

FORMAL SUBMISSION TO THE SECRETARY OF STATE

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Cumulative Flood Impact Assessment of Saturated Post-Development Solar Infrastructure on 62 Communities in the River Trent and River Witham Catchments

1. Introduction

The hydrologically linked catchments of the River Trent and River Witham represent some of the most complex, low-lying, and flood-prone drainage systems in the United Kingdom.[1] Driven by minimal topographic gradients, extensive low-lying peat and clay plains, and outfalls highly sensitive to tidal locking and surges from the Humber Estuary and the North Sea, these catchments require highly coordinated hydraulic management.[2] The primary hydrologic conduit between these two major systems is the Fossdyke Navigation.[7] This historic canal connects the tidal River Trent at Torksey Lock to the River Witham at Brayford Pool in the centre of Lincoln.[7] Because there are no locks or control structures between Lincoln and Torksey, the canal acts as an open, backwater channel in direct hydraulic continuity with the River Witham.[8] Surcharges on the River Trent routinely propagate eastwards through this hydraulic corridor, transferring flood volumes into the Witham catchment and directly threatening the city of Lincoln.[10]

The proposed construction of seven major utility-scale solar photovoltaic (PV) projects—the Great North Road (GNR) Solar and Biodiversity Park, Tillbridge Solar, Gate Burton Energy Park, Cottam Solar, West Burton Solar, One Earth Solar, and Springwell Solar—represents an unprecedented land-use change.[12] Collectively, these developments represent an active PV array footprint of 4,752.95 hectares across a combined site boundary order limit of 8,844 hectares.[13] Under extreme rainfall events falling on saturated catchments, such as those witnessed during the winter of 2023–2024 under Storm Babet and Storm Henk, the conversion of thousands of hectares of agricultural soil into concentrated PV panel driplines and compacted access tracks has the potential to trigger catastrophic systemic flood risk.[15] This report provides an independent evaluation of the cumulative hydrological and hydraulic impacts of these projects on critical receiving conurbations.

2. Gauging Station Analysis and Historical Peak Water Levels

Accurate evaluation of catchment-scale flood risks requires cross-referencing telemetry data from key Environment Agency gauging stations. Torksey Lock (Station Reference 4065) on the River Trent serves as the critical operational node managing the

hydrologic boundary between the River Trent and River Witham catchments.[19] At this junction, the Fossdyke Navigation meets the River Trent, and the timing of the closure of the Torksey flood gates dictates the volume of water permitted to bypass the Trent and flow eastwards toward Lincoln.[45] The Torksey Lock station has a zero-gauge datum set to Mean Sea Level (mAOD).[20]

Historical flood peak data at Torksey Lock demonstrates a clear upward trend in flood severity, driven by climate change and persistent catchment saturation.[16] During the landmark flood of November 10, 2000, the River Trent at Torksey reached a peak stage of 7.307 mAOD.[23] In 2012, while a single acute peak is not formally isolated in local telemetry logs, the region suffered prolonged, multi-week saturation, leaving the largest local flood storage area at Torksey entirely inundated for ten consecutive weeks over the Christmas period.[24] The high-water events of November 2019 and February 2020 (Storm Dennis) further illustrated the vulnerability of this reach, with fluvial peaks frequently forcing the out-of-bank bypass channels on the right bank into active operation.[25, 26] These historical precedents were shattered during Storm Henk on January 6, 2024, when the Torksey gauge recorded its absolute maximum on record at 7.423 mAOD, demonstrating that the physical containment thresholds of the local embankments are increasingly being exceeded.[16]

Downstream of Torksey, the River Trent at Gainsborough experiences a complex triple-interaction of fluvial flows, astronomical tides, and tidal surges from the Humber Estuary.[2] The Gainsborough gauge (Station Reference 4099) has a datum defined Above Stage Datum (mASD) with a stage datum equivalent to 0.00 mAOD (Newlyn Ordnance Datum), operating as a tidal-fluvial recording node.[34] The highest recorded peak at Gainsborough occurred on November 10, 2000, reaching 5.68 mASD.[33] During Storm Henk in January 2024, the gauge recorded a peak stage of 4.574 mASD.[35]

In the River Witham catchment, the primary monitoring stations include Brayford Pool (Station Reference E1608) and Stamp End Sluice (Station Reference E1406) in Lincoln.[38, 43] Brayford Pool reached its maximum on record during Storm Babet on October 21, 2023, peaking at 1.360 mAOD.[39] This event triggered severe local warning protocols due to the restricted capacity of the medieval High Bridge downstream, which acts as a hydraulic bottleneck in Lincoln.[7] Stamp End Sluice previously peaked at 1.352 mAOD on June 26, 2007, and recorded an instantaneous stage of 0.497 mASD during winter flows.[43]

Gauging Station	Station Reference	Primary River	Datum Type	Zero Datum (mAOD)	Historical Event	Peak Stage (mAOD)
Torksey [19]	4065	River Trent	mAOD	0.000	November 2000	7.307

Gauging Station	Station Reference	Primary River	Datum Type	Zero Datum (mAOD)	Historical Event	Peak Stage (mAOD)
					Winter 2012 November 2019 February 2020 Storm Henk (Jan 2024)	Saturated High Stage High Stage 7.423
Gainsborough [34, 35]	4099	River Trent (Tidal)	mASD	0.000	November 2000 Winter 2012 November 2019 February 2020 Storm Henk (Jan 2024)	5.680 High Stage High Stage High Stage 4.574

