



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 09:29 PM UTC

PDB ID : 5MI4 / pdb_00005mi4
Title : BtGH84 mutant with covalent modification by MA3
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Deposited on : 2016-11-27
Resolution : 1.80 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

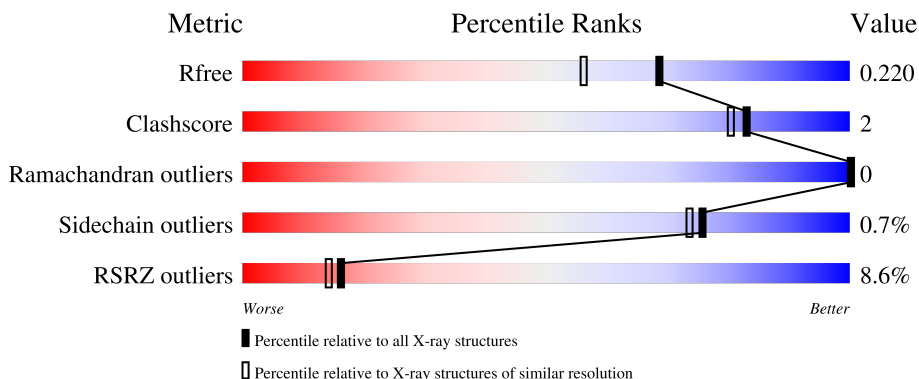
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	7662 (1.80-1.80)
Clashscore	190562	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)
RSRZ outliers	180081	7663 (1.80-1.80)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	727	

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 6406 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

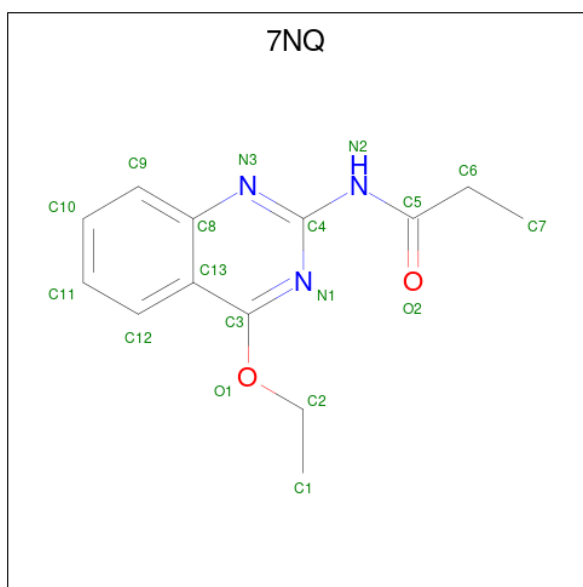
- Molecule 1 is a protein called O-GlcNAcase BT_4395.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	689	Total	C	N	O	S	0	14	0
			5659	3629	953	1057	20			

There are 15 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-10	MET	-	initiating methionine	UNP Q89ZI2
A	-9	GLY	-	expression tag	UNP Q89ZI2
A	-8	SER	-	expression tag	UNP Q89ZI2
A	-7	SER	-	expression tag	UNP Q89ZI2
A	-6	HIS	-	expression tag	UNP Q89ZI2
A	-5	HIS	-	expression tag	UNP Q89ZI2
A	-4	HIS	-	expression tag	UNP Q89ZI2
A	-3	HIS	-	expression tag	UNP Q89ZI2
A	-2	HIS	-	expression tag	UNP Q89ZI2
A	-1	HIS	-	expression tag	UNP Q89ZI2
A	0	GLN	-	expression tag	UNP Q89ZI2
A	1	TRP	-	expression tag	UNP Q89ZI2
A	420	SER	CYS	engineered mutation	UNP Q89ZI2
A	550	CYS	TYR	engineered mutation	UNP Q89ZI2
A	654	SER	CYS	engineered mutation	UNP Q89ZI2

