Living the Farm to Fork Strategy on the Farm

Prof. John Gilliland

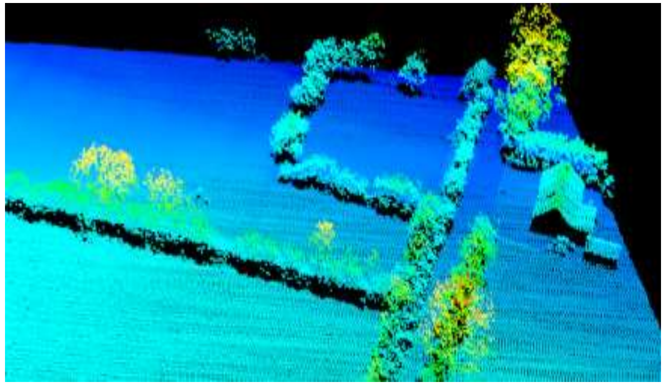
08/03/23

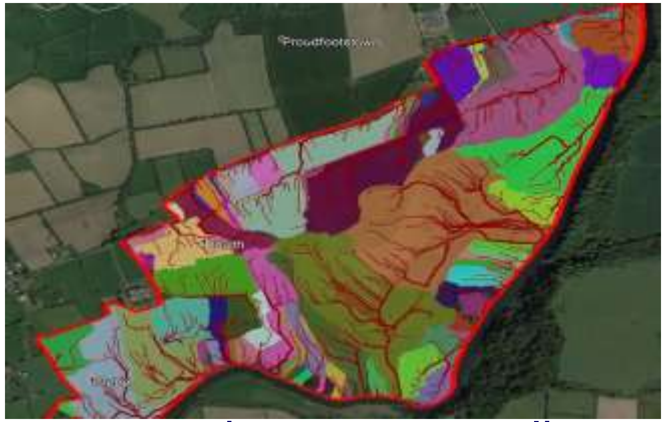
The Start of the Journey - The Lands at Dowth, Ireland