Gauging Station	Station Reference	Primary River	Datum Type	Zero Datum (mAOD)	Historical Event	Peak Stage (mAOD)
Brayford Pool [38, 39]	E1608	River Witham	mAOD	0.000	June 2007	1.352
					Storm Babet (Oct 2023)	1.360
Stamp End Sluice [43]	E1406	River Witham	mASD	0.000 (Nominal)	June 2007	1.352

3. Local Flood Defence Heights and Freeboard Margins

The defence network protecting conurbations along the Trent and Witham corridors is a patchwork of raised earth embankments, concrete flood walls, and automated sluice structures.[40] The structural integrity and height of these defences vary significantly, dictating the baseline freeboard margin, which represents the safety envelope between the peak flood stage and the defense crest.

At Gainsborough, the tidal flood walls were historically reconstructed to a crest level of 6.80 mAOD.[11] Under the standard 1-in-200-year design event, still-water levels are estimated to rise to 6.50 mAOD.[11] This provides a nominal design freeboard of exactly 300 mm (0.30 m).[11]

In the City of Lincoln, the Witham Washlands scheme actively regulates fluvial flood levels, attempting to restrict peak stages along the Witham and Fosdyke within a strict operating band between 4.36 mAOD and 5.70 mAOD.[10, 43] Adjacent to Brayford Pool and Stamp End, concrete flood walls stand at crest heights ranging between 5.64 mAOD and 5.69 mAOD.[43] Under a 1% Annual Exceedance Probability (AEP) flood event, Witham water levels are modelled to rise to 5.59 mAOD. When factoring in climate change projections, the water level matches the 5.64 mAOD crest height, reducing the remaining freeboard to 0.00 m and causing immediate overtopping. [42, 43]

For Torksey, the lock gates close to isolate the Fosdyke when Trent levels surcharge.[45] Major defences protect the dry side up to a crest level of 7.26 mAOD.[44] Under Storm Henk, the peak level of 7.423 mAOD exceeded this defence crest, resulting in a deficit of -163 mm (negative freeboard).[16]

Girton and Collingham are protected by a combination of minor washland banks and major flood embankments.[44] The minor defences protecting the Lea Marsh Washland stand at a low crest level of 5.34 mAOD, providing a nominal 1-in-3 year standard of protection.[44] Once these are bypassed, floodwaters are contained by major western embankments standing at 7.26 to 7.30 mAOD.[44] During Storm Henk, these major defences were overtopped and bypassed, with water levels surcharging the surrounding land and flooding the villages.[47]

For North Clifton and South Clifton, the defence system is divided into a low-lying primary agricultural bank and a secondary inner flood bank designed to protect the dry side of the villages themselves.[51] Topographic and modelling data from the West Lindsey Strategic Flood Risk Assessment (SFRA) shows that the 100-year modelled fluvial channel peak at North Clifton reaches 8.066 mAOD (with a 200-year peak of 8.417 mAOD and 1000-year peak of 8.515 mAOD).[1] The primary embankments stand at a crest height of approximately 7.50 mAOD.[51] This creates an immediate baseline deficit of -566 mm (negative freeboard) during a 100-year event.[51] Lived-experience data from the 2020 (Storm Dennis) and 2024 (Storm Henk) peaks confirms that even without the introduction of solar infrastructure, the secondary flood banks were already actively overtopping, leaving zero safety margin at the bottom of the village.[51]

Dunham-on-Trent does not possess formal, high-elevation urban flood walls; instead, it relies on broad floodplain agricultural embankments.[47] Ground-level raising is strictly controlled, and local planning policies require finished floor levels (FFL) for new developments to be elevated to at least 8.19 mAOD to provide safety against a 100-year plus climate change still-water level of 8.14 mAOD. This leaves a nominal structural freeboard of just 50 mm (0.05 m) relative to habitable spaces.[49]

Community	Major Flood Defence Type	Defence Crest Height (mAOD)	Extreme Baseline Design Storm Peak (mAOD)	Baseline Freeboard Margin (m)	Critical Operational Threshold / Notes
Gainsborough [11]	Reinforced Concrete Tidal Wall	6.80	6.50 (1-in-200 Yr Still Water)	+0.30 (300 mm)	Defences confine narrow floodplain within the town.

Community	Major Flood Defence Type	Defence Crest Height (mAOD)	Extreme Baseline Design Storm Peak (mAOD)	Baseline Freeboard Margin (m)	Critical Operational Threshold / Notes
Lincoln / Witham [42, 43]	Concrete Wall / Piled Flood Defences	5.64	5.59 (1% AEP Fluvial Peak)	+0.05 (50 mm)	Reduces to 0.00 m under 1% AEP + CC (5.64 mAOD).
Torksey [44, 45]	Clay Embankment / Lock Structures	7.26	7.423 (Storm Henk peak)	-0.163 (-163 mm)	Lock gates close to isolate the Fosdyke when Trent levels surcharge.
Girton [44, 47]	Earth Embankment	7.26	7.423 (Storm Henk Peak)	-0.163 (-163 mm)	Minor washland banks at 5.34 mAOD overtopped frequently. Secondary flood bank overtopped in 2012, 2020, and 2024.
Collingham [44, 50]	Earth Embankment	7.26	7.423 (Storm Henk Peak)	-0.163 (-163 mm)	Churchyard wall historically acts as

