



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 08:41 PM UTC

PDB ID : 1VDR / pdb_00001vdr
Title : DIHYDROFOLATE REDUCTASE
Authors : Pieper, U.; Herzberg, O.
Deposited on : 1997-11-30
Resolution : 2.55 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)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

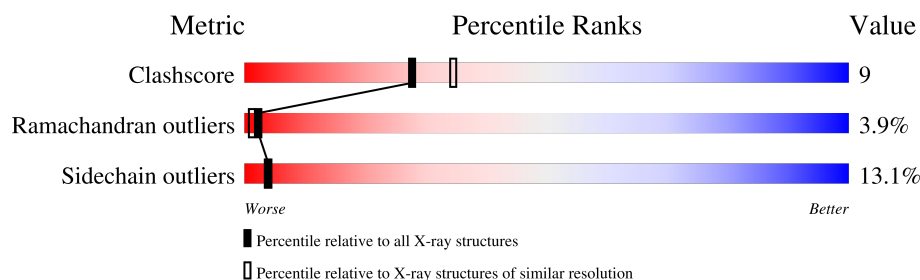
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.55 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))
Clashscore	190562	1120 (2.54-2.54)
Ramachandran outliers	187476	1106 (2.54-2.54)
Sidechain outliers	187428	1106 (2.54-2.54)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	162	
1	B	162	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	PO4	A	163	-	-	X	-
2	PO4	B	163	-	-	X	-

2 Entry composition [i](#)

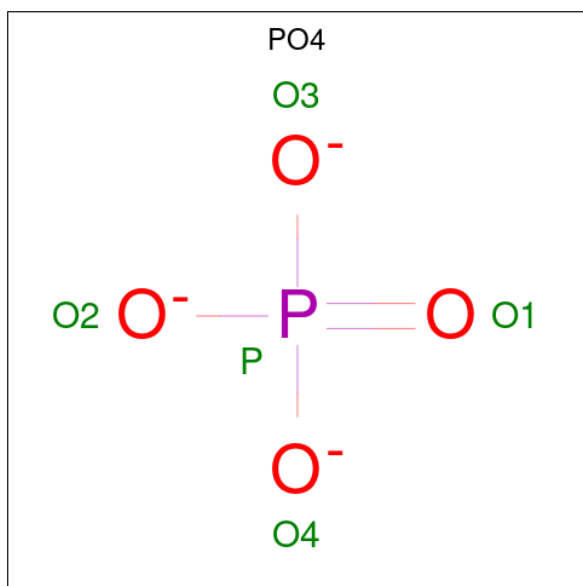
There are 3 unique types of molecules in this entry. The entry contains 2489 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 DIHYDROFOLATE REDUCTASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	157	Total	C	N	O	S	0	0	0
			1211	759	207	242	3			
1	B	155	Total	C	N	O	S	0	0	1
			1183	739	205	236	3			

- Molecule 2 is PHOSPHATE ION (CCD ID: PO4) (formula: O₄P).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	P	0	0
			5	4	1		
2	A	1	Total	O	P	0	0
			5	4	1		
2	B	1	Total	O	P	0	0
			5	4	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	29	Total 29	O 29	0	0
3	B	51	Total 51	O 51	0	0

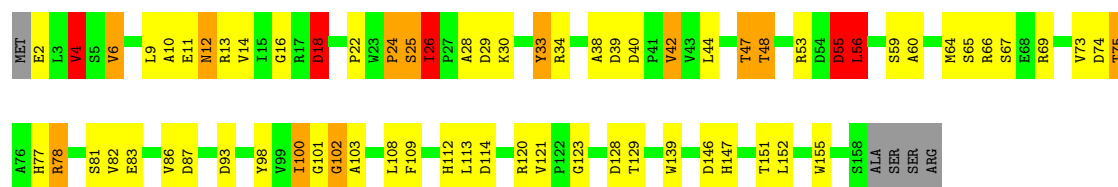
3 Residue-property plots

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. 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. 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.

Note EDS was not executed.

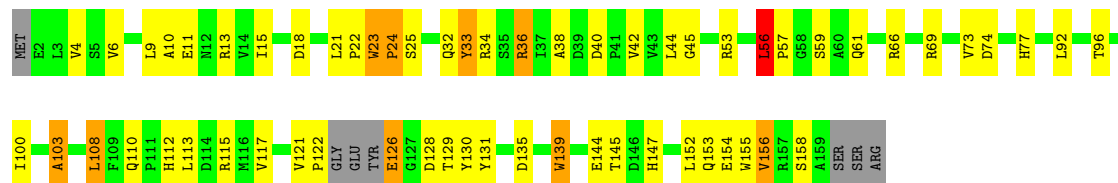
• Molecule 1: DIHYDROFOLATE REDUCTASE

Chain A: 



• Molecule 1: DIHYDROFOLATE REDUCTASE

Chain B: 



