Data set title:
Historic sea level records in the Thames Estuary, UK, 1911 - 1995.

Data set creator(s) and institute(s):
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Data set abstract:
This dataset contains high and low water values manually digitised from historic hand-written tabulated ledgers, from the Port of London Authority (PLA). The dataset contains 463 years of data, from across 15 tide gauge sites along the Thames Estuary (bounding box = -0.3159°W, 51.3914°N, 1.3797°E, 51.8428°N), for the period 1911 to 1995. When these historic records are combined with digital records available from the PLA since 1995, the new sea level time-series spans the 111-year period from 1911 to 2021. London is one of the world's most important coastal cities and is located around the Thames Estuary. Quantifying changes in sea levels in the Thames Estuary over the 20th century and early part of the 21st century is vital to inform future management of flood risk in London. This dataset is of importance for ongoing monitoring of mean sea-level rise, and changes in tidal range and extreme sea levels in the Thames Estuary. The project was led by the School of Ocean and Earth Science, University of Southampton and the Environment Agency, with contributions from the Port of London Authority. The study contributes to the objectives of UK National Environment Research Council (NERC) project E-Rise: Earliest detection of sea-level rise accelerations to inform lead time to upgrade/replace coastal flood defence infrastructure (NE/P009069/1; I.D.H.).

Data set format:
The dataset consists of 3 directories. The first contains photographs (in jpg format) of every tabulated sheet from the 34 PLA ledgers. The spreadsheet directory contains 333 spreadsheets (saved as both .xlsx and .csv) and the data directory contains 13 text files.

The spreadsheets (.xlsx) are designed to look similar to the 6 different ledgers formats. These contain the raw digitised tabulated dataset of HW and LW values. Prior to 1935, each Excel file contains one year of data for all the sites. From 1935 onwards, each Excel file contains a year of data for a specific site. Each separate sheet within these Excel files contains the tabulated data for any given month. The

text files are the final datasets for each site, containing the combined, corrected and quality-controlled time-series of high and low water.

Parameter	Description	Unit
1_Photos: This file contains photographs (in jpg format) of every tabulated sheet from the 34 PLA ledgers.		
N/A	N/A	N/A
2_Spreadsheets: These Excel spreadsheets (XLSX) are formatted to look similar to the 6 different ledgers formats. The spreadsheets contain the raw digitised tabulated dataset of high water and low water values. Prior to 1935, each Excel file contains one year of data for all the sites. From 1935 onwards, each Excel file contains a year of data for a specific site. Each separate sheet within these Excel files contains the tabulated data for any given month. The spreadsheets have also been saved as .csv files, with a separate file for each worksheet.		
Date and time	Date and time of measurement to GMT. Note the tide gauge is accurate to one minute.	dd/mm/yyyy hh:mm:ss
Water level	High or low water level measured by tide gauge. Tide gauges are accurate to 1 centimetre.	The units are the same as in the PLA ledgers. They are either feet and inches or metres (see Table 2). The datums are also the same as what are in the PLA ledgers. They vary between being Admiralty Chart Datum (CD), Ordnance Datum Newlyn (ODN or Trinity High Water (THW) (see Tables 2 and 3).
3_Data: These text files are the final datasets for each site, containing the combined, corrected and quality-controlled time-series of high and low water. We combined data from near-by sites, to produce more continuous records of longer data length. The tide gauge was removed from Old Swan Pier and installed at Tower Pier on 23/02/1929, so we combined the records from Old Swan Pier and Tower Pier. We call this combined dataset London Bridge. We also combined the records from Gallions and North Woolwich, given their close vicinity, and called this combined dataset Silvertown, as it is near the current Silvertown PLA tide gauge.		
Date and time	Date and time of measurement to GMT. Note the tide gauge is accurate to one minute.	dd/mm/yyyy hh:mm:ss
Water level	High or low water level measured by tide gauge. Tide gauges are	metres Admiralty Chart Datum (CD), Ordnance Datum Newlyn (ODN or Trinity High Water (THW)

	accurate to 1 centimetre.	
Flag	High water flag = 1, low water flag = 0	N/A

Reference:

Inayatillah, A., Haigh, I.D., Brand, J., Francis, K., Mortley, A., Fantuzzi, L., Palmer, E., Miller, C., Hogarth, P., 2020. Digitising historic sea level records in the Thames Estuary, UK. In review Scientific Data.

Table 1: Location and duration of the sea level datasets held by the Port of London Authority.

Gauge	Latitude (Degrees)	Longitude (Degrees)	Analogue (continuous analogue curve on microfilm)	Analogue (tabulated HW & LWs)	Digital (10min 1994 - 1999, 1min 2000 - current)
1. Walton-on-Naze	51.8428	1.2817	25/09/1967 - 03/11/1996	01/01/1968 - 31/12/1978, 01/06/1980 - 31/12/1995	01/01/1995 - current
2. Margate Harbour	51.3914	1.3797	21/03/1970 - 08/01/1997	22/09/1967 - 31/12/1977, 01/01/1979 - 31/12/1995	01/01/1994 - current
3. Shivering Sand	51.4723	1.1081	22/06/1964 - 09/05/1988	01/01/1974 - 31/12/1974	01/01/1995 – current (missing 2001)
4. Southend	51.5139	0.7255	03/01/1929 - 03/01/1997	01/01/1911 - 31/12/1995	01/01/1994 - current
5. Coryton	51.5041	0.5068	17/10/1969 - 23/01/1983	01/01/1969 - 31/12/1983	01/01/1994 - current
6. Tilbury	51.4562	0.3368	24/01/1929 - 12/10/1989	08/08/1912 - 31/12/1995	01/01/1994 - current
7. Gallions Pier (Albert Dock)	51.5069	0.0518	20/07/1950 - 08/05/1990	01/01/1915 - 07/09/1935, 01/01/1976 - 31/12/1990	01/01/1994 - current
8. Silvertown (North Woolwich)	51.4982	0.0478	20/07/1950 - 08/05/1990	20/07/1950 - 31/12/1975	01/01/1994 - current
9. Cherry Garden Pier	51.5013	-0.0610	-	01/01/1911 - 31/12/1934	-
10. Tower Pier	51.5070	-0.0775	01/01/1929 - 10/01/1997	23/04/1929 - 31/12/1995	01/01/1995 - current

