying the incident will notify the Supervisor / Shift Boss **IMMEDIATELY** either directly or through a third party and where possible take action (remove persons from any imminent danger, emergency first aid etc.) so long as it is safe to do so.
The Shift Boss/ Supervisor will

- notify a member of the Management Team on Surface (Surface Contact)
- ensure that all personnel are removed from the Danger Zone

In the event of an emergency on surface or underground the Surface Contact will appoint a person to the Tag Board, organise for emergency services to be contacted and initiate the call out of the incident response team

Examples: serious injury, containable fire underground or, containable environmental damage.

c) Level 3 – Major Incident
The person identifying the incident will notify the Shift Boss / Supervisor **IMMEDIATELY** either directly or through a third party and where possible take action (remove persons from any imminent danger, emergency first aid etc.) so long as it is safe to do so.
The Shift Boss / Supervisor will

- notify a member of the Management Team on Surface (Surface Contact)
- ensure that all personnel are removed from the Danger Zone

In the event of an emergency on surface or underground the Surface Contact will appoint a person to the Tag Board, organise for emergency services to be contacted and initiate the call out of the incident response team

Examples: persons trapped, serious fire underground, threat to the safety of personnel, serious environmental damage.

2. ROLES & RESPONSIBILITIES – SITE PERSONNEL:

In the event of an emergency underground the roles and responsibilities of the individuals and groups are described below:

(1) Identifier:
The person identifying the incident will notify the Shift Boss / Supervisor **IMMEDIATELY** either directly or through a third party and where possible take immediate action (notify other personnel in the area, remove persons from any imminent danger, emergency first aid etc.) so long as it is safe to do so. Where the Shift Boss / Supervisor cannot be contacted (within 3 attempts) the Identifier will notify the Surface Contact directly and request that the Emergency Response Procedures be initiated.
In the event of a Level 2 or 3 Incident the identifier will send the following message over the two-way radio system:

- 'I have an Emergency (type) in the (name location) – (Shift Boss / Supervisor name) call back' and immediately thereafter request radio silence – 'All personnel please maintain radio silence'.

Remember: One of the most important pieces of information to be communicated in any emergency is the location.

(2) Persons working underground:
If you smell Stench Gas / hear emergency communication warn other persons in the vicinity and immediately go to your nearest Refuge Station. **Refuge Stations** are equipped with water, air and radio connection to surface.

REMEMBER: NEVER PASS A REFUGE STATION

Follow Refuge Station Procedure as set out in DSWP 21 – Safe Use of Refuge Stations. This procedure is posted in each Refuge Station.
Stay in the Refuge Station or other place of safety until instructed to leave by an authorised person.
If you cannot get to a Refuge Station and are close to a portable radio / base unit make contact with the Tag Board (Radio Channel 1) and give location and circumstances

- Go to a dead end heading
- Sit quietly – do not walk around
- Use your Ocenco M20.2 EEBD only if required (smoke, gas…..)
- Listen for and call to Rescue Team when you hear them.
- Wait until Rescue Team arrives at your location

On return to surface, move your Tag on the Tag Board from the Underground side to the Surface side, and report to your designated assembly area immediately.

DO NOT LEAVE MINE SITE UNTIL YOU ARE AUTHORISED TO DO SO.

(3) Shift Boss / Supervisor:
On receipt of information that there is an emergency the Shift Boss / Supervisor shall without endangering their own safety:

- Organise for the 'Stench Gas' Dispersal System to be activated (Underground only)
- Notify Surface Contact
- Notify all persons in the vicinity
- Transport as many persons as possible to the nearest Refuge Station, surface or other place of safety (subject to nature of Incident).

(4) Drummond Mine – Surface Contact:
This is any member of the Management Team on site who is notified by the Shift Boss / Supervisor of an emergency (underground / on surface). On being advised of any Level 2 or 3 emergency this person will immediately take responsibility for

- Appointing a person to the Tag Board
- Notifying Emergency Services
- Mobilising the Incident Team

(5) Safety & Training Officer / Mine Rescue Officer:
The Safety & Training Officer will be called out for all Level 2 or 3 incidents involving Drummond Mine / Knocknacran Quarry employees. He / she will carry out an incident investigation and complete an incident investigation report which will be will be copied to the Mine Manager. In the event of a Level 2 or 3 incident where Mine Rescue Team/s are required to be deployed the Safety & Training Officer will immediately assume the duties of Mine Rescue Officer to the exclusion of all other duties unless directed by the Incident Controller.

(6) Mine Manager:
The Mine Manager has overall responsibility for the site and in the event of a Level 2 or 3 emergency will be responsible for co-ordinating the appropriate response and will assume the role of Incident Controller.

3. DRUMMOND MINE INCIDENT TEAM;

- Mine Manager
- Safety & Training Officer / Mine Rescue Officer
- Mine Maintenance Co-ordinator
- Mine Surveyor

In the event of an emergency the Incident Team will assemble in the Incident Control Room (see Resources - Incident Control Room)

4. INCIDENT RESPONSE - KEY ROLES:
(1) Tag Board Official:
In an emergency on site the Surface Contact will immediately designate one person to go directly to the Mine Tag Board and perform the duties of the Tag Board Official.
The Tag Board Official will **SWITCH ON THE RED LIGHT** above the Tag Board and immediately thereafter make the following announcement over the two-way radio:

MINE EMERGENCY – THIS IS NOT A DRILL
ALL PERSONNEL UNDERGROUND – GO TO YOUR NEAREST REFUGE STATION
PERSONNEL ON SURFACE – REPORT TO THE LAMP ROOM

This announcement will be repeated:

- **Once every 30 seconds x 4**
- **Once every minute x 4**

and as required thereafter.

The Tag Board Official will remain by the radio adjacent the Tag Board and will be responsible for maintaining contact with personnel forced to remain underground during an emergency. The Tag Board Official will also ensure that

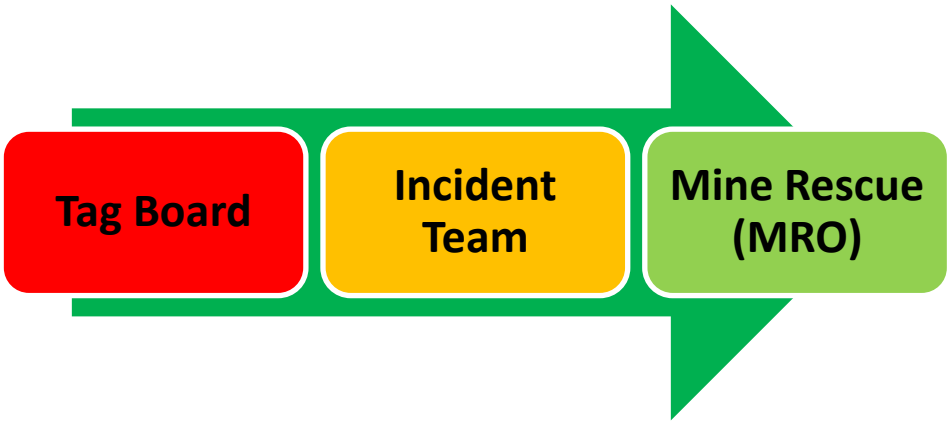
- the information on the Tag Board is accurate and up to date
- the information is relayed to the Incident Team.