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	70.87Å 59.45Å 78.15Å 90.00° 95.80° 90.00°	Depositor
Resolution (Å)	7.00 – 2.55	Depositor
% Data completeness (in resolution range)	75.0 (7.00-2.55)	Depositor
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.184 , 0.300	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2489	wwPDB-VP
Average B, all atoms (Å ²)	25.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: PO4

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	1.00	7/1239 (0.6%)	1.94	33/1688 (2.0%)
1	B	0.98	4/1209 (0.3%)	1.81	27/1647 (1.6%)
All	All	0.99	11/2448 (0.4%)	1.88	60/3335 (1.8%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	2

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	147	HIS	CD2-NE2	-6.67	1.30	1.37
1	A	112	HIS	CD2-NE2	-6.54	1.30	1.37
1	B	112	HIS	CD2-NE2	-6.48	1.30	1.37
1	A	147	HIS	CD2-NE2	-6.32	1.30	1.37
1	B	77	HIS	CD2-NE2	-6.31	1.30	1.37
1	A	77	HIS	CD2-NE2	-5.99	1.31	1.37
1	A	4	VAL	CA-CB	5.65	1.62	1.54
1	A	100	ILE	CA-CB	5.50	1.61	1.54
1	B	112	HIS	CG-ND1	-5.48	1.32	1.38
1	A	75	THR	CA-CB	5.28	1.59	1.52
1	A	26	ILE	CA-CB	5.15	1.60	1.54

All (60) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	87	ASP	CA-CB-CG	11.43	124.03	112.60
1	A	101	GLY	O-C-N	-10.08	114.23	122.90
1	B	57	PRO	N-CA-C	9.78	126.59	113.98
1	B	103	ALA	N-CA-C	8.11	121.14	111.33
1	B	128	ASP	CA-CB-CG	8.06	120.66	112.60
1	B	38	ALA	N-CA-C	7.87	121.99	112.38
1	A	26	ILE	N-CA-CB	-7.82	100.26	111.21
1	A	112	HIS	CA-CB-CG	-7.58	106.22	113.80
1	A	114	ASP	CA-CB-CG	7.58	120.18	112.60
1	A	38	ALA	N-CA-C	7.54	120.45	111.33
1	B	56	LEU	N-CA-C	7.32	118.88	109.65
1	A	53	ARG	N-CA-C	7.27	121.06	111.75
1	A	26	ILE	N-CA-C	7.16	124.35	108.88
1	A	12	ASN	CB-CA-C	-6.94	102.96	109.83
1	B	24	PRO	N-CA-C	6.70	126.26	112.47
1	A	18	ASP	N-CA-C	6.67	125.01	110.80
1	A	28	ALA	N-CA-C	-6.57	105.08	113.23
1	B	126	GLU	CB-CG-CD	6.49	123.62	112.60
1	B	130	TYR	N-CA-C	6.46	119.24	109.23
1	A	25	SER	N-CA-C	6.17	123.94	110.80
1	A	75	THR	CB-CA-C	6.11	119.43	111.42
1	A	24	PRO	N-CA-C	6.10	125.04	112.47
1	A	55	ASP	CA-C-O	-6.08	114.32	120.77
1	B	21	LEU	N-CA-C	6.03	123.15	109.81
1	B	56	LEU	CA-C-N	5.97	125.67	119.82
1	B	56	LEU	C-N-CA	5.97	125.67	119.82
1	B	40	ASP	CA-C-N	5.96	125.90	119.76
1	B	40	ASP	C-N-CA	5.96	125.90	119.76
1	A	73	VAL	N-CA-C	-5.81	97.26	109.34
1	A	42	VAL	N-CA-CB	-5.79	104.11	111.64
1	A	103	ALA	N-CA-C	5.77	118.32	111.33
1	A	67	SER	CA-CB-OG	5.68	122.47	111.10
1	B	112	HIS	CA-CB-CG	-5.60	108.20	113.80
1	A	69	ARG	O-C-N	5.55	130.07	123.24
1	B	147	HIS	CB-CG-CD2	-5.47	124.08	131.20
1	B	69	ARG	N-CA-C	5.47	118.37	108.69
1	B	155	TRP	CG-CD2-CE3	5.46	139.35	133.90
1	A	11	GLU	N-CA-C	-5.44	102.43	110.48
1	A	47	THR	CA-CB-OG1	-5.43	101.46	109.60
1	A	12	ASN	CA-CB-CG	5.39	117.99	112.60
1	B	77	HIS	CB-CG-CD2	-5.39	124.20	131.20
1	B	139	TRP	CG-CD2-CE3	5.37	139.27	133.90
1	B	53	ARG	N-CA-C	5.36	118.61	111.75