Delivering Multiple Public Goods, Simultaneously, from farming livestock


Purchased in 2013, 185ha
Grasslands & Woods


Delivering Soil Improvement
Fertility & Health


Measuring Carbon
Sequestration, Above & Below


Improving Water Quality
Reducing Over Land Flow

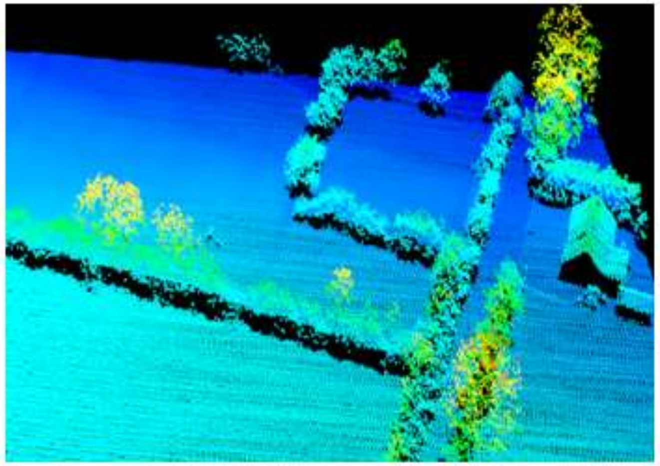

Optimising Biodiversity,
Understanding Trade Offs

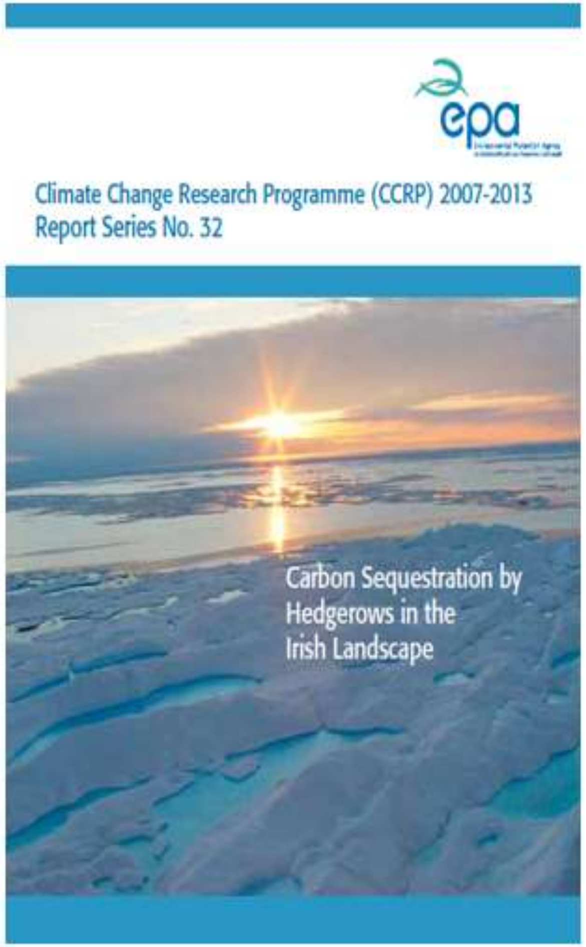

Managing our Landscape
UNESCO World Heritage Site

teagasc SIGNPOST GLOBAL NETWORK OF LIGHTHOUSE FARMS DEVENISH

Created Carbon Baselines

Aerial LiDAR Survey measured Total Above Ground Biomass (2014)





	Woods	Hedges	Total
Biomass Density (t C/ha)	83	127	86
Total Biomass in Dowth (t C)	3495	385	3880
Sequestration Potential for Dowth (t C/Yr)	50	1.2	51

S. Green, Teagasc, 2014

Created Carbon Baselines

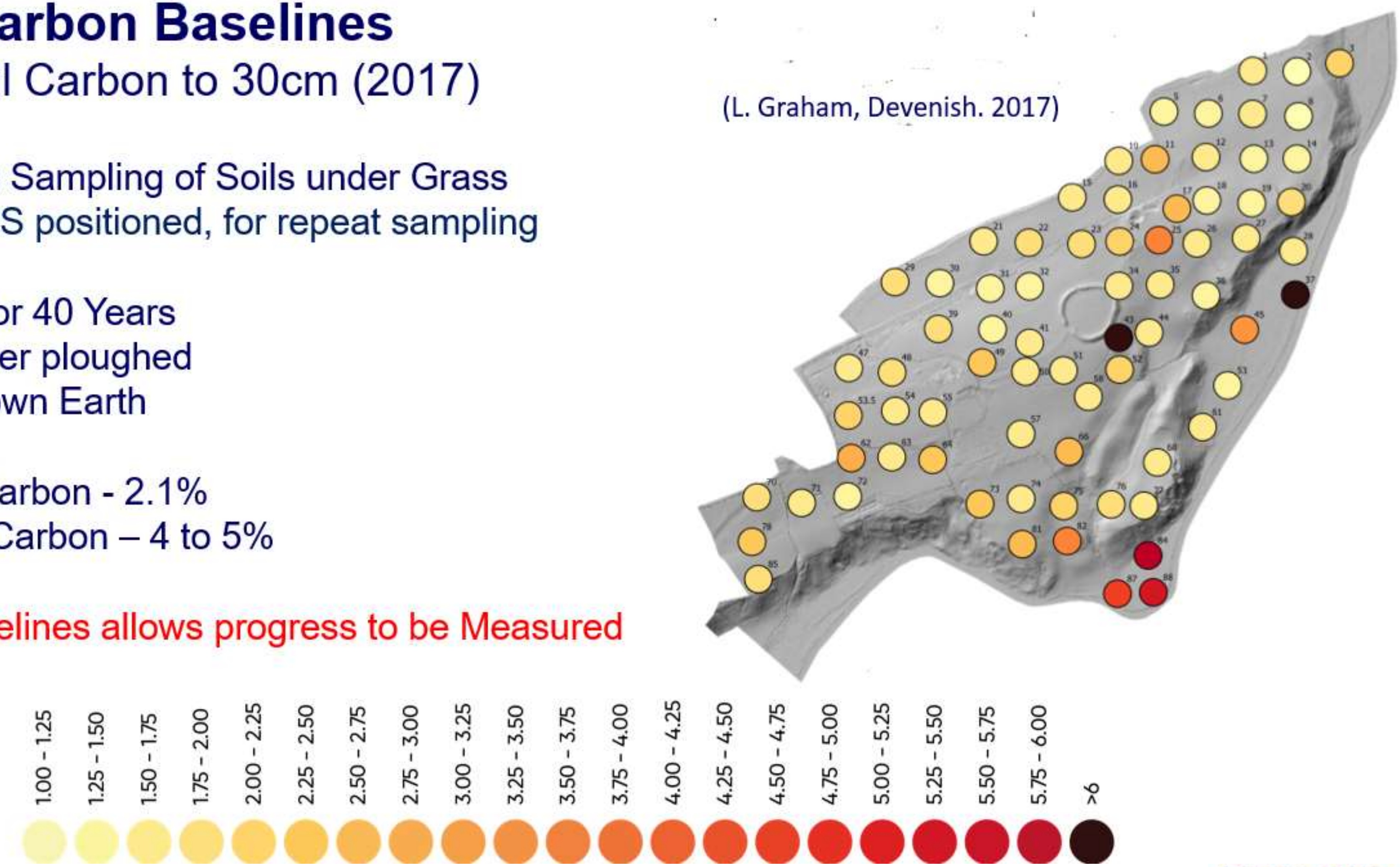
Sampled Soil Carbon to 30cm (2017)