11. Old Swan Pier	51.5072	-0.0919	01/01/1929 - 10/01/1997	01/05/1911 - 22/04/1929	01/01/1995 - current
12. All Hallows Pier	51.4468	0.7601	-	01/01/1911 - 31/01/1911	-
13. Temple Pier	51.5107	-0.1123	-	01/01/1911 - 31/12/1918	-
14. Strand-on-Green	51.4867	-0.2841	-	01/01/1911 - 31/12/1924	-
15. Richmond	51.4623	-0.3159	30/06/1962 - 10/01/1997	01/01/1911 - 31/12/1995	01/01/1995 - current

Table 2: The time format, units and datums for each of the historic tide gauge sites.

YEARS	Type 1: 1911-1920	Type 2: 1921-21 Aug 1934	Type 3: 22 Aug 1934-Jul 1938	Type 4: Aug 1938-1953	Type 5: 1954-1973	Type 6: 1974-1995
1. Walton-on-Naze					Ft.	Metres
					ODN	CD
					24-hour	24-hour
2. Margate					Ft.	Metres
					ODN	CD
					24-hour	24-hour
3. Shivering Sand						Metres
						CD
						24-hour
4. Southend	Ft. and In.	Ft. and In.	Ft. and In.	Ft. and In.	Ft.	Metres
	THW	THW	ODN	ODN	ODN	CD
	A.M. and P.M.	A.M. and P.M.	24-hour	24-hour	24-hour	24-hour
5. Coryton					Ft.	Metres
					ODN	CD
					24-hour	24-hour
6. Tilbury	Ft. and In.	Ft. and In.	Ft. and In.	Ft. and In.	Ft.	Metres
	THW	THW	ODN	ODN	ODN	CD
	A.M. and P.M.	A.M. and P.M.	24-hour	24-hour	24-hour	24-hour
7. Gallions Pier (Albert Dock)	Ft. and In.	Ft. and In.				Metres
	THW	THW				CD
	A.M. and P.M.	A.M. and P.M.				24-hour
8. Silvertown (North Woolwich)				Ft. and In.	Ft.	Metres
				ODN	ODN	CD
				24-hour	24-hour	24-hour
9. Cherry Garden Pier	Ft. and In.	Ft. and In.				
	THW	THW				
	A.M. and P.M.	A.M. and P.M.				
10. Tower Pier		Ft. and In.	Ft. and In.	Ft. and In.	Ft.	Metres

YEARS	Type 1: 1911-1920	Type 2: 1921-21 Aug 1934	Type 3: 22 Aug 1934-Jul 1938	Type 4: Aug 1938-1953	Type 5: 1954-1973	Type 6: 1974-1995
		THW	ODN	ODN	ODN	CD
		A.M. and P.M.	24-hour	24-hour	24-hour	24-hour
11. Old Swan Pier	Ft. and In.	Ft. and In.				
	THW	THW				
	A.M. and P.M.	A.M. and P.M.				
12. All Hallows Pier	Ft. and In.					
	THW					
	A.M. and P.M.					
13. Temple Pier	Ft. and In.					
	THW					
	A.M. and P.M.					
14. Strand-on-Green	Ft. and In.	Ft. and In.				
	THW	THW				
	A.M. and P.M.	A.M. and P.M.				
15. Richmond	Ft. and In.	Ft. and In.	Ft. and In.	Ft. and In.	Ft.	Metres
	THW	THW	ODN	ODN	ODN	ODN
	A.M. and P.M.	A.M. and P.M.	24-hour	24-hour	24-hour	24-hour

Table 3: The corrections (in metres) used to convert all data from Trinity High Water (THW) or Chart Datum (CD) to Ordnance Datum Newlyn (ODN).

YEARS	Type 1: 1911-1920	Type 2: 1921-21 Aug 1934	Type 3: 22 Aug 1934-Jul 1938	Type 4: Aug 1938-1953	Type 5: 1954-1973	Type 6: 1974-1995
1. Walton-on-Naze					ODN	-2.16
2. Margate					ODN	-2.50
3. Shivering Sand						-2.68
4. Southend	3.3726	3.3726	ODN	ODN	ODN	-2.90
5. Coryton					ODN	-3.05
6. Tilbury	3.475	3.475	ODN	ODN	ODN	-3.12
7. Gallions Pier (Albert Dock)	3.475	3.475				-3.35
8. Silvertown (North Woolwich)				ODN	ODN	-3.35
9. Cherry Garden Pier	3.475	3.475				
10. Tower Pier		3.459	ODN	ODN	ODN	-3.2
11. Old Swan Pier	3.459	3.459				
12. All Hallows Pier	3.475					
13. Temple Pier	3.475					
14. Strand-on-Green	3.475	3.475				
15. Richmond	3.4036	3.4036	ODN	ODN	ODN	ODN