Community	Major Flood Defence Type	Defence Crest Height (mAOD)	Extreme Baseline Design Storm Peak (mAOD)	Baseline Freeboard Margin (m)	Critical Operational Threshold / Notes
					secondary local barrier.
North Clifton [51]	Primary & Secondary Earth Embankments	7.50	8.066 (100-Yr Fluvial Channel Peak)	-0.566 (-566 mm)	Active Overtopping: Secondary floodbank already overtopping.
South Clifton [51]	Primary & Secondary Earth Embankments	7.50	8.066 (100-Yr Fluvial Channel Peak)	-0.566 (-566 mm)	Surcharged outfalls prevent local dry-side drainage.
Dunham-on-Trent [49]	Agricultural Bank / FFL Control	8.19 (FFL Threshold)	8.14 (100-Yr + CC Still Water)	+0.05 (50 mm)	Settlement designated with zero housing allocation constraints

4. Section 19 and Environment Agency Report Scrutiny

Under Section 19 of the Flood and Water Management Act (FWMA) 2010, Lead Local Flood Authorities (LLFAs) are mandated to formally investigate significant flooding conurbations.[4] Extensive reviews of these statutory reports, alongside Environment

Agency incident records, reveal a history of critical close-calls, near-overtopping events, and structural systemic failures.

The Routine Closure of Pumping Stations (The Odder Pumps) Beyond static overtopping, the Witham and Till catchments are acutely vulnerable to deliberate operational "locking." To protect the highly populated City of Lincoln and its critical infrastructure from being overwhelmed during winter storms, the Environment Agency routinely orders the shutdown of key upstream transfer pumps. A primary example is the Odder pumping station, located at the confluence of the River Till and Fosssdyke Navigation.[18]

While this emergency action saves Lincoln, it deliberately sacrifices the upstream catchment. When these pumps are turned off, the River Till is physically locked and backs up rapidly into the surrounding valleys. Forcing thousands of additional cubic metres of artificially accelerated, unattenuated solar runoff (from Cottam, Tillbridge, and West Burton) into this deliberately locked system guarantees catastrophic, unpumped flooding across thousands of acres of upstream farmland and communities like Saxilby, Sturton by Stow, and Broxholme.[18, 64]

Tailwater Backing and Outfall Failures

In January 2024, Storm Henk brought intense precipitation across the East Midlands, generating high-magnitude fluvial flows that tested the limits of the River Trent corridor.[16] The Section 19 report for the community of Girton records that Storm Henk caused both the River Trent and its tributary, The Fleet, to flood out of bank.[47] This resulted in the internal inundation of 25 properties in the village, representing the highest number of reported residential floodings in over a decade.[47] The primary failure mechanism identified was a severe tailwater backing effect.[47] As the River Trent surcharged to record-breaking levels, it created a hydraulic block that completely prevented The Fleet from discharging.[47] This in turn caused a cascading surcharge of the Mill Dam Dyke, effectively paralyzing the local gravity-fed surface drainage assets and drowning the low-lying village.[47] A major incident was subsequently declared by the Nottinghamshire Local Resilience Forum.[30]

Further upstream, the Section 19 report for Laneham during Storm Babet in October 2023 documents a similar systemic failure.[53] Sustained heavy rainfall of 124 mm over a 48-hour period caused the North Beck to surcharge, rapidly overwhelming the critical culvert under Dunham Road.[53] Due to the localized topography, floodwaters surcharged onto Dunham Road and flowed directly into residential zones, flooding five properties internally.[53] This was compounded by significant surface water sheets shedding directly off adjacent agricultural fields, highlighting the vulnerability of roads and conurbations to altered field runoff regimes.[53]

For North Clifton, statutory representations submitted during the DCO examination of the One Earth project detail severe localized surface water and fluvial interactions.[51] During the January 2024 event, residents had to run emergency pumps in 2-hour supervised shifts 24/7 over a local storm drain at the edge of the village to prevent rising

water from flooding homes and streets, pumping the runoff directly over the secondary flood bank.[51] The local sluice gates had to be completely closed to prevent the surcharged River Trent from back-filling the village via gravity outfalls.[51] This confirms that the North Clifton community is hydrologically “only just hanging on” under baseline conditions, meaning any incremental surface water runoff from adjacent solar sites will immediately compromise local safety.[51]

Historically, the Torksey and Spalford Bank reaches have experienced extreme close-calls that could have resulted in widespread inundation.[3] Spalford Bank—an ancient, sand-dune-reinforced embankment running between Girton and Marton Cliff—acts as a vital hydrological divide.[3] If a structural breach were to occur at Spalford Bank, major flood flows from the River Trent would bypass local containment and spill directly eastward into the Witham Valley.[3] This would inundate the City of Lincoln and subsequently drain into the Fens, causing catastrophic regional damage.[3] During past flood events, including those in 1947, 2000, and 2024, the Trent floodbank in the Torksey area suffered active overtopping, submerging parts of Torksey village.[11] While Spalford Bank held, its structural safety margins were depleted to near-zero, and the Environment Agency has repeatedly flagged this reach as a highly sensitive geomorphic risk.[3]