Representative Sampling of Soils under Grass
88 soil pits, GPS positioned, for repeat sampling

No ploughing for 40 Years
Some land never ploughed
Soil Type – Brown Earth

Average Soil Carbon - 2.1%
Expected Soil Carbon – 4 to 5%

Repeating Baselines allows progress to be Measured

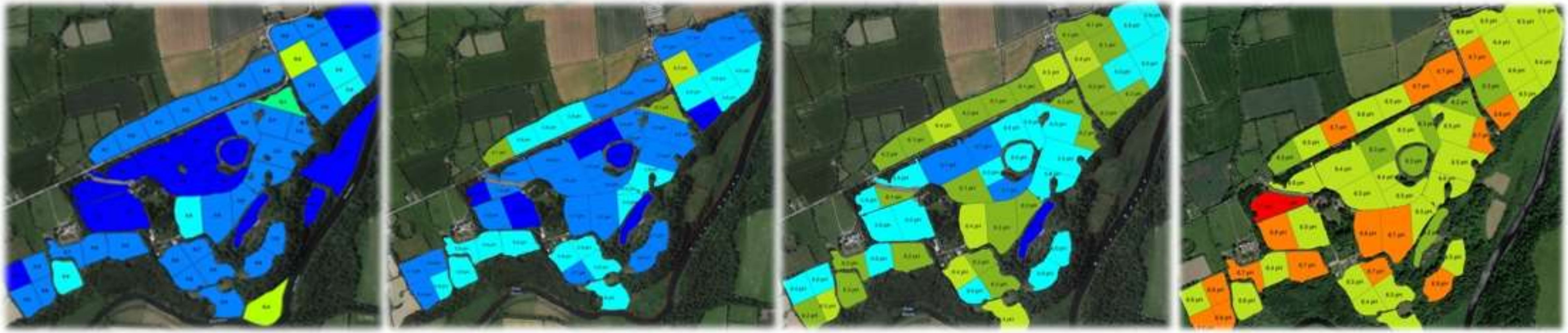


DEVENISH
Beyond Nutrition

Accelerating Productivity & Sequestration - Improving Soil pH

Through disciplined precision, GPS, Biennial, Soil Sampling & Analysis, every 2 Yrs

Feb. 2014	Feb. 2016	Feb. 2018	Feb 2020
Average pH 5.5	Average pH 5.7	Average pH 6.1	Average pH 6.6



- Above 7.0 pH
- 6.7 - 7.0 pH
- 6.4 - 6.6 pH
- 6.1 - 6.3 pH
- 5.8 - 6.0 pH
- 5.5 - 5.7 pH
- 5.0 - 5.4 pH
- Below 5.0 pH