The Tag Board Official will remain at the Tag Board until instructed to leave by the Incident Controller

(2) Incident Controller:
The Incident Controller will be the Drummond Mine Manager or in his absence the Designated Person (as appointed by the Mine Manager) in the event of an emergency on site. On being advised of a level 2 or 3 incident, he shall proceed immediately to the Incident Control Room (The Mine Surveyors office), assess the situation and manage the emergency response in consultation with the Incident Team. He shall promptly appoint a person to maintain an accurate log of events.

(3) Mine Rescue Officer (MRO):
In an emergency situation The Mine Rescue Officer will go directly to the Mine Rescue Station and co-ordinate the Mine Rescue response. Deployment of Mine Rescue Teams is the sole responsibility of the Mine Rescue Officer.

EMERGENCY - INFORMATION FLOW



5. INCIDENT RESPONSE – ADDITIONAL ROLES:

(1) Staff specialists:
Staff specialists are Drummond Mine and Saint-Gobain Construction Products (Ireland) Ltd personnel whose specialist skills may be called upon to assist in the emergency response. Such personnel will be called out by the Mine Manager and may include the Maintenance Manager (Factory) & Electrical Engineer (Factory) etc.

(2) Senior Management Representative:
The Saint-Gobain Mining (Ireland) Ltd Senior Management representative will monitor the situation, lend assistance where required and communicate with third parties if required e.g. The Health and Safety Authority, Local Clergy etc. They will also communicate with, and call for assistance where required from, other Saint-Gobain staff and ensure that, through the Operations Director, Gyproc Saint-Gobain's Managing Director is kept fully informed. The contact names and telephone numbers for the Senior Management Representatives are given in Appendix 1. Any media responses will be formulated after consultation with the Operations Director or the HR Director. Statements should not be issued without agreement from the Managing Director.

6. (1) <u>EMERGENCY SERVICES (see Appendix 1 contact details):</u>

a) Ambulance Service:
The Ambulance Service will be called when required as directed by the Shift Boss / Supervisor. Immediately on arrival the Ambulance Service will be met by a member of staff at the Main Site Entrance and directed to the Mine Rescue Station / escorted to the required area.

b) Fire Service:
The local Fire Service will be called in the event of <u>any</u> fire on site either to deal with the incident (surface) or to lend assistance / advise in the event of a fire underground. On arrival the Fire Service will be met by a member of staff and directed to the Mine Rescue Station / escorted to the required area.

c) An Garda Siochana:
The Garda Siochana will be

- Notified of Level 2 Incidents as directed by the Incident Controller
- Called out for all Level 3 Incidents

(2) Contacting Emergency Services:
Direct Dial 999 or 112
The 'call-taker will request you to state which service/s you require (ie: An Garda Siochana, Fire Service, Ambulance service or Coast Guard)'. The call is then transferred to the Emergency Service Control Centre you requested based on your location and handled accordingly.

MOST IMPORTANTLY IF THE LINE IS BUSY PLEASE DO NOT HANG UP. THE CALL WILL BE ANSWERED AS QUICKLY AS POSSIBLE.

Some of the key information you will require is as follows:

- Telephone No. you are calling from.
- Location of incident – in this case this will be as follows:

  Saint-Gobain Mining (Ireland) Ltd.,
  Drummond Mine,
  Magheracloone,
  Carrickmacross,
  Co. Monaghan.
  A81 YW31 (Essential)

Note: Please be clear where the incident has occurred – **Surface or Underground**.
You will be asked additional questions around the nature of the incident so it is important that you:

- Stay calm
- Listen carefully to the Operator
- Speak slowly and clearly
- Only finish the call when the operator tells you.

It is essential that you remain by the phone as the Emergency Service may need to call you back and get more information.

(3) Health and Safety Authority:
The H.S.A. Inspector will be contacted in the event of a level 2 or 3 incident by the Mine Manager.

7. EMERGENCY RESOURCES:

(1) Communication: there are two methods of communication at Drummond Mine & Knocknacran Quarry

- Two-way radio system
- Telephone

a) Two-Way Radio system:

Drummond Mine & Knocknacran Quarry utilises a two-way radio system as its principal method of communication. The system incorporates the following:

- Main Repeater Station (at the entrance to the Conveyor Drift) which facilitates communication across all areas of operation both surface and underground.
- Coaxial (radiating) cable (Leaky Feeder) - extending from the Main Repeater Station through the underground Mine only.
- Fixed location two-way radios (base units)
- Hand Held Radios

The coaxial (radiating) cable extends throughout the underground mine from the main repeater station
The coaxial (radiating) cable has small sections of its copper shielding stripped away to allow radio frequency (RF) signals to be transmitted and received back and forth between communicators (two-way radios) This allows communication from

- Underground → Underground
- Underground → Surface → Underground

Communication underground using the 'Leaky Feeder' system depends on 'line of sight'- in other words the hand held or base units(aerials) in use must be able to 'see' the coaxial (radiating) cable. As the underground Mine develops the coaxial (radiating) cable is extended into new areas of development

There is only one channel for general communication or in the event of an emergency on site - **Radio Channel 1** and **all** two-way radios are pre-set to this channel.
Documented radio checks are carried out in all areas to ensure that the system is functioning correctly. All personnel are encouraged to report areas of poor communication through the Near Miss system.

All personnel are briefed on the importance of radio etiquette in the event of an emergency.

b) Telephone

I. Surface:

Telephones are available in the following areas:

- Main Office – all offices
- Workshop
- Surface Crusher Control Room

II. Underground:

A telephone is available in the Shift Boss Office at the C3 only. In the event of an emergency underground, where, for example, communication cannot be established using the two-way radio system, personnel can contact surface using the telephone provided at this location.

III. Emergency Telephone:

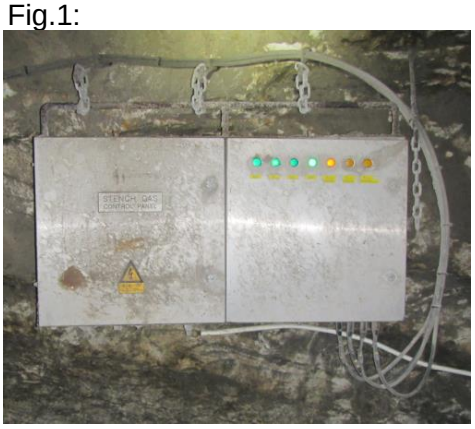
A dedicated Emergency Telephone Line is provided in the Mine Surveyors Office (Incident Control Room). In the event of an emergency on site personnel can ring the Emergency Telephone No. (2310) If the call remains unanswered all telephones in the office area will ring simultaneously.

REMEMBER: If you have to use a telephone or radio during an emergency, please speak slowly, making sure your information is clearly understood. Do not tie up the communication link any longer than is necessary – it may save a life

(2) <u>Mine Warning System – 'Stench Gas' Dispersal System (Underground Emergency Only):</u>

Stench Gas' (Ethyl Mercaptan) is a widely used warning device for use in mines when audible alarms cannot be heard. Ethyl Mercaptan, a colourless organic liquid that has a strong odour is added to odourless gasses for fuel as a warning agent. In underground mining it is considered the most reliable way of alerting underground personnel as to a problem within the Mine. The smell can be compared to the smell of rotten cabbages.
The 'Stench Gas' Dispersal system is located at the V1/HD (on the intake side of the main Fan Station – see drawing attached - Appendix 2).