Similarly, the City of Lincoln’s Level 2 Strategic Flood Risk Assessment (SFRA) and Associated Technical Reports indicate that flood defences along both the Fosdyke and Witham are highly prone to failure.[39] Under 2D hydrodynamic modelling of 100-year and 1000-year events factoring in climate change, flood defences are projected to systematically overtop.[39] Breach analysis demonstrates that failure on the western bank of the River Witham would submerge large swaths of low-lying urban land, placing the Western Growth Corridor (WGC) and adjacent conurbations under severe hazard.[42]

5. Saturated Post-Development Cumulative Impact Analysis (The Source Mechanism)

Standard developer assessments rely on static maps that treat floodwater as a slow, predictable rise. The updated Independent Hydrological Assessment, presented with this report, accurately evaluates the cumulative hydrological impact of the seven solar projects by assessing catchment behavior under **Surge Saturated soil conditions (Scenario 3c/d)**. [12] This evaluates what happens when intense rainfall hits saturated ground simultaneously with a downstream tidal surge that hydraulically “locks” outfalls.

Crucially, while this report and the Independent Hydrological Assessment utilise Scenario 3c/d to mathematically represent the extreme compound conditions of a 'Storm Henk' type event, lived experience makes it absolutely clear that the devastating flooding and locked outfalls witnessed during Storm Henk were, in fact, already fully realised under the standard saturated baselines of Scenario 2. Because the catchments are already structurally failing and hydraulically locking under Scenario 2 conditions alone, we are significantly understating our case. By basing our ultimate impact models on the theoretical compound extremes of Scenario 3c/d, this independent assessment is deliberately conservative. The baseline system is already failing under standard

historical winter saturation; superimposing the artificially accelerated runoff of 8,844 hectares of solar infrastructure onto this everyday winter reality guarantees a catastrophic, systemic collapse far worse than even these models predict.

Under this compound Stress Test 2 scenario, the combined 7-project active PV footprint of 4,752.95 hectares yields devastating cumulative hydrologic values:[12]

- **Combined Peak Flow Surge:** 1,962.97 m³/s
- **Combined Lateral Overtopped Volume:** 5,493,384.25 m³

The unmitigated peak discharge rate of nearly 2,000 m³/s represents a critical kinematic shockwave. Because the receiving rivers are already “hydraulically locked,” this generates a staggering **5.49 million cubic metres** of unattenuated lateral overtopping that cannot drain. The theoretical hydrostatic exceedance index spikes to 23.37 metres. Because open-channel fluid mechanics dictate that water cannot physically stack vertically to these extreme heights, the massive vertical potential energy immediately converts into horizontal kinetic energy, violently blasting the unattenuated volumes into adjacent communities.[12]

This cumulative stage rise is applied below to evaluate the remaining freeboards for key constrained communities.

Community	Major Defense Crest (mAOD)	Baseline Storm Peak (mAOD)	Updated Localised Post-Dev Stage Rise (m)	Cumulative Saturated Storm Level (mAOD)	Saturated Post-Dev Remaining Freeboard (m)	Failure / Overtopping Hazard Assessment
Gainsborough [11]	6.80	6.50	0.85 (Tillbridge Max)	7.35	-0.55	Major Failure: Overtopping of flood walls by 550 mm; severe risk of breach.
Lincoln / Witham [42, 43]	5.64	5.59	1.43 (Spring)	7.02	-1.38	Catastrophic Failure:

Community	Major Defence Crest (mAOD)	Baseline Storm Peak (mAOD)	Updated Localised Post-Dev Stage Rise (m)	Cumulative Saturated Storm Level (mAOD)	Saturated Post-Dev Remaining Freeboard (m)	Failure / Overtopping Hazard Assessment
			well Max)			Immediate overtopping of Witham walls by 1.38 m.
Torksey [44, 45]	7.26	7.423	0.85 (Tillbridge Max)	8.27	-1.01	Catastrophic Failure: Overtopping of major Trent embankments by 1.01 m.
Girton [44, 47]	7.26	7.423	0.63 (GNR Local)	8.05	-0.79	Major Failure: Surcharging of embankments by 790 mm; bypass of primary Fleet outfall.
Collingham [44, 50]	7.26	7.423	0.63 (GNR Local)	8.05	-0.79	Major Failure: Surcharging of

Community	Major Defence Crest (mAOD)	Baseline Storm Peak (mAOD)	Updated Localised Post-Dev Stage Rise (m)	Cumulative Saturated Storm Level (mAOD)	Saturated Post-Dev Remaining Freeboard (m)	Failure / Overtopping Hazard Assessment
						eastern embankments by 790 mm; Churchyard wall bypassed.
North Clifton [51]	7.50	8.066	0.84 (One Earth Local)	8.91	-1.41	Catastrophic Failure: Embankment overtopped by 1.41 m; secondary inner flood bank drowned.
South Clifton [51]	7.50	8.066	0.84 (One Earth Local)	8.91	-1.41	Catastrophic Failure: Embankment overtopped by 1.41 m; severe dry-side flooding.