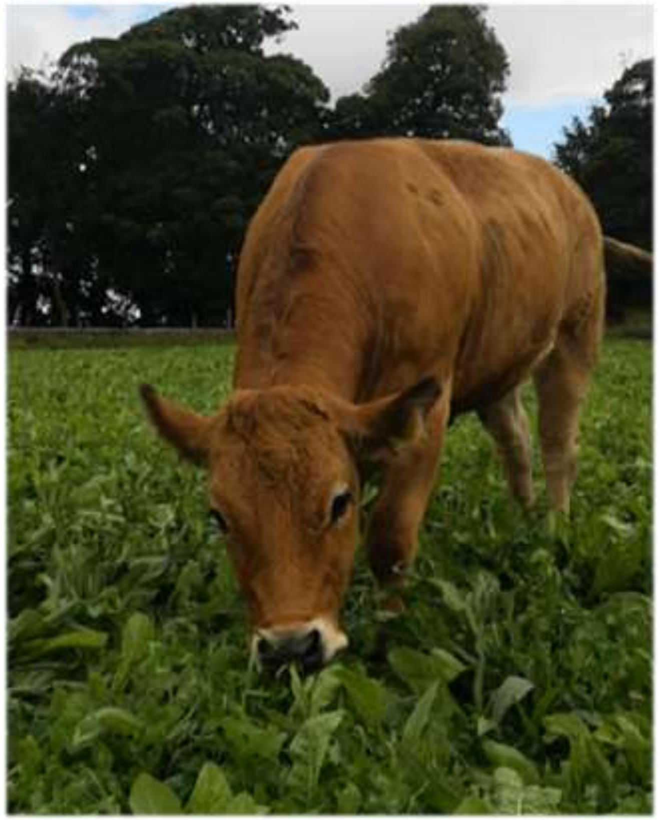
Delivered Credible Transparency of Soil Improvement at Dowth

Dowth Soils now at Optimal pH after six years, with expecting increase in Carbon

DEVENISH

Reducing GHG Emissions through the use of a “Living Lab….”

Investigated & Delivered Multiple Benefits by switching to Multispecies Swards



In One Year…..

65% Reduction in Nitrogen

20% Improvement in ADWG

300% Increase in earthworms

14 times faster water infiltration of soil

HEARTLAND
ONE HEALTH FROM SOIL TO SOCIETY

UCD DUBLIN

WAGENINGEN UNIVERSITY & RESEARCH

A 26% reduction in GHG intensity per kg of meat, without recognition of increases in soil carbon…..

agrecalc

Leveraging Dowth's Experience
Accelerating Seven farms towards Net Zero

ARCZero
ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

Delivering Positive Change by Empowering Farmers with

Gross Emissions, Gross Sequestration & Net Carbon Position; Soil fertility; Soil, Nutrient and Pesticide Run Off Risk Maps.