- Molecule 2 is {N}-(4-ethoxyquinazolin-2-yl)propanamide (CCD ID: 7NQ) (formula: C₁₃H₁₅N₃O₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			18	13	3	2		

- Molecule 3 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			4	2	2		
3	A	1	Total	C	O	0	0
			4	2	2		
3	A	1	Total	C	O	0	1
			8	4	4		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			4	2	2		
3	A	1	Total	C	O	0	0
			4	2	2		

- Molecule 4 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Ca	0	0
			1	1		

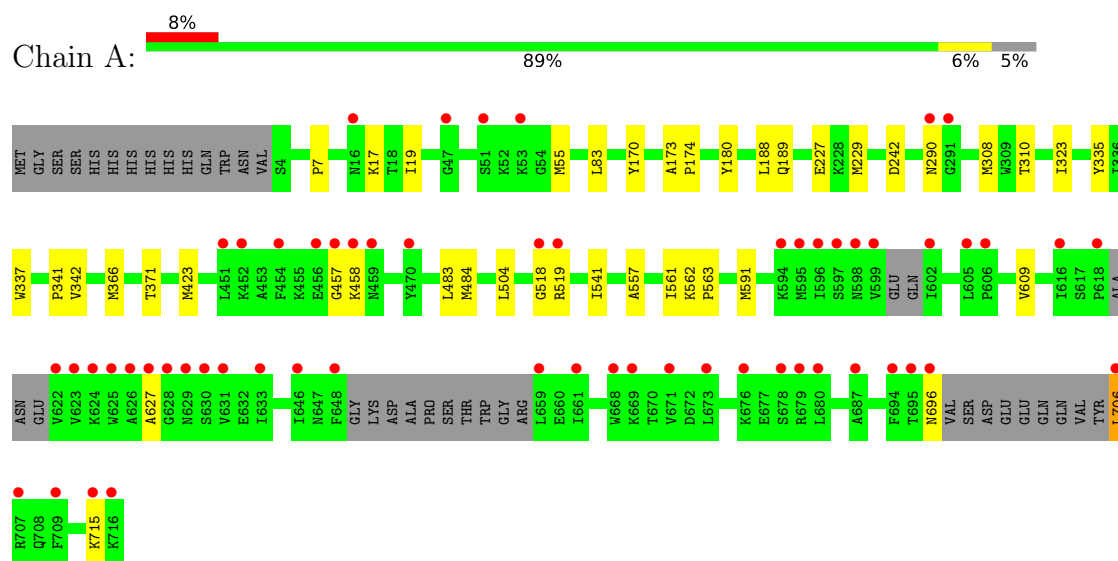
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	704	Total	O	0	0
			704	704		

3 Residue-property plots

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

• Molecule 1: O-GlcNAcase BT_4395



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	195.03Å 51.66Å 111.87Å 90.00° 113.41° 90.00°	Depositor
Resolution (Å)	57.14 – 1.80 57.14 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.9 (57.14-1.80) 99.9 (57.14-1.80)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.08 (at 1.80Å)	Xtriage
Refinement program	REFMAC 5.8.0155	Depositor
R, R_{free}	0.161 , 0.200 (Not available) , 0.220	Depositor DCC
R_{free} test set	4808 reflections (2.99%)	wwPDB-VP
Wilson B-factor (Å ²)	22.7	Xtriage
Anisotropy	0.585	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 39.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	6406	wwPDB-VP
Average B, all atoms (Å ²)	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.69% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 7NQ, EDO, CA

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	0.95	0/5838	0.92	4/7902 (0.1%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	519	ARG	N-CA-C	6.39	118.05	111.14
1	A	518	GLY	N-CA-C	6.05	122.31	113.48
1	A	7	PRO	CA-C-N	-5.07	115.16	120.38
1	A	7	PRO	C-N-CA	-5.07	115.16	120.38

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	5659	0	5626	27	0
2	A	18	0	0	0	0
3	A	24	0	36	3	0
4	A	1	0	0	0	0
5	A	704	0	0	8	0
All	All	6406	0	5662	27	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 2.