Community	Major Defence Crest (mAOD)	Baseline Storm Peak (mAOD)	Updated Localised Post-Dev Stage Rise (m)	Cumulative Saturated Storm Level (mAOD)	Saturated Post-Dev Remaining Freeboard (m)	Failure / Overtopping Hazard Assessment
Dunham-on-Trent [49]	8.19 (FFL)	8.14	0.84 (One Earth Local)	8.98	-0.79	FF Level Inundation: Water level rises 790 mm above required FFL; internal flooding of properties

6. Comprehensive Community-by-Community Cumulative Exposure and Impact Matrix

To evaluate the true catchment-wide vulnerability, this section details the impact of the newly updated Exceedance Indices and the 5.49 million cubic metres of Lateral Overtopped Volume across 62 individual conurbations.

Part 1: River Trent Catchment Communities (Nottinghamshire & Lincolnshire) – combined population ~74,000. *The conurbations along this stretch are highly vulnerable to fluvial-tidal interactions, tailwater backing of local dykes, and the potential catastrophic failure of key geomorphic features such as Spalford Bank.[3]*

- Newark-on-Trent (Population: 39,839):** As a major urban anchor and critical transport hub (A1/A46 corridors) situated downstream of the GNR cluster, Newark is highly sensitive to the “hydraulic locking” of its tributaries. Cumulative high-velocity runoff from upstream arrays, specifically the 626,000 m³ of unattenuated lateral volume from GNR, will exacerbate the surcharging of the River Trent. This creates a severe hydraulic block that prevents the River Devon and Middle Beck from discharging naturally. Regional stage rises directly threaten to flank Newark’s established flood alleviation schemes, projecting devastating backwater flooding into the town’s low-lying residential and commercial zones, particularly jeopardising the Tolney Lane caravan areas which operate on zero-margin evacuation thresholds.[4]

- **Gainsborough (Population: 20,537):** Bounded by direct tidal-fluvial defenses.[11] Saturated runoff from Tillbridge and Gate Burton generates a combined lateral overtopped volume of 1,384,263 m³. Under regional cumulative conditions, with an updated stage rise of 0.85 m, flood levels reach 7.35 mAOD, completely overtopping the 6.80 mAOD concrete flood wall.[11] Expected impact is widespread urban flooding across the low-lying parts of town, affecting approximately 2,000 homes.[11]
- **Torksey (Population: 777):** Operational node at the mouth of the Fosdyke.[19] Surcharged by Tillbridge and Gate Burton's 1.38 million m³ lateral overtopping.[14] Post-development stage rise of 0.85 m elevates water levels to 8.27 mAOD, overtopping major Trent embankments (7.26 mAOD) by 1.01 m.[44] Under regional cumulative conditions, the massive 5.49 million m³ volumetric displacement drowns the lock gates and causes catastrophic backwater flow through the Fosdyke.[11]
- **Girton (Population: 138):** Low-lying village bordered by The Fleet and Mill Dam Dyke.[47] Surcharged by GNR, which contributes 626,000 m³ of unattenuated lateral overtopping.[58] Local stage rise of 0.63 m pushes Trent water levels to 8.05 mAOD, overtopping the 7.26 mAOD earth embankments by 790 mm.[44] The village street will be deeply submerged under more than 2.3 m of water, cutting off the A1133.[47] Historically, Girton acts as the largest flood storage washland on the Trent, meaning it is exceptionally sensitive to localized runoff volume increases.[24]
- **North Clifton (Population: 176):** Located on the east bank of the River Trent, directly bordering the proposed One Earth site. Lived-experience data confirms that during the 2020 and 2024 peaks, the secondary inner floodbank was already overtopping under greenfield conditions.[51] Runoff from the One Earth site includes approximately 10 hectares of solar panels planned on a steep slope rising directly above the village (elevated at 20-24 mAOD, sloping down to the 9 mAOD village low point).[51] One Earth generates an immense 844,725 m³ of unattenuated lateral overtopping.[12] Under the updated post-development rise of 0.84 m, water levels reach 8.91 mAOD, drowning the secondary inner flood bank by 1.41 m and releasing unattenuated sheet flows directly into Croft's farmyard and village homes.[51] Under regional cumulative conditions, the village's lower streets will be submerged, making the area entirely uninhabitable.[51]
- **South Clifton (Population: 308):** Bordered by the eastern floodplain of the Trent. Surcharged by One Earth's 844,725 m³ lateral displacement.[66] Saturated clay soils and compaction from grid cable routing accelerate runoff.[51] Under localized rise of 0.84 m, water levels reach 8.91 mAOD, overtopping the 7.50 mAOD floodbank by 1.41 m.[51] Gravity drainage is rendered impossible due to outfall tailwater locking, causing local sewers and dykes to back up directly into properties.[51]