Partners

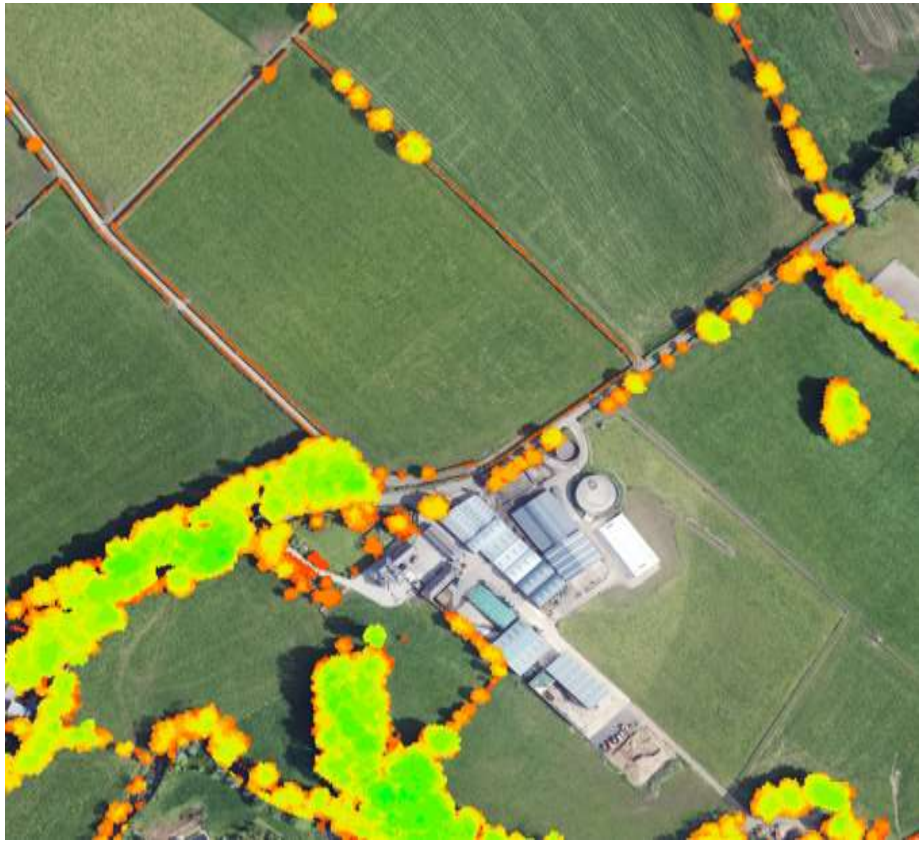
AFBI – Carbon in trees, hedges & soil P risk maps
AgriSearch – Communications
Devenish – Net farm Carbon Calculation
QUB – Soil Carbon
SRUC – AgReCalc calculator for Gross Emissions

Department of Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk

The European Agricultural Fund for Rural Development: Europe investing in rural areas

rural Development Programme

A Case Study - Accelerating change at Ballydevitt Dairy farm



100ha, family partnership, managed by Hugh & Thompson Harbison

180 Autumn Calving Cows, averaging 8,600 litres of milk, Aghadowey

Baselining of Above Ground Carbon, Trees & Hedges (Alex Higgins, 2021)

	Harbison Farm Totals					
Vegetation type	Hedge Length (km)	AGB (t)	C (t)	BGB* (t)	C (t)	Total C (t)
Hedge 0-4m	10.34	154.52	73.7	29.67	13.9	**87.6**
Hedge 4-7m	2.42	45.59	21.7	8.75	4.1	**25.9**
Hedge 7-10m	2.13	88.59	42.2	17.01	8.0	**50.2**
Hedge >10m	3.89	398.23	189.9	76.46	35.9	**225.9**
Total Hedges	**18.78**	**686.92**	**327.6**	**131.9**	**62.0**	**389.6**
	Canopy Area (ha)					
Single Trees	0.11	5.05	2.4	0.97	0.5	**2.9**
Deciduous Woodland	4.51	256.28	122.2	49.21	23.1	**145.3**
Coniferous Woodland	0	0.00	0.0	0.00	0.0	**0.0**
Total	**4.62**	**948.25**	**452.2**	**182.1**	**85.6**	**537.8**

AGB – Above Ground Biomass (Trees & Hedges)

BGB – Below Ground Biomass (Roots)

Getting a better Understanding of Soil Organic Carbon

How to measure it….. What influences it……

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ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