Fig.1:



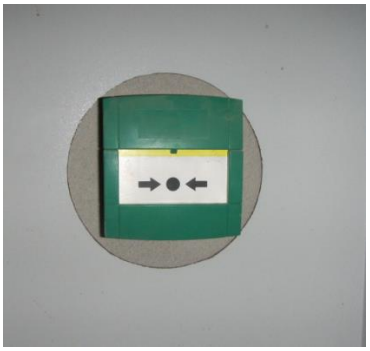
There are 3 Activation Points – (See drawing attached - Appendix 2)

- Surface Entrance to Intake (Haulage) Drift - behind gate
- C1/HD (beside entrance door to Sub-station)
- C1/CD (beside entrance door to Crusher Control Room)

Fig 1 & 2 below show an Activation point and Activation switch:

Fig 1: Activation Point

Fig. 2: Activation Switch



In the event of an emergency the Stench Gas Warning System can be activated at one of any of the above activation points (whichever safest) prompting personnel underground to go to their nearest Refuge Station immediately. If for any reason the Shift Boss is unable to access any / all of the activation points the warning system can be activated by a person on surface (so long as it is safe to so) at the Surface Entrance to Intake (Haulage) Drift - behind gate

Note: In the event of an emergency on surface where communication cannot be established with personnel underground the Stench Gas Warning System <u>may</u> be utilised to notify personnel underground – utilisation of the Stench Gas Warning System for this purpose will be at the discretion of the Incident Controller.

(3) EEBD - Emergency Escape Breathing Device / Self Rescuer (underground only):
All personnel working underground are issued with an Ocenco M20.2 EEBD (Emergency Escape Breathing Device / Self Rescuer). Training of all personnel, including any underground visitors, in the use of EEBDs (Self Rescuers) is carried out by the Safety Training Officer at induction. It is a mandatory requirement that Oxygen generating self-contained EEBDs (self-rescuers) are carried by all personnel on their person at all times when entering the underground mine. The Safety Training Officer maintains a record of each person who has undergone such training.

(4) Refuge Stations (underground only)
Prefabricated steel refuge stations are installed near the main working areas underground, so as to provide safe havens for personnel in the event of an emergency when persons may not be able to get to surface. There are currently 3 Refuge Stations in the Drummond Underground Mine:

- 2 x 8 Man Refuge Stations
- 1 x 4 Man Refuge Station (Mini-sub)

Exterior View

Interior View

As the mine workings extend, the refuge stations are moved forward.
The locations of these stations is highlighted on the Tag Board in the Lamp Room and locations are updated on the board immediately after move-up.
In use each person will have his/her own breathing mask connected directly to a separate air cylinder containing Medical Grade Air (J) - each cylinder has enough air to last 16 to 18 hours.

The first person to enter the Refuge Station will immediately notify the Tag Board Official and thereafter will remain as 'point of contact' for the duration of the time that personnel are required to remain in the Refuge Station. The 'point of contact' will notify the Tag Board Official when other personnel enter the Refuge Station to include

- Names
- Condition (physical & emotional)

The reported condition of personnel (both physical & emotional) will potentially dictate how Mine Rescue Teams are deployed.

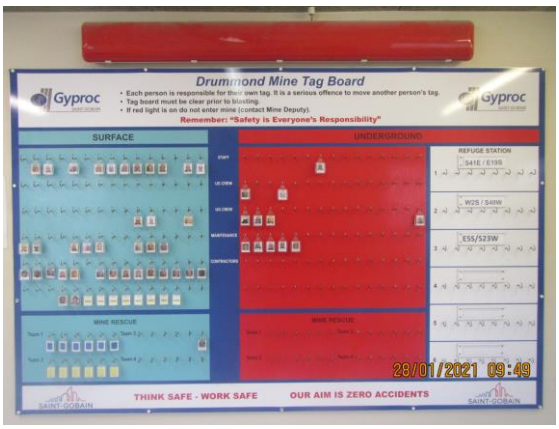
(5) Emergency Escape Route (underground only):

The Emergency Escape Route is the Air Intake of the Underground Mine – it extends from the Surface / HD →E17/S41 (See drawing attached – Appendix3). Access to the Emergency Escape Route is via the following locations:

- E17/S41
- S29/E7 (Roller Door)
- S26/E11 (Regulator Door)
- S6/E12 (Brattice Door)
- HD/E12 (Brattice Door)

(6) Tag Board System:

The **Tag Board** is situated in the main Offices of the mine, in the Lamp room, and is an integral part of the Underground Safety System. Each person working in the mine is issued with their own personal **Tag** which is placed on the Tag Board and is used to check who is underground at any particular time.
In the event of an emergency situation it provides a method to ensure all underground personnel are accounted for, and may trigger the deployment of mine rescue teams for missing workers.



The Tag Board is divided into the following sections (3 in total):

- Surface (to include a sub-section showing Mine Rescue personnel availability)
- Underground (to include a sub-section showing Mine Rescue personnel (teams) deployed underground during an emergency)
- Refuge Stations (showing the location of each Refuge Station underground)

When personnel enter the Lamp Room the Tag Board Official will check and ensure that they have moved their tag from the Underground section to the Surface Section of the Board. Personnel who rotate between surface and underground operations will also be accounted for using the Tag Board system.

When personnel enter a Refuge Station underground the 'point of contact' for that Refuge Station will communicate the name and condition (physical / emotional) of that person to the Tag Board Official. The Tag Board Official will then move that persons tag to section of the Board relevant to that Refuge Station and note their condition (the physical and emotional condition of personnel within a Refuge Station will influence how Mine Rescue Teams are deployed). As the situation unfolds this will allow the Tag Board Official to communicate accurate / up to date information to the Incident Team regarding the location and status of personnel underground.

(7) Incident Control Room:

In the event of **any** emergency (surface or underground) the Incident Control Room will be the Mine Surveyors Office, located on the first floor of the Administration Building. The Mine Surveyors Office / Incident Control Room is equipped with:

- 2 x Internal / External Telephone lines (one of which is a dedicated emergency telephone line for internal / external communication – see section xx Communication
- Two way-radio (base & hand held units)
- Emergency Contact Numbers (Internal & External)
- All site drawings (surface & underground) to include all site services (electrical, water, ventilation….)
- Internet access

(8) First Aid:

a) First Aiders:

Drummond Mine and Knocknacran Quarry currently has a total of 7 (seven) trained First Aiders - names and internal contact details are listed below (Appendix 1)

b) First Aid Room:
The First Aid Room is located on the ground floor of the Administration Building.

First Aid Room

Ground Floor – Administration Block

The First Aid Room is equipped with:

- AED
- Examination Couch
- First Aid cabinet (25 persons)
- Eye Wash Station
- Drinking Water

c) First Aid Kits:
First Aid Kits are available at the following locations:
Surface:

- Workshop
- Homogeniser Control Room
- Secondary Crusher Control Room
- Surface Crusher Control Room

Underground:

- Refuge Stations
- Shift Boss Office Underground.

Mobile Equipment:

- All 4x4 Light Vehicles

First Aid kits are 1 - 10 person kits with the exception of the Site Ambulance, Mine Rescue Station and First Aid Room (1 – 25)

d) AEDs:

Drummond Mine has 2 x AEDs:

1. Surface - First Aid Room
2. Underground - Shift Boss Office at the C3

AED – Shift Boss Office Underground:

(9) Site Ambulance:

The Site Ambulance (Fig. 1 below) is parked underground at the S1/E14 on the Air Intake (see drawing attached - Appendix 4) adjacent the Shift Boss Office. The Ambulance keys are kept in the ignition and the Ambulance is kept on 'trickle' charge to ensure the vehicle is ready for use (Fig 2 below - must be disconnected prior to use).