- **Collingham (Population: 3,052):** High-velocity flood zone protected by western earth embankments.[44] Surcharged by GNR's 626,000 m³ lateral volume.[58] Under localized post-development rise of 0.63 m, levels reach 8.05 mAOD, overtopping the 7.26 mAOD embankments.[12] Widespread backing of local drains floods the lower village, bypassing the historic churchyard wall.[50]
- **Dunham-on-Trent (Population: 361):** Bounded by direct agricultural banks and controlled by finished floor level (FFL) planning restrictions.[49] Surcharged by One Earth's 844,725 m³ lateral overtopping.[66] Post-development levels of 8.98 mAOD surcharge the designated FFL of 8.19 mAOD by 790 mm, causing severe internal inundation of low-lying properties.[49]
- **Newton-on-Trent (Population: 389):** Situated east of the River Trent, directly exposed to One Earth runoff.[14] Surcharged drainage ditches back up, flooding low-lying agricultural land and blocking local highway access at the A57/A1133 junction.
- **Laneham (Population: 392):** Bounded by the North Beck.[53] Post-development runoff surcharges the beck, rapidly overwhelming the culvert under Dunham Road.[53] Floodwaters spill across the road, cutting off the main link to the village and flooding residential properties internally.[53] This was compounded by significant surface water sheets shedding directly off adjacent agricultural fields, highlighting the vulnerability of roads and conurbations to altered field runoff regimes.[53]
- **Rampton (Population: 360):** Positioned on the west bank, exposed to cumulative runoff from One Earth and Cottam cable route corridors.[74] Runoff backs up local field dykes, flooding several hectares of BMV farmland.[64]
- **Fledborough (Population: 85):** Directly adjacent to the west bank of the Trent, bordered by One Earth.[66] Surcharged river levels prevent local field drains from discharging, drowning agricultural fields for multiple weeks.[66]
- **Ragnall (Population: 88):** Bordered by One Earth.[66] Post-development sheet flow from the panel arrays concentrated down the local topographic slope, flooding agricultural lanes and low-lying farmsteads.[66]
- **Darlton (Population: 118):** Bounded by minor agricultural drains leading to the Trent, exposed to One Earth.[66] Compacted soils from construction trigger localized surface water flooding along the A57.
- **Cromwell (Population: 271):** Situated west of Cromwell Weir.[58] Surcharged by GNR's 626,000 m³ lateral volume.[58] Elevated river stages drown out the weir, backing up local outfalls and flooding low-lying grassland.[28]
- **Carlton-on-Trent (Population: 230):** Directly adjacent to the Trent, exposed to GNR. Surcharged river levels cause agricultural dykes to back up, inundating the western fringe of the parish.

- **Sutton-on-Trent (Population: 950):** Large conurbation characterized by a vulnerable dyke network. Runoff from the surrounding GNR parcels overwhelm local culverts, flooding low-lying roads and properties.[58]
- **North Muskham (Population: 981):** Bounded by the River Trent and the A1 corridor. Exposed to direct runoff from GNR. High river stages submerge local footpaths and flood the western access lanes.
- **South Muskham (Population: 469):** Bordered by the River Trent. Surcharged fluvial peaks threaten Smeaton's historic causeway and the B6325, with water spilling onto low-lying pastures.
- **Little Carlton (Population: 95):** Hamlet within South Muskham, exposed to GNR. Surface runoff from the western slopes pools in local hollows, flooding Bathley Lane.[73]
- **Bathley (Population: 247):** Exposed to GNR runoff. Compacted soils and panel driplines accelerate flows into minor tributaries, overwhelming localized highway drainage.
- **Kettlethorpe (Population: 464):** Bounded by the Trent. Backing of drainage outfalls floods local access roads and cuts off low-lying hamlets.[10]
- **Fenton (Population: 481):** Low-lying parish west of the Trent. Surcharged Trent levels prevent gravity outfalls from discharging, resulting in prolonged agricultural flooding.[10]
- **Spalford (Population: 90):** Critical geomorphic node.[3] Under the 23.37m theoretical hydrostatic pressure spike of the regional post-development surge, water levels threaten the absolute structural integrity of Spalford Bank.[3] If breached, 5.49 million cubic metres of displaced floodwaters will spill directly eastward into the Witham Valley, bypassing Lincoln's defenses.[3]
- **Wigsley (Population: 110):** Exposed to cable route construction runoff.[74] Surface water pools in local depressions, blocking minor roads.[74]
- **Thorney (Population: 125):** Bordered by the One Earth grid infrastructure search area. Topsoil compaction and soil structure loss lead to accelerated surface discharges into local dykes, causing prolonged waterlogging.
- **Harby (Population: 346):** Positioned on the eastern boundary of the Trent floodplain. Heavy machinery traffic during the installation of grid cable trenches compacts the local clay layers, preventing natural field absorption and flooding minor access routes.
- **Kexby (Population: 337):** Bounded by the Till river basin. Runoff from adjacent solar sites surcharges the Kexby outfalls, flooding agricultural land.

- **Marton (Population: 718):** Bordered by Yewthorpe Beck.[14] Surcharged by Tillbridge's 845,443 m³ lateral displacement.[62] Peak stage rise of 0.85 m causes Yewthorpe Beck to flood out of bank, submerging adjacent farmland.[14]
- **Gate Burton (Population: 85):** Bordered by Gate Burton solar park.[6] High-velocity surface runoff from compacted array fields drains into local ditches, surcharging the minor outfalls to the Trent.[6]
- **Knaith & Knaith Park (Population: 341):** Protected by local earth banks.[14] Post-development stage rises surcharge the local wetland outfalls, inundating Knaith's low-lying pastures.[14]
- **Lea (Population: 1,103):** Protected by the Lea Marsh Washland defenses (5.34 mAOD).[44] Saturated post-development stage rise easily overtopped these minor banks, filling the washlands prematurely and placing Gainsborough's secondary defenses under immediate pressure.[11]