All (27) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:457:GLY:C	5:A:908:HOH:O	2.25	0.79
1:A:17:LYS:NZ	5:A:903:HOH:O	2.25	0.70
1:A:627:ALA:HA	1:A:696:ASN:HD21	1.62	0.64
1:A:242:ASP:OD2	3:A:804[B]:EDO:H22	2.01	0.59
1:A:242:ASP:OD2	3:A:804[B]:EDO:C2	2.50	0.59
1:A:458:LYS:N	5:A:908:HOH:O	2.38	0.57
1:A:715:LYS:NZ	5:A:905:HOH:O	2.35	0.56
1:A:189:GLN:CD	5:A:919:HOH:O	2.51	0.54
1:A:19:ILE:CD1	1:A:55:MET:HE1	2.37	0.54
1:A:19:ILE:HD12	1:A:55:MET:HE1	1.91	0.51
1:A:323:ILE:CD1	1:A:366[B]:MET:HG2	2.40	0.51
1:A:310:THR:HG21	3:A:804[A]:EDO:H11	1.92	0.51
1:A:227:GLU:OE1	5:A:902:HOH:O	2.20	0.48
1:A:423[A]:MET:HE3	5:A:1334:HOH:O	2.13	0.47
1:A:188:LEU:HD13	1:A:229:MET:HE1	1.97	0.47
1:A:706:LEU:N	1:A:706:LEU:HD23	2.31	0.46
1:A:189:GLN:NE2	5:A:919:HOH:O	2.48	0.46
1:A:562:LYS:HB3	1:A:563:PRO:HD3	2.00	0.44
1:A:170:TYR:HB2	1:A:180:TYR:CE1	2.53	0.44
1:A:341:PRO:O	1:A:342:VAL:C	2.62	0.43
1:A:83:LEU:C	1:A:83:LEU:HD23	2.44	0.42
1:A:308:MET:HA	1:A:335:TYR:O	2.19	0.42
1:A:557:ALA:HB1	1:A:561:ILE:HB	2.01	0.42
1:A:504:LEU:HD12	1:A:541:ILE:HD12	2.01	0.42
1:A:591:MET:HE1	1:A:609:VAL:HG23	2.01	0.41
1:A:173:ALA:HA	1:A:174:PRO:HA	1.89	0.41
1:A:483[B]:LEU:HD23	1:A:484:MET:HE3	2.02	0.41

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	693/727 (95%)	675 (97%)	18 (3%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	621/640 (97%)	617 (99%)	4 (1%)	78	77

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	290	ASN
1	A	337	TRP
1	A	371	THR
1	A	706	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	267	GLN
1	A	425	ASN
1	A	645	GLN
1	A	708	GLN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 8 ligands modelled in this entry, 1 is monoatomic - leaving 7 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
3	EDO	A	804[A]	-	3,3,3	0.49	0	2,2,2	0.97	0
3	EDO	A	803	-	3,3,3	0.36	0	2,2,2	0.29	0
3	EDO	A	802	-	3,3,3	0.35	0	2,2,2	1.35	0
3	EDO	A	805	-	3,3,3	0.51	0	2,2,2	0.24	0
3	EDO	A	806	-	3,3,3	0.40	0	2,2,2	0.30	0
3	EDO	A	804[B]	-	3,3,3	0.39	0	2,2,2	0.53	0
2	7NQ	A	801	1	19,19,19	0.59	0	25,25,25	1.41	5 (20%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	EDO	A	804[A]	-	-	1/1/1/1	-
3	EDO	A	803	-	-	0/1/1/1	-
3	EDO	A	802	-	-	1/1/1/1	-
3	EDO	A	805	-	-	1/1/1/1	-
3	EDO	A	806	-	-	0/1/1/1	-
3	EDO	A	804[B]	-	-	0/1/1/1	-
2	7NQ	A	801	1	-	5/9/9/9	0/2/2/2