Fig. 1:

Fig. 2:

The Ambulance will be used when required to transport any injured person/s to surface.

In the event of a serious injury on surface the Ambulance will be deployed for use as directed by Mine management conferring with Emergency Services.

The Ambulance is equipped with a Resuscitator, Stretcher, back-board, splints, neck brace and appropriate First Aid materials (to include Burns Kit)

In the absence of a vehicle from the Ambulance Service, it may be used to transport an injured person (under escort) to hospital.

(10) Fire Fighting:

All Saint-Gobain Mining (Ireland) Ltd personnel receive basic fire-fighting training which is repeated once in every 2 years.

Fire Fighting Equipment:

- Surface Mobile Plant: dry powder extinguishers
- Underground Mobile Plant: ANSUL / Kidde (suppression) Systems & dry powder extinguishers.
- Fixed Electrical Equipment: CO2 extinguishers
- Diesel fuel stores: foam extinguishers.

Fire Extinguishers & Suppression systems are inspected once in every six months by the supplier.

See Appendix 5: Surface Fire Points

Picture below shows example of Fire Point Underground (adjacent Electrical Panel):

Important Note: there are no fire hydrants on site.

(11) Mine Rescue:

a) Mine Rescue Station:

The Mine Rescue Station (pictured below) is located just inside the Main Entrance to the site (see drawing – Appendix 6). The room is equipped in accordance with requirements of the Safety, Health & Welfare at Work (Mines) Regulations 2018 and has changing facilities for 20 x Mine Rescue Personnel.

Drummond Mine Rescue Station:

b) Mine Rescue Team – Drummond Mine & Knocknacran Quarry:

Drummond Mine & Knocknacran Quarry currently retains 1 x 5person Mine Rescue Team (Rescue Team names and mobile phone numbers are given in Appendix 1)

The Mine Rescue Team will be mobilised for all Level 2 & Level 3 Incidents (surface / underground).

In the event of any incident underground which requires the deployment of the Mine Rescue Team, assistance will be immediately requested from IMRC affiliated Mines. For Level 3 incidents underground requiring the wearing of breathing apparatus deployment of the Mine Rescue Team will only occur when a back-up Team is on site.

In the event that Mine Rescue Team members are rendered unavailable (may be underground at the time of the emergency) the available Team Members will perform the role of guide & additional Team Member for Mine Rescue Teams from other mines.

Availability of Mine Rescue Team Members who are off site at any time is confirmed by the location of their tag on the Tag Board (Surface – Mine Rescue).

c) Underground Rescue Teams – Back Up

Depending on the level of severity the Incident Controller will determine the requirement to request Mine Rescue assistance from the IMRC affiliated Mines.

In the event that back-up is required the Incident Controller will give the instruction that assistance be requested from the following Mining Operations (sequentially, based on proximity, as set out below)

1. Boliden Tara Mines
2. Dalaradian Gold Ltd.
3. Irish Salt Mining

Contact names and numbers as per Appendix 1

The following information should be requested:

1. Number of Teams available
2. Estimated time of arrival

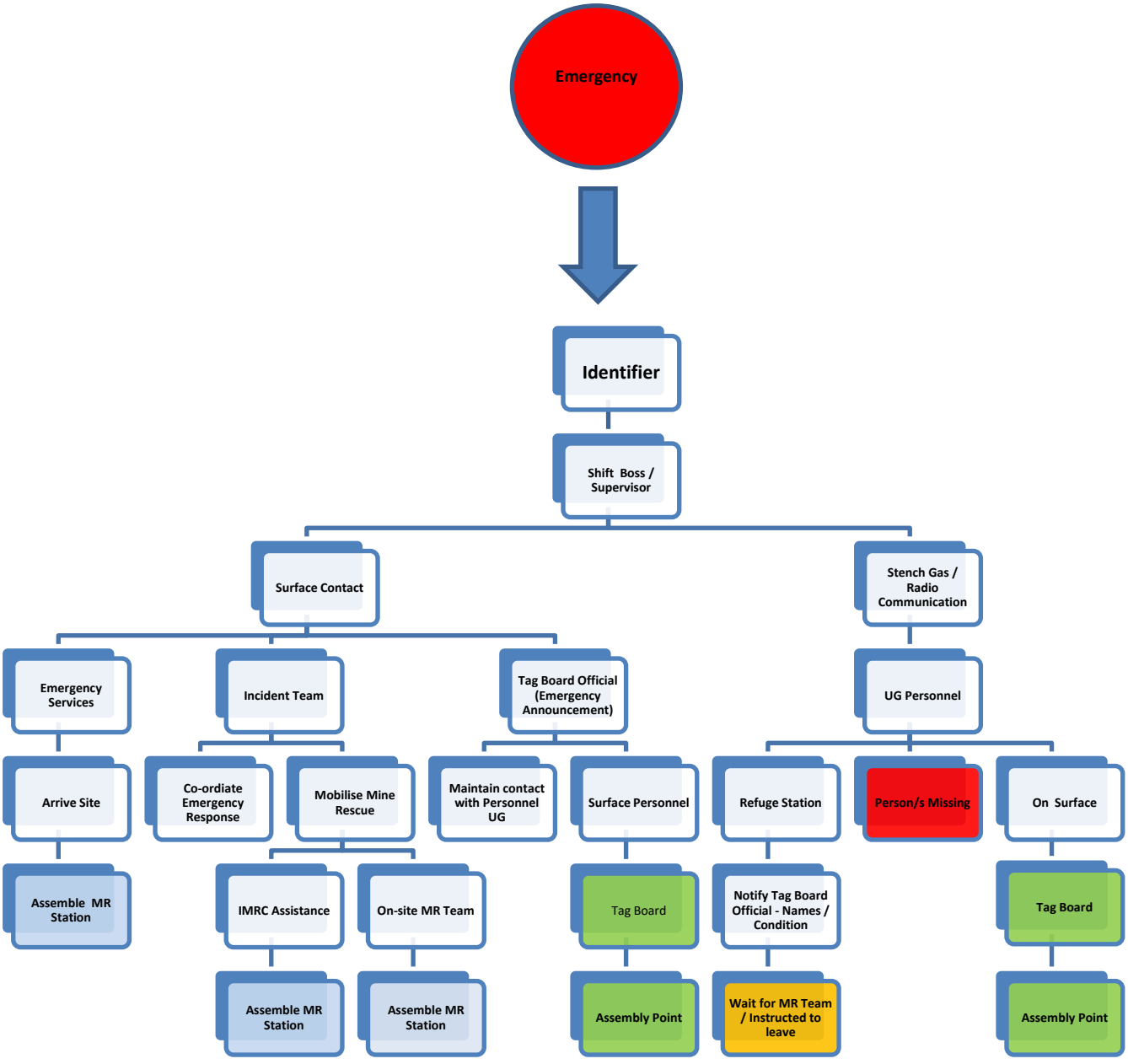
On arrival Rescue Teams will proceed directly to Mine Rescue Station where they will mobilise for deployment. Thereafter Rescue Teams will be briefed by the Mine Rescue Officer and the agreed plan of action noted. Deployment of Rescue Team(s) will be the sole responsibility of the Mine Rescue Officer.