Part 2: River Witham Catchment Communities (Lincolnshire) – combined population 132,935. *These conurbations are situated along the River Till, the Fosdyke Navigation, and the Upper and Lower River Witham. Flooding here is driven by backing of pumping stations, the restricted capacity of the High Bridge bottleneck in Lincoln, and high-velocity runoff shedding from the Lincoln Cliff escarpment.*[18]

- **Lincoln (City Core) (Population: 102,411):** Brayford Pool and Stamp End core.[39] The city is hydrologically downstream of a massive solar cluster. Cottam alone generates 1,030,142 m³ of lateral overtopping, West Burton adds 836,980 m³, and Springwell adds 771,274 m³. [12] Due to the heavily constrained bottleneck of the Witham, Springwell generates an extreme localized stage index of 1.43 m. Water levels violently rise to 7.02 mAOD, overtopping the concrete flood walls (5.64 mAOD) by 1.38 m.[43] Driven by the regional 5.49 million m³ lateral overtopping surge, this causes catastrophic flooding across the Western Growth Corridor, University campus, and central commercial districts.[42]
- **Saxilby (Population: 4,719):** Located at the confluence of the River Till and Fosdyke Navigation.[18] High Witham stages force the Environment Agency to order the shutdown of the Odder transfer pumps to protect Lincoln.[18] This locks the River Till, causing it to back up rapidly.[18] Saturated runoff from Cottam, Tillbridge, and West Burton (amounting to 8,800 acres of catchment and over 2.7 million m³ of combined overtopping) causes the Till to flood out of bank, inundating thousands of acres of farmland and blocking the A57.[64]
- **Sturton by Stow (Population: 1,593):** Bordered by Cottam 1 and Tillbridge. Saturated clay soils generate high-velocity sheet runoff.[64] Post-development peak flow surges surcharge local field drains, flooding adjacent roadways and isolating rural properties.[18]
- **Stow (Population: 373):** Bordered by Cottam 1. Rainwater concentrated along the panel driplines rapidly overwhelms local road ditches, flooding the B1241 and restricting emergency vehicle access.[64]

- **Broxholme (Population: 57):** Directly adjacent to the River Till, bordered by West Burton 1.[18] Saturated runoff from Cottam and Tillbridge surcharges the Till.[18] This results in the complete inundation of the parish's agricultural plain, leaving local roads under 1.0 m of water.[64]
- **Bransby (Population: 90):** Bordered by West Burton 1 and Cottam 1. Surcharged Till flows flood local fields, inundating the Bransby Horse Rescue Centre and rendering grazing land unusable for months.[64]
- **Ingham (Population: 1,044):** Situated at the foot of the Lincoln Cliff. High runoff shedding from the elevated scarp Tillbridge parcels surcharges local streams, flooding village lanes.[62]
- **Cammeringham (Population: 211):** Bordered by Cottam 1. Surface water pools heavily across agricultural access tracks due to topsoil compaction during array construction.[64]
- **Brattleby (Population: 115):** Bounded by Cottam 1. High-velocity sheet flows from the scarp arrays concentrate along the field boundaries, surcharging local culverts.[64]
- **Fillingham (Population: 225):** Bordered by Tillbridge.[62] Fillingham Beck surcharges rapidly under saturated post-development peak flows, overtopping its banks and flooding low-lying fields.[62]
- **Glentworth (Population: 330):** Bordered by Tillbridge.[14] Surface runoff from the large, open fields surcharges local agricultural dykes.[14]
- **Harpwell (Population: 61):** Bordered by Tillbridge.[62] Yewthorpe Beck surcharges, overtopping local farm bridges and cutting off northern agricultural access.[62]
- **Heapham (Population: 122):** Bordered by Tillbridge. Post-development peak flows exceed the capacity of local drainage dykes, causing localized waterlogging of BMV soils.
- **Blyton (Population: 1,370):** Bordered by Cottam 3a. High-velocity runoff surcharges the River Eau, flooding low-lying commercial and residential fringes.[64]
- **Pilham (Population: 95):** Bordered by Cottam 3b. Infiltration loss on saturated, compacted soils leads to extensive surface water ponding, flooding local lanes.[64]
- **Corringham (Population: 459):** Bordered by Cottam 2 and Tillbridge. Corringham Beck surcharges rapidly, overtopping local agricultural banks.
- **Springthorpe (Population: 105):** Bordered by Tillbridge.[62] Runoff from the western arrays backs up local field drains, flooding village access lanes.[62]

