

Drainage: choosing your aggregates

A wide range of sizes, types and costs of aggregate materials are available for use in land drainage across the country.

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In Ireland, there is a broad range of materials available for use in land drainage systems. These materials, predominantly gravels, can vary widely in type and grade, due to local rock types. The performance and working life of land drainage systems depend on the quality and suitability of the materials used in the field drains, and on keeping such drains well maintained.

The range of materials available in terms of pipes and gravels does not easily fit into any standard classification, and many different combinations are in use. Field drains have to satisfy the often conflicting requirements for water flow and retention of soil particles. Their effectiveness is often reduced by blockages of the drain pipe or the envelope material (the material around the pipe) over time.

Cost and practicality usually drive the choice of material used. The relative costs of stone aggregate can direct the farmer towards unsuitable materials in some cases. While some of these are adequate, many more are unsuitable and as a result there are large variations in the performance of drainage systems.

Currently there is little guidance on the availability and cost of these materials from around the country. A survey conducted in January 2019 aimed to assess this variability in cost and availability of suitable materials. Twenty-five counties are represented within the survey, in which 93 quarries were assessed for the availability of materials and their related costs.

Figure 1: The distribution of quarry types around the country



Legend
 ◆ Basalt ◆ Gravel ◆ Limestone
 ◆ Dolorite ◆ Greywhacke ◆ Sandstone



What aggregates are available and where?
 Figure 1 shows the distribution of these quarries across the country.

There are 61 crushed rock quarries and 32 sand and gravel pits. The most common quarry type is Limestone (42%) due to the abundance of this

rock type in Ireland. Gravels (38%) have a wide geographical distribution.

Sandstone (11%) is widely available in Munster. Other quarries include Greywacke, a sandstone with >15% clay, and Dolorite and Basalt, medium-grained igneous rocks.

Generally, a single sized, clean stone, in the range of 10-40mm is preferable for use around drainage pipes. A large variation in size will reduce pore space and hinder the ability of the gravel to transmit water. Elongated aggregates can interlock, reducing flow rate.

Although it is important to have adequate flow of water through the gravel, it also needs to act as a filter. The size of aggregates used will depend on the proportion of sand, silt and clay that is within the soil and should be assessed before drainage works commence. However, this is not always possible and differences exist between crushed aggregates and gravels, quarry practices and local preferences.

Gravels act as an ideal drainage stone due to their rounded surface and being a generally clean material when washed, although gravel material is generally more expensive than crushed rock and isn't universally available. Crushed stone has more angular surfaces and is commonly used as base material in construction and concrete production.

Different sized materials are preferred in different areas of the country. The most common aggregate type is 50mm, making up 25% of the used materials, followed by 20mm, 20-40mm and 20-50mm sizes, with the rest being made up of sizes ranging from 10mm to 100mm (Figure 2).

When these data are classified by province, Munster has the highest average size of 53mm, followed by Connacht at 42mm and Leinster at 33mm. Although rainfall levels can vary with elevation and topography, the average annual rainfall is higher in western counties and around Wicklow. The drier counties tend to use a smaller stone size (average size of 36mm) as drainage material, compared to the wetter counties where the average size is 48mm.

What are the costs?

The costs of the materials are quoted per tonne, excluding both haulage and VAT. Fifty millimetre stone, on average, costs €8.87. This can vary anywhere from €5.50 to €12.50. The average cost for 20mm, 20-40mm and 20-50mm stone is €10.00. The larger 75mm and 100mm stone is cheaper at €8.41 on average, with the smaller 10mm, 12mm and 14mm stone costing around €11.



Table 1: Aggregate price by type

Size	Gravel	Sandstone	Limestone
10	€10.16	-	€8
20	€10	-	€9.50
50	€10.13	€9.30	€8.11
75	-	€10	€8.57
100	€10	€7.75	€8.10
20-40	€9	€9.50	€6.50
20-50	€10	€9	€11.5

Table 2: Aggregate price by region

Size	Munster	Connacht	Leinster
50mm	€9.42	€8.36	€8.14
20mm	€10	€9	€10
20-40 & 20-50mm	€11	€9	€9
75 & 100mm	€8.20	€8.86	-
10, 12, 14mm	-	-	€9

 Farmers considering a drainage project can acquire a copy of the Teagasc Drainage Manual via their local Teagasc office or on the Teagasc website.

Figure 2: Various aggregates in % total

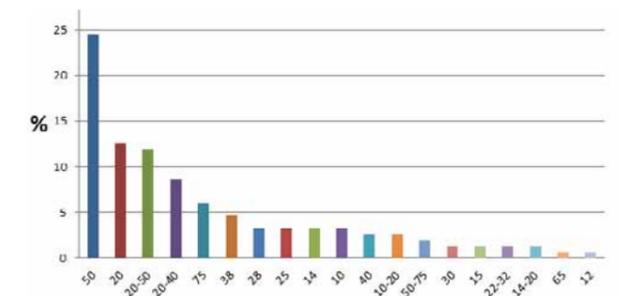


Table 1 shows the breakdown of stone types for the three main rock types. Table 2 outlines the prices for average sizes by region. The prices vary with rock type, size, quantity purchased, delivery distance, and the intensity of grading and washing conducted.

The potential use of limestone and its viability as a drainage stone has come under question and work to assess the suitability of limestone in drainage systems is under way to address questions of excessive dust, the binding together of aggregates and the breakdown of the material over time.

Following this survey, aggregates

were collected from 40+ locations across the country with a large geographical spread. These aggregates vary in size, shape and lithology, representing all the aggregates currently used as an envelope material in land drains. A number of tests will be conducted to assess hydraulic capacity, filtration and overall performance of these materials.

This work is part of an ongoing research project to assess the suitability of materials used in land drainage systems. The capacity, performance and lifespan of a range of pipe and envelope combinations will be assessed to provide guidance on their appropriateness.