Agricarbon

Baselining Ballydevitt's Total Farm Carbon Stocks in Soils, Trees & Hedges

Land Category	Total ha	Av. LOI/SOM	No of soil Cores	No of Samples	Av. C. 0-10cm	Av. C. 0-30cm	Av. C/ha	Av. C/Category	C. 0-30cm Variation	Av. pH
10-20% Soil Org. Matter, Rotational Grass, Slurry, Only Cut	13.7ha	16.10%	35	7	5.80%	4.10%	133t	1,825t	3.1 - 5.1%	6
10-20% Soil Org. Matter, Rotational Grass, Slurry, Cut & Grazed	6.7ha	17.30%	25	5	6.40%	4.80%	153t	1,032t	3.8 - 5.3%	6.2
10-20% Soil Org. Matter, Rotational Grass, Slurry, Only Grazed	30.9ha	17.20%	50	10	7.70%	5.20%	162t	4,998t	4.4 - 5.3%	6.4
10-20% Soil Org. Matter, Permanent Grass, Slurry, Only Grazed	2.2ha	17.90%	15	3	5.50%	4.70%	159t	346t	4.0 - 6.1%	6.7
20-30% Soil Org. Matter, Rotational Grass, Slurry, Only Cut	4.2ha	21.10%	15	3	7.60%	4.40%	144t	605t	2.6 - 5.9%	5.8
20-30% Soil Org. Matter, Permanent Grass, No Slurry, Only Grazed	2.2ha	21.20%	15	3	10.50%	5.70%	168t	370t	5.1 - 6.7%	6
20-30% Soil Org. Matter, Rotational Grass, Slurry, Cut & Grazed	1.6ha	23.10%	15	3	15.40%	9.40%	247t	395t	5.7 - 15.8%	6.2
20-30% Soil Org. Matter, Rotational Grass, Slurry, Only Grazed	32.7ha	22.60%	60	12	8.80%	6%	183t	5,984t	3.4 - 9.8%	6.3
>30% Soil Org. Matter, Rotational Grass, Slurry, Only Grazed	7.7ha	40%	25	5	16.90%	13.90%	344t	2,649t	7.2 - 23.2%	6.4
10-20% Soil Org. Matter, Decideous Woodland	1.5ha	15.70%	15	3	8.20%	6%	167t	228t	3.6 - 10.7%	6.1
20-30% Soil Org. Matter, Scrubland	0.8ha	21.60%	15	3	10.30%	8.80%	210t	162t	7.9 - 9.6%	5.9
Sampling Density, 1 composite sample per 1.8ha or 2.7 cores/ha	**104ha**		**285 Soil Cores**	**57 C. Samples**			**179t/ha**	**18,594t of C.**		

Total Soil Carbon 18,594t of C, or 68,054t of CO2e

Baselining Ballydevitt's Total Farm Carbon Stocks in Soils, Trees & Hedges

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Total Soil Carbon 18,594t of C

Total Carbon in Trees & Hedges 538t of C

Total Farm CO_2e Stocks 19,132t of C x 3.66 = **70,023t of CO_2e**

And if you repeat every five years, you can measure change transparently

ARCZero

ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

Measuring Ballydevitt's Gross & Net Emissions using LCA

Activity	Farm Emissions (kg CO_2e)
Gross operation emissions	**2,019,742**
Compared to AgReCalc. Av.	***-2.20%***
Soil Carbon Sequestration	**-525,478**
Woodland Sequestration	**-23,958**
Renewables avoided emissions	**-13,077**
Net Farm Carbon Emissions	**1,457,229**

Net Emissions 28% less than Gross Emissions, when Sequestration & Renewables recognised…….

agrecalc

ARCZero
ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

Reducing Emissions from Ballydevitt Farm

Planting more herbs & legumes to reduce use of synthetic Nitrogen

	Baseline: (25% clover pasture/silage) Currently 181 units on Grazing	60% reduction in N, 35%/30% clover, all urea Percentage Change (%) rel to baseline
Sward Clover Content (%)	25	20.0
C02 Emissions	686,945	-9.5
Methane Emissions	925,993	0.1
Nitrous Oxide Emissions	398,942	-14.3
Total CO2e Emissions from Farming	2,011,880	-6.0
Whole farm C02e Emissions	1.20	-5.8
Emissions per hectare*	20,145	-6.0