- **Scopwick (Population: 800):** Bordered by Springwell.[78, 79] Saturated post-development runoff from the 1,280-hectare site dumps 771,274 m³ of lateral overtopping into the local limestone stream, causing groundwater backup and fatally flooding local sewerage infrastructure.[79]
- **Kirkby Green (Population: 100):** Bordered by the Springwell eastern boundary.[78] Surcharged limestone streams overflow, flooding adjacent low-lying fields and roads.
- **Metheringham (Population: 3,518):** Bordered by Springwell.[78] Metheringham Beck surcharges, overtopping its banks and flooding low-lying properties.
- **Blankney (Population: 261):** Stone-built estate village bordered by Springwell. Compacted soils and panel driplines accelerate runoff into local drains, surcharging the village pond.[78]
- **Navenby (Population: 2,541):** Situated on the Lincoln Cliff. While the village core remains dry, high-velocity runoff from the western Springwell parcels descends to the lower plain, flooding agricultural outfalls and blocking key transport routes. [78, 80]
- **Coleby (Population: 416):** Runoff from the western scarp surcharges local drains, cutting off minor access roads to the cliff. [79]
- **Harmston (Population: 692):** Bounded by scarp runoff, surcharging local highway drains.
- **Dunston (Population: 756):** Dunston Beck surcharges under post-development peak flows, overtopping local minor banks. [78]
- **Nocton (Population: 913):** Nocton Delph surcharges, flooding adjacent low-lying fenland.[7]
- **Potterhanworth (Population: 872):** Compacted soil runoff surcharges the local agricultural drains, causing waterlogging of adjacent fields.
- **Canwick (Population: 604):** Bordered by Springwell cable routes. Surface water runoff surcharges local ditches, flooding minor highways.[78]
- **Branston (Population: 4,959):** Branston Delph surcharges under saturated post-development flows, overtopping its banks and flooding low-lying pastures.[7]
- **Heighington (Population: 3,123):** Bounded by direct drains to the Witham. Backup of drainage outfalls floods local access roads and cuts off low-lying hamlets.

7. Conclusion

This **INDEPENDENT HYDROLOGICAL & HYDRAULIC ASSESSMENT** demonstrates that once the seven proposed solar projects are constructed, their joint operation under saturated, extreme storm conditions (resembling Storm Babet and Storm Henk) will systematically overwhelm the flood defence networks of both catchments.[12]

The model proves that the rapid translation of rainfall into 1,962.97 m³/s of high-velocity peak flow will drastically exceed local conveyance capacity.[12] This converts nominal safety freeboards into extreme negative margins, violently blasting 5,493,384 cubic metres of unattenuated lateral overtopping into the 62 communities detailed above.

The Physical Impossibility of Attenuation While standard planning frameworks might typically suggest that developers simply mitigate this risk via 'volumetric attenuation' (such as SuDS or attenuation ponds), applying standard mitigation theory to a 5.49 million cubic metre displacement requires a stark dose of physical reality.

To safely capture and hold 5.49 million cubic metres of displaced floodwater—the volumetric equivalent of nearly 2,200 Olympic-sized swimming pools—the developers would be required to construct macro-scale engineered reservoirs. Given the flat topography, restrictive clay geology, and naturally high winter water tables of these valleys, basins cannot be dug deeply without instantly filling with groundwater. Assuming a highly optimistic, viable basin depth of 2 metres, storing this volume would necessitate the excavation of over 275 hectares (nearly 680 acres) of pure reservoir space. At a 1-metre depth, this footprint expands to 550 hectares (1,350 acres).

Undertaking earthworks of this astronomical magnitude would require the excavation and removal of millions of tonnes of soil, permanently sterilising hundreds of hectares of Best and Most Versatile (BMV) agricultural land. The heavy civil engineering and hundreds of thousands of HGV movements required would cause catastrophic ecological destruction and permanent, irreversible scarring of the historic landscape. This completely obliterates the solar industry's central planning premise that these NSIPs are 'temporary, light-touch, and reversible' interventions.

Ultimately, the applicants face an insurmountable Catch-22: they must either discharge the unattenuated water and catastrophically flood 62 rural communities, or attempt to attenuate it by executing an environmentally devastating campaign of mass excavation that is totally unacceptable in planning and ecological terms.

The Procedural Imperative Alarmingly, this physical impossibility does not exist in a theoretical vacuum. The statutory planning context has reached a highly dangerous juncture. Five of these seven Nationally Significant Infrastructure Projects (Tillbridge, Gate Burton, Cottam, West Burton, and Springwell) have already been granted Development Consent Orders (DCOs). These approvals were granted in a cumulative data vacuum, relying on fragmented, static, single-site modelling that fundamentally failed to capture the physical reality of compound kinematic acceleration across 8,844 hectares.

Because realistic, environmentally acceptable mitigation for 5.49 million cubic metres of displaced water is physically impossible, the regional system has already been pushed past its tipping point by these flawed approvals. Adding the localized runoff of the remaining unapproved projects to this already fatal burden would constitute a gross dereliction of statutory duty by the decision-makers.

Therefore, to protect the lives, properties, and critical infrastructure of the 62 communities across the Trent and Witham valleys, the only legally and hydrologically safe conclusion is to enact the following immediate actions:

1. **Immediate Rejection:** The remaining live applications—specifically the **One Earth** and **Great North Road (GNR)** proposals—must be unconditionally rejected. The region has entirely exhausted its environmental and hydrological carrying capacity.
2. **Immediate Suspension:** The five previously approved DCOs within this conjoined catchment must be immediately suspended. Proceeding with their construction based on siloed, micro-catchment data invites a regional catastrophe.
3. **Root-and-Branch Policy Review & Mandatory 3D Catchment Modelling:** These suspensions must remain in place pending a root-and-branch review of national and regional flood risk assessment policies for macro-scale solar infrastructure. Furthermore, the developers and statutory authorities must be compelled to fund and execute a comprehensive, continuous, region-wide 3D hydrodynamic model to mathematically and physically disprove the catastrophic 5.49 million cubic metre systemic failure proven in this independent assessment.

Until the solar industry can explicitly prove where these 5.49 million cubic metres of water will go without breaching third-party defences, no further ground can be safely or legally broken in the Trent and Witham valleys.

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