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	801	7NQ	C2-O1-C3	3.63	121.99	117.32
2	A	801	7NQ	C13-C3-N1	-3.36	121.24	124.68
2	A	801	7NQ	C4-N1-C3	2.26	119.23	115.38
2	A	801	7NQ	C3-C13-C8	2.21	116.22	114.77
2	A	801	7NQ	O1-C3-C13	2.17	117.31	115.01

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	801	7NQ	N1-C4-N2-C5
2	A	801	7NQ	N3-C4-N2-C5
2	A	801	7NQ	C13-C3-O1-C2
2	A	801	7NQ	N1-C3-O1-C2
2	A	801	7NQ	C1-C2-O1-C3
3	A	802	EDO	O1-C1-C2-O2
3	A	805	EDO	O1-C1-C2-O2
3	A	804[A]	EDO	O1-C1-C2-O2

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	804[A]	EDO	1	0
3	A	804[B]	EDO	2	0

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	689/727 (94%)	0.17	59 (8%) 16 14	10, 23, 67, 94	14 (2%)

All (59) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	457	GLY	7.4
1	A	696	ASN	5.4
1	A	627	ALA	5.0
1	A	706	LEU	4.8
1	A	680	LEU	4.7
1	A	716	LYS	4.5
1	A	622	VAL	4.5
1	A	625	TRP	4.4
1	A	623	VAL	4.1
1	A	454	PHE	3.9
1	A	695	THR	3.8
1	A	291	GLY	3.5
1	A	602	ILE	3.5
1	A	673	LEU	3.4
1	A	668	TRP	3.3
1	A	290	ASN	3.3
1	A	659	LEU	3.3
1	A	606	PRO	3.3
1	A	678	SER	3.2
1	A	451	LEU	3.2
1	A	707	ARG	3.1
1	A	626	ALA	3.1
1	A	624	LYS	3.0
1	A	452	LYS	3.0
1	A	628	GLY	3.0
1	A	648	PHE	2.9
1	A	694	PHE	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	631	VAL	2.8
1	A	599	VAL	2.8
1	A	715	LYS	2.8
1	A	53	LYS	2.7
1	A	458	LYS	2.7
1	A	596	ILE	2.7
1	A	671	VAL	2.7
1	A	616	ILE	2.5
1	A	709	PHE	2.5
1	A	459	ASN	2.4
1	A	519	ARG	2.4
1	A	598	ASN	2.4
1	A	518	GLY	2.4
1	A	630	SER	2.4
1	A	605	LEU	2.4
1	A	16	ASN	2.3
1	A	687	ALA	2.3
1	A	456	GLU	2.3
1	A	629	ASN	2.3
1	A	618	PRO	2.2
1	A	597	SER	2.2
1	A	661	ILE	2.2
1	A	679	ARG	2.2
1	A	676	LYS	2.2
1	A	594	LYS	2.1
1	A	669	LYS	2.1
1	A	646	ILE	2.1
1	A	51	SER	2.1
1	A	47	GLY	2.1
1	A	595	MET	2.1
1	A	633	ILE	2.0
1	A	470	TYR	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
3	EDO	A	805	4/4	0.77	0.22	63,63,64,66	0
2	7NQ	A	801	18/18	0.85	0.18	50,58,63,63	0
3	EDO	A	802	4/4	0.92	0.11	30,31,32,36	0
3	EDO	A	804[B]	4/4	0.94	0.09	16,19,20,20	4
3	EDO	A	804[A]	4/4	0.94	0.09	21,21,21,21	4
3	EDO	A	803	4/4	0.95	0.10	38,38,38,41	0
3	EDO	A	806	4/4	0.96	0.10	32,33,35,35	0
4	CA	A	807	1/1	1.00	0.02	21,21,21,21	0

6.5 Other polymers [i](#)

There are no such residues in this entry.