Reduces Total Emissions from Farming by 6%, retrospectively
Saving £15,838 annually, at today's fertiliser prices

agrecalc

ARCZero
ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

Delivering Multiple Public Goods by planting Herbs & Legumes

Comparing Soil Carbon change after two years

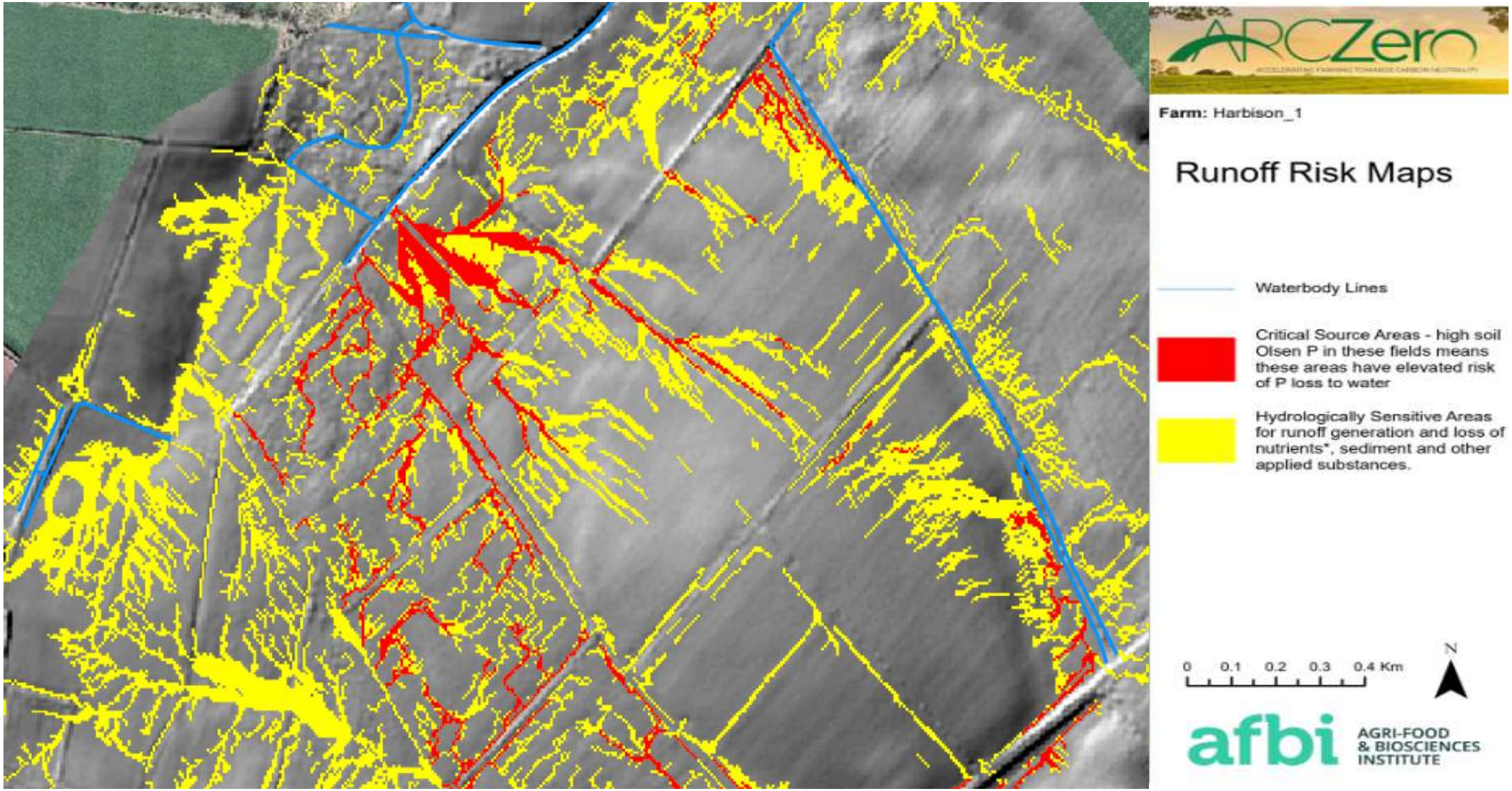
	Acreage	SOM 7.5cm	SOC 10cm	SOC 30cm
Perennial Rye Grass	5.8ha	16.90%	8%	5.40%
Multi Species	4.9ha	16.10%	8.30%	7.32%

Herbs, Legumes & Grass together, creating more & deeper Carbon

ARCZero

Delivering Multiple Public Goods by Planting Herbs & Legumes

Improving Water Quality by using Run Off Risk Maps (Rachel Cassidy, 2021)