8. DRILLS & PRACTICES:

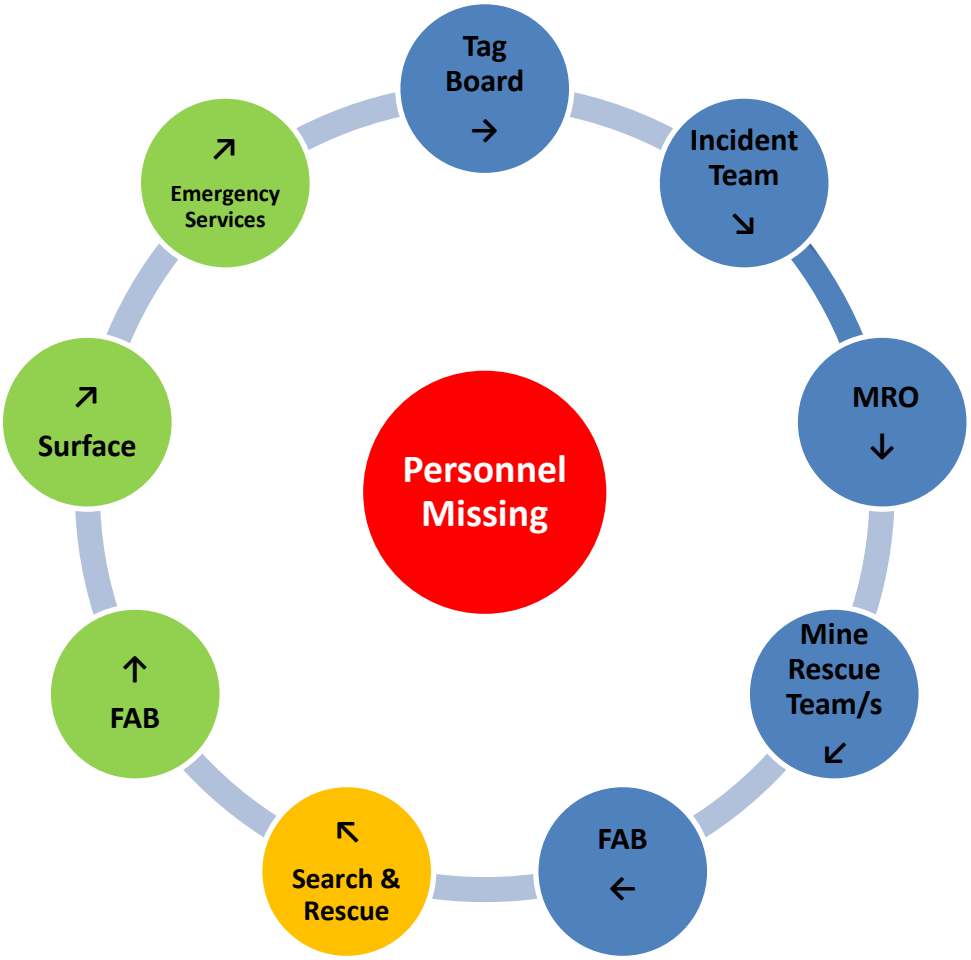
A planned full evacuation of the underground mine will be practiced once every 12 months. The date and time of the practice will be determined by the Mine Manager and communicated only to the Mine Safety/Training Officer. The Mine Safety/Training Officer will make the necessary arrangements, monitor the response and make a written report, outlining corrective actions where / if identified, to the Mine Manager.

9. EMERGENCY RESPONSE:

a)