Net Emissions across the ARC Zero farms

Giving farmers an understanding where they are on journey to Net Zero

Name	Enterprises	Gross Emissions	Gross Sequestration	Net Emissions	% Reduction
Ian McClelland	Dairy	1,125t/yr	309t/yr	816t/yr	27%
Hugh Harbison	Dairy	2,012t/yr	550t/yr	1,462t/yr	27%
John Egerton	Beef	1,404t/yr	442t/yr	962t/yr	31%
Roger Bell	Sheep with Beef	820t/yr	455t/yr	365t/yr	56%
Simon Best	Arable with Beef	1,799t/yr	738t/yr	1,061t/yr	59%
John Gilliland	Willow with dry cows	151t/yr	156t/yr	-5t/yr	103%

All farms are in a different place on their Journey to Net Zero
Some Farms will find the Journey a lot easier than others….

Some farms will never reach Net Zero…..

ARCZero ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

agrecalc

DEVENISH Beyond Nutrition

But…… There is a Catch…..

All Governments must report annually against their agreed International GHG reduction targets
The **GHG National Inventory** is the vehicle used to do this.

IPCC SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O
1. Energy	**M T1, T2, T3**	**M, T1, T2, T3**	**M, T1, T2, T3**
A. Fuel Combustion (Sectoral Approach)	M, T1, T2, T3	M, T1, T2, T3	M, T1, T2, T3
1. Energy Industries	T1, T3	T1, T2	T1, T2
2. Manufacturing Industries and Construction	T1, T2, T3	T1	T1
3. Transport	M, T2, T3	M, T1, T3	M, T1, T3
4. Other Sectors	T1, T2	T1	T1
5. Other			
B. Fugitive Emissions from Fuels	CS. T3	CS, T1, T3	CS, T3
1. Solid Fuels	NA	T1	NA
2. Oil and Natural Gas	CS, T3	CS, T1, T3	CS, T3
C. Carbon Dioxide Transport and Storage	NA		
3. Agriculture	**T1**	**CS, T1, T2**	**T1, T2**
A. Enteric Fermentation		CS, T1, T2	NA
B. Manure Management		T1, T2	T2
C. Rice Cultivation		NA	NA
D. Agricultural Soils		NA	T1
E. Prescribed Burning of Savannas		NA	NA
F. Field Burning of Agricultural Residues		NA	NA
G. Liming	T1		
H. Urea Application	T1		
I. Other	NA		

4. Land-Use, Land-Use Change and Forestry	**CS, D, T1, T2, T3**	**D, T1, T2**	**D, T1, T2**
A. Forest Land	CS, T1, T2, T3	D, T1	D, T1
B. Cropland	CS, D	D, T1	D, T1
C. Grassland	D, T1, T2, T3	D, T1	D, T1
D. Wetlands	D, T1, T2, T3	D, T2	D, T2
E. Settlements	D, T1, T3	NA	T1
F. Other Land	T1, T3	NA	T1
G. Harvested wood products	T2		
H. Other	NA	NA	NA
5. Waste	**T1**	**T1, T2**	**T1**
A. Solid Waste Disposal	NA	T2	NA
B. Biological treatment of solid waste	NA	T1	T1
C. Incineration and open burning of waste	T1	T1	T1
D. Wastewater treatment and discharge	NA	T1, T2	T1
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It is a collection of Individual Silos designed for easy Accounting & Reporting

But…… There is a Catch…..

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E. Other	NA	NA	NA

Farm Businesses don't fit within the Inventory, as they are multifaceted, they are split between a possibility of four different Silos, which do not allow recognition of each other…..

Living the Farm to Fork Strategy on the Farm

- **Systems thinking essential** to deliver **Multiple Public Goods,** simultaneously
- **Baselines essential** at individual farm level, to inform **Positive Behavioural Change**
- **Good quality MRV** needed to show the **journey has Integrity**
- **Net Zero** will only happen when **farmers Unshackled** & allowed to use **sequestration & renewables,** as well as emission reductions

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