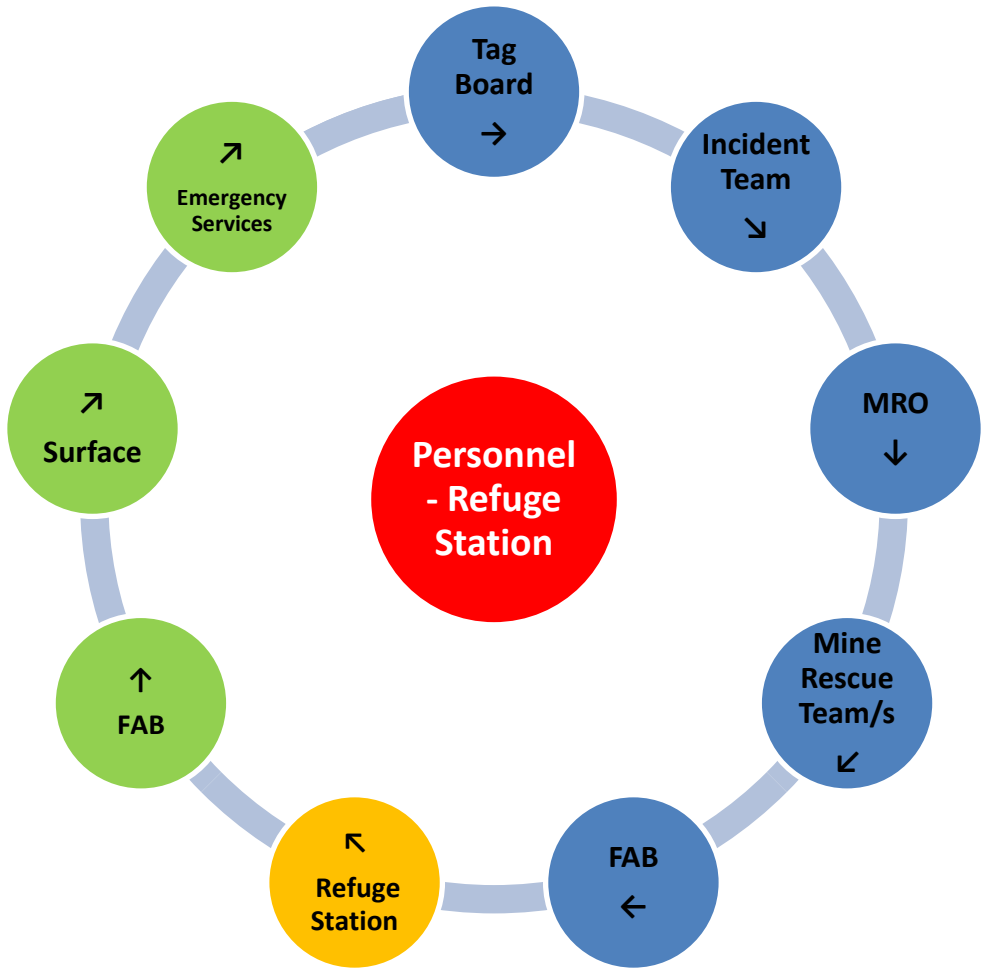


b) **Personnel Missing (underground)**



PROCESS REPEATS UNTIL ALL PERSONNEL REMOVED TO SURFACE

c) **PERSONNEL – REFUGE STATION**



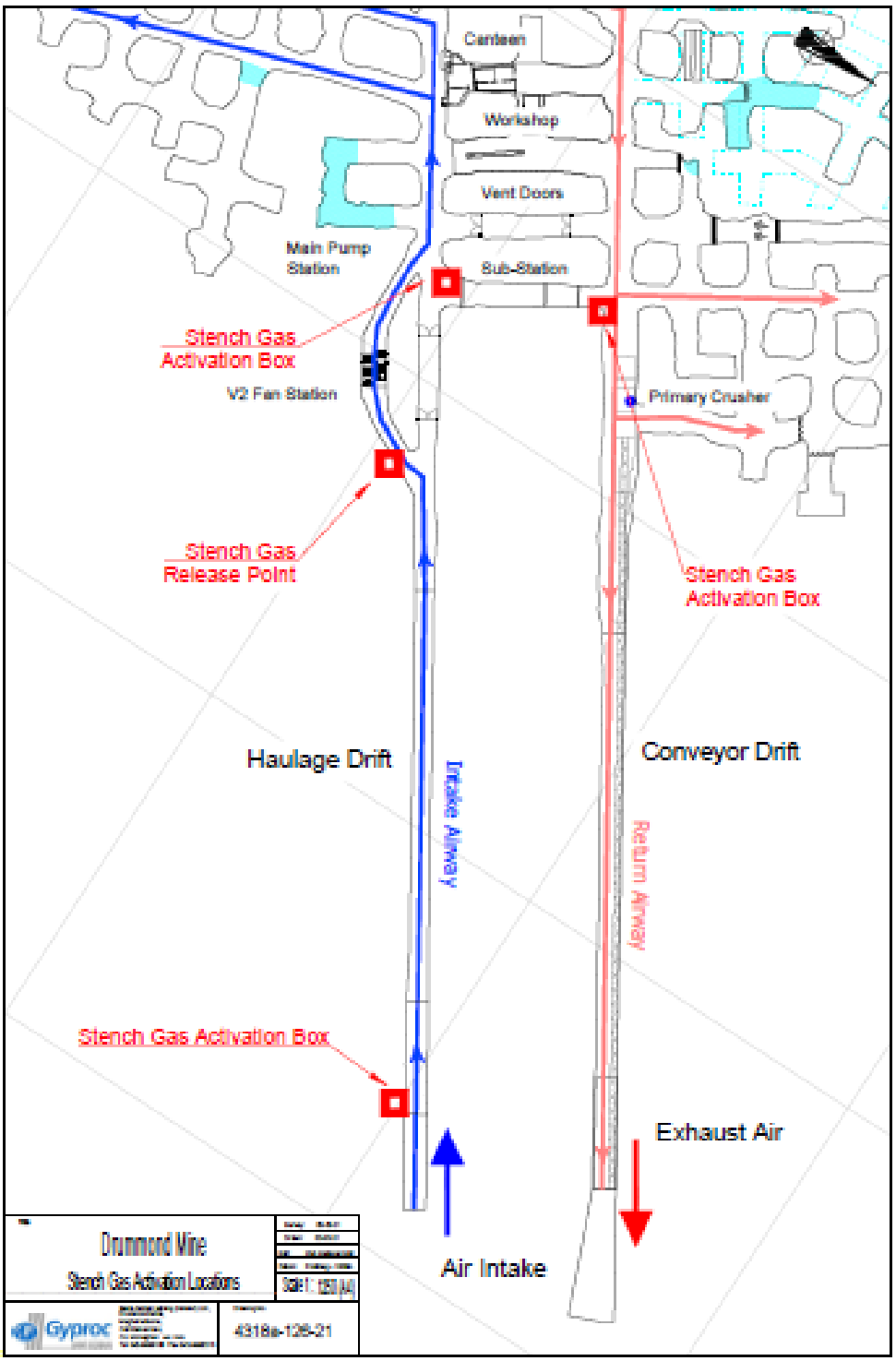
PROCESS REPEATS UNTIL ALL PERSONNEL REMOVED TO SURFACE

Site First Aiders:

No.	Name:	Position:	Ext. No. / Radio Channel
1	Liam Kelly	Operator	Radio Channel 1
2	Kevin Proudfoot	Mechanic	Radio Channel 1
3	Sean Ledwith	Fitter	Radio Channel 1
4	Luke Reilly	Electrician	Radio Channel 1
5	Colm O'Neill	Shift Boss	2311 / Radio Channel 1
6	Shane Califf	Operator	Radio Channel 1
7	Andrew Dimbylow	Operator	Radio Channel 1

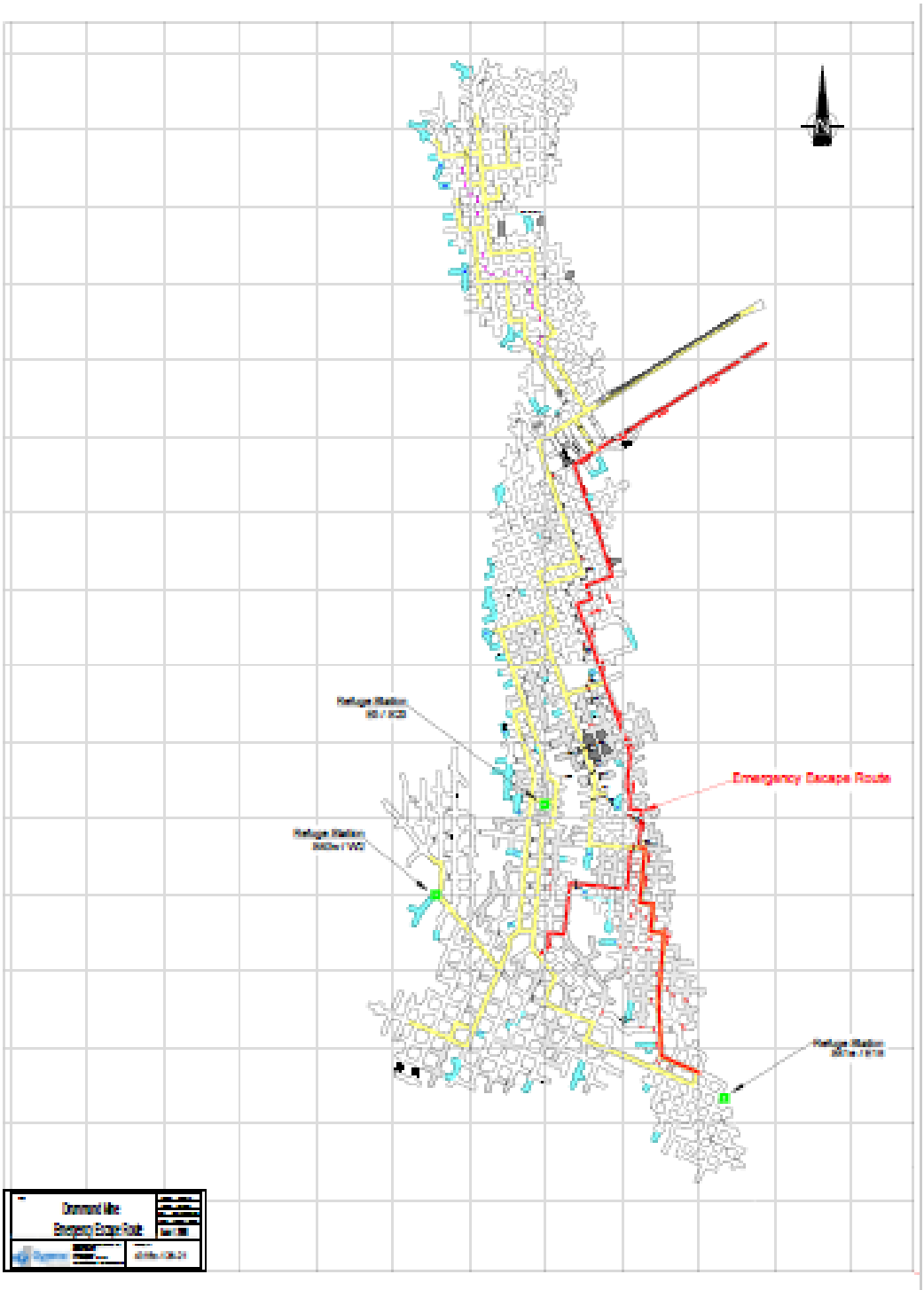
Appendix 2:

STENCH GAS DISPERSAL SYSTEM & ACTIVATION POINTS



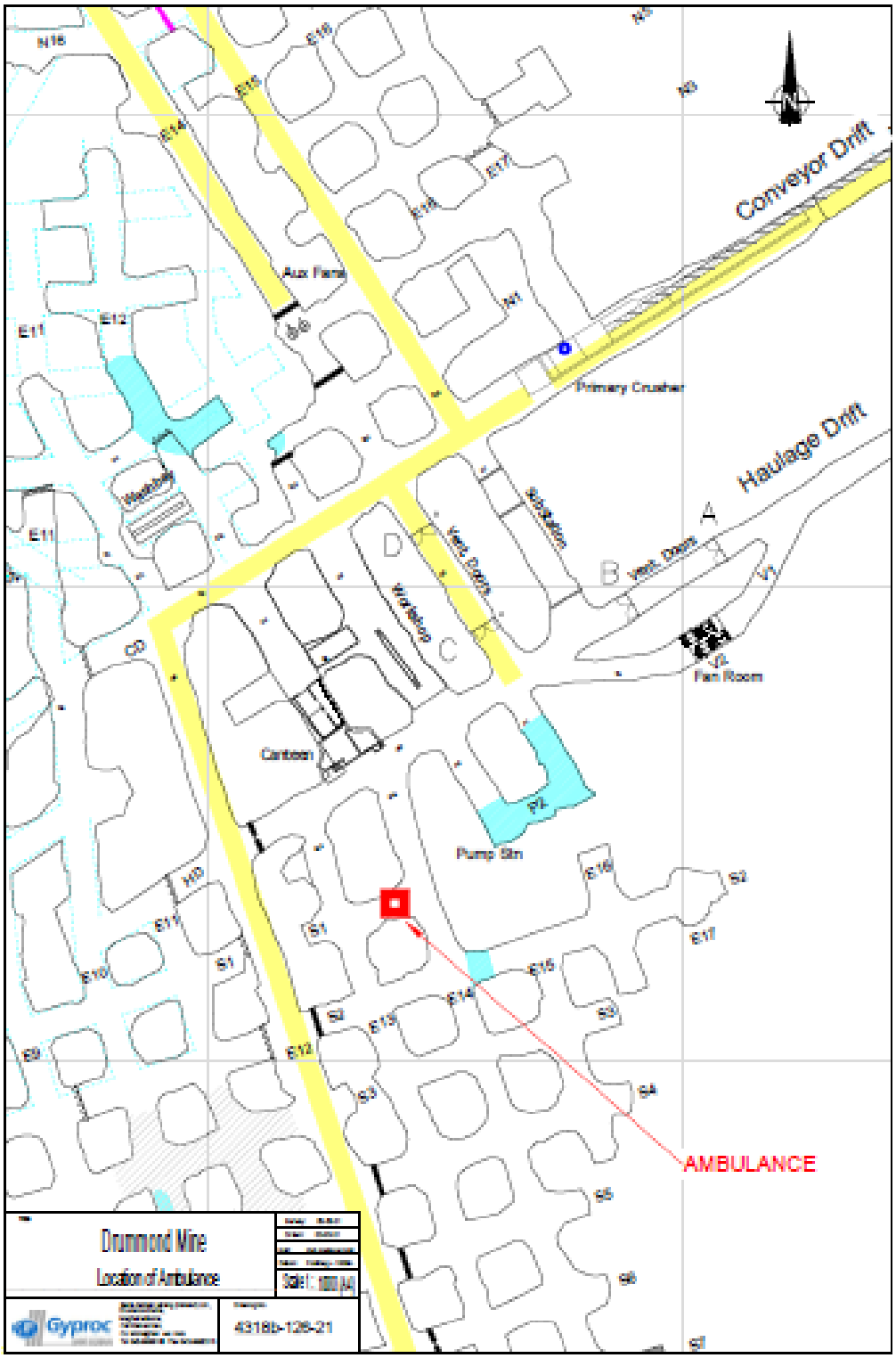
Appendix 3:

EMERGENCY ESCAPE ROUTE



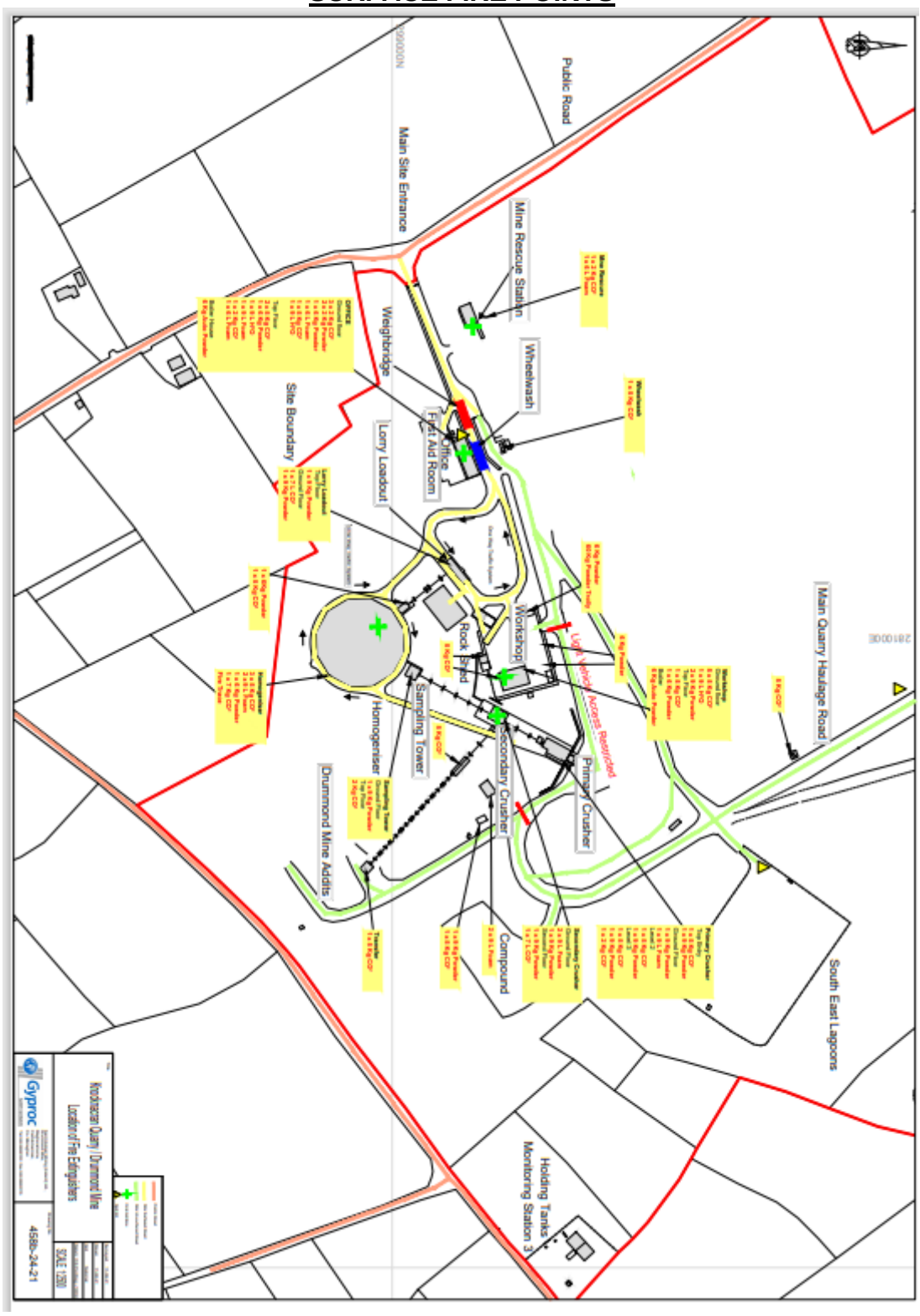
Appendix 4:

AMBULANCE BAY



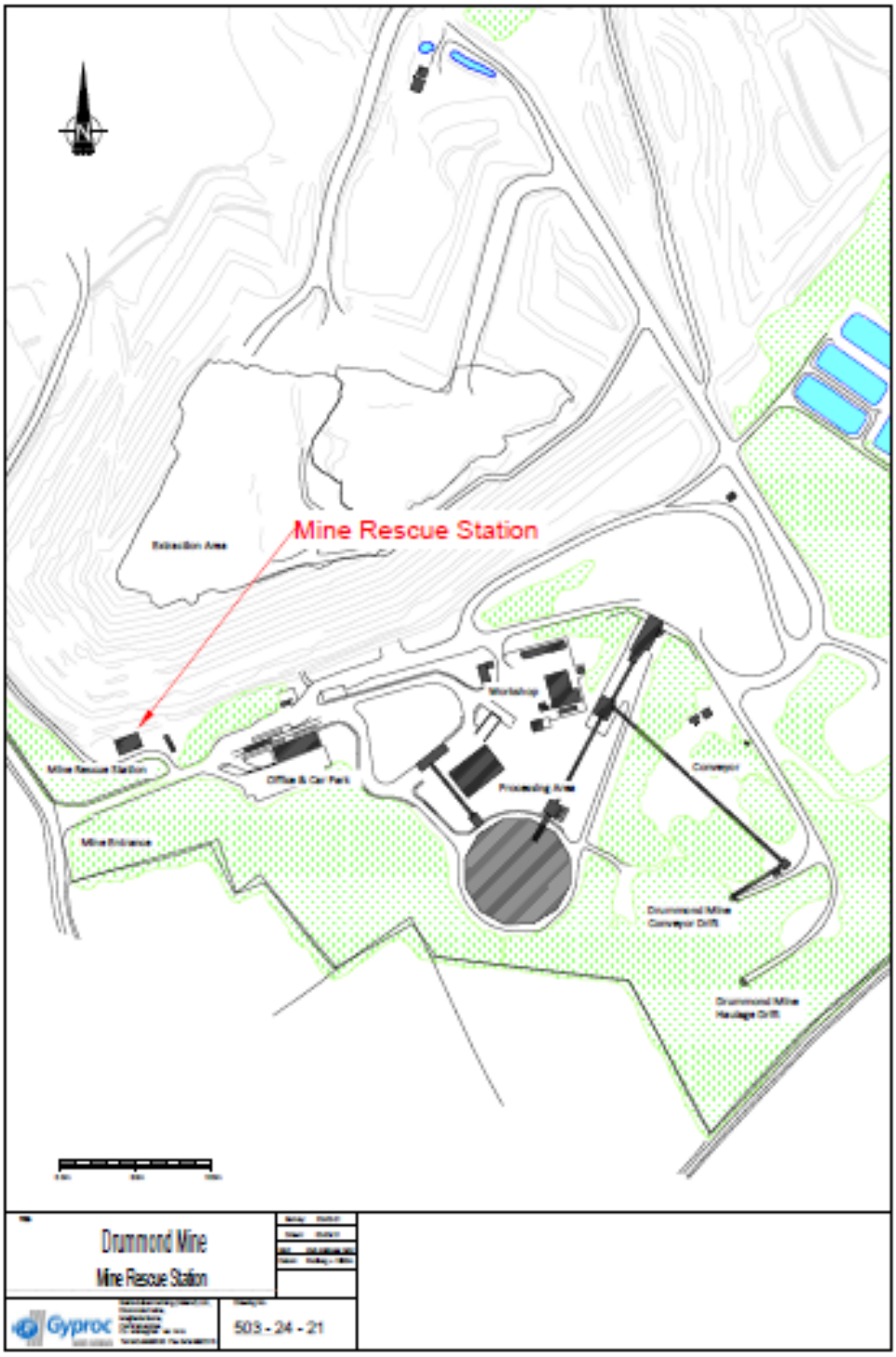
Appendix 5:

SURFACE FIRE POINTS



Appendix 6:

DRUMMOND MINE RESCUE STATION



Appendix 3.12

Proposed EPA Licence - Map

PLANNING BOUNDARY REG. REF. 22/34 (KNOCKNACRAN WEST)

EXISTING IE LICENCE BOUNDARY

PROPOSED IE LICENCE BOUNDARY (SUBJECT TO LICENCE REVIEW PROCESS WITH THE EPA)

SLR CONSULTING IRELAND
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14
T: +353-1-2964667
F: +353-1-2964676
www.slrconsulting.com

SAINT-GOBAIN MINING (IRELAND) LTD.

KNOCKNACRAN WEST RFI

PROPOSED IE LICENCE AREA DRAFT

APPENDIX 3.12

Scale	Date
1:3,000 @A0	OCTOBER 2022

RECEIVED: 11/04/2023

NOTES

OSI Map Series:
==========

Raster 1
1:5000

1887
REVISION DATE = 14-Jun-2009
SURVEY DATE = 31-Jul-2000

1825
REVISION DATE = 14-Jan-2014
SURVEY DATE = 31-Jul-2000

1764
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1765
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1826
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

1:2500

1886-B
REVISION DATE = 27-Mar-2015
SURVEY DATE = 17-Dec-2003

1887-A
REVISION DATE = 27-Mar-2015
SURVEY DATE = 13-Jan-2004

1887-B
REVISION DATE = 27-Mar-2015
SURVEY DATE = 15-Jan-2004

1887-C
REVISION DATE = 30-Mar-2016
SURVEY DATE = 31-Aug-2003

1886-D
REVISION DATE = 30-Mar-2016
SURVEY DATE = 31-Oct-2002

Projection:
==========
IG
ITM Centre Point Co-ordinate:
==========
X,Y = 680784,798862

LEGEND

Knocknacran West Wastewater Treatment System

Treated wastewater discharged to ground here from Community Sports Complex

Surface water discharge from Community Sports Complex

Surface water drainage (Knocknacran plant site) and mine wastewater outfall (mine sites) to Lagoons

Knocknacran Plant Site Wastewater Treatment System

Outfall to River Bursk from Mine Site

KNOCKNACRAN EAST
Cnoc na Crannchа Thoir

KNOCKNACRAN WEST
Cnoc na Crannchа Thiar

CLONSEDY
Cluain Saighde

DERRYNASCOBE
Doire na Scuab

DRUMMOND
An Droimainn

DERRYNAGLAH
Doire na gCleath

BALLYCARTLAN
Bealach Cartlann

ENAGH
An tEanach

301,000N
300,500N
300,000N
299,500N
299,000N
298,500N
298,000N
280,000E
280,500E
281,000E
281,500E
282,000E

0 120 240 360m
1:3,000

IE Licence Area_Draft.dwg