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	112	HIS	CB-CG-CD2	-5.33	124.26	131.20
1	B	122	PRO	N-CA-C	5.28	125.31	112.10
1	A	40	ASP	CA-CB-CG	-5.26	107.33	112.60
1	B	139	TRP	CE2-CD2-CG	-5.26	100.89	107.20
1	B	11	GLU	N-CA-C	5.20	118.72	112.38
1	A	74	ASP	N-CA-C	5.17	118.36	111.75
1	A	26	ILE	CA-C-N	5.16	126.18	120.45
1	A	26	ILE	C-N-CA	5.16	126.18	120.45
1	B	112	HIS	CB-CG-CD2	-5.15	124.50	131.20
1	A	139	TRP	CG-CD2-CE3	5.12	139.02	133.90
1	A	147	HIS	CB-CG-CD2	-5.08	124.60	131.20
1	A	48	THR	N-CA-C	-5.07	105.45	111.69
1	B	23	TRP	CE2-CD2-CG	-5.03	101.16	107.20
1	A	155	TRP	CE2-CD2-CG	-5.02	101.18	107.20
1	A	78	ARG	CA-CB-CG	5.01	124.12	114.10
1	B	100	ILE	N-CA-C	5.01	117.79	112.83
1	B	155	TRP	CE2-CD2-CG	-5.00	101.19	107.20

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	121	VAL	Peptide
1	A	56	LEU	Peptide

5.2 Too-close contacts

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	1211	0	1136	20	0
1	B	1183	0	1106	23	0
2	A	10	0	0	3	0
2	B	5	0	0	3	0
3	A	29	0	0	1	0
3	B	51	0	0	1	0
All	All	2489	0	2242	42	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 9.

All (42) 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:65:SER:HB2	2:A:163:PO4:O4	1.72	0.89
1:B:36:ARG:HH22	1:B:152:LEU:HD11	1.55	0.70
1:A:64:MET:HE2	1:A:109:PHE:CE1	2.34	0.63
1:A:64:MET:HE2	1:A:109:PHE:HE1	1.64	0.62
1:A:6:VAL:HG13	1:A:100:ILE:HD13	1.83	0.61
1:A:39:ASP:O	1:A:59:SER:HB3	2.01	0.60
1:B:115:ARG:HG3	1:B:156:VAL:HG23	1.84	0.59
1:A:16:GLY:HA2	1:A:22:PRO:HD3	1.84	0.59
1:A:12:ASN:HB2	1:A:14:VAL:HG23	1.84	0.58
1:A:82:VAL:O	1:A:86:VAL:HG23	2.05	0.56
1:B:32:GLN:HE21	1:B:152:LEU:HG	1.71	0.55
1:B:42:VAL:HG12	1:B:44:LEU:HD22	1.87	0.55
1:B:6:VAL:HG11	1:B:33:TYR:HB2	1.89	0.55
1:A:102:GLY:N	2:A:164:PO4:O4	2.35	0.54
1:B:144:GLU:HG3	1:B:153:GLN:HG2	1.91	0.52
1:B:13:ARG:HD2	1:B:131:TYR:O	2.10	0.52
1:A:4:VAL:O	1:A:98:TYR:HA	2.09	0.52
1:B:110:GLN:HA	1:B:113:LEU:HG	1.93	0.50
1:A:66:ARG:HB2	2:A:163:PO4:O3	2.11	0.50
1:B:22:PRO:HG2	1:B:23:TRP:CZ3	2.47	0.49
1:B:66:ARG:NH1	2:B:163:PO4:O3	2.44	0.49
1:B:22:PRO:HG2	1:B:23:TRP:CE3	2.48	0.49
1:B:56:LEU:HD21	1:B:73:VAL:HG21	1.93	0.49
1:B:135:ASP:O	1:B:139:TRP:HD1	1.96	0.48
1:B:66:ARG:HH11	2:B:163:PO4:P	2.36	0.48
1:B:15:ILE:HD11	1:B:103:ALA:HB2	1.96	0.47
1:A:9:LEU:HD12	1:A:13:ARG:HA	1.96	0.47
1:B:44:LEU:HD21	1:B:61:GLN:HB3	1.98	0.46
1:B:45:GLY:HA3	3:B:184:HOH:O	2.16	0.45
1:A:26:ILE:HG13	1:A:29:ASP:HB2	1.98	0.44
1:B:117:VAL:HG22	1:B:154:GLU:HG2	1.98	0.44
1:A:34:ARG:HH22	1:A:55:ASP:HB3	1.82	0.44
1:B:32:GLN:NE2	1:B:152:LEU:HG	2.33	0.44
1:B:10:ALA:HA	1:B:121:VAL:O	2.19	0.43
1:B:56:LEU:CD2	1:B:73:VAL:HG21	2.49	0.43
1:A:108:LEU:HD13	1:B:108:LEU:HD13	2.01	0.43
1:A:30:LYS:HA	1:A:33:TYR:HD2	1.84	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:113:LEU:HD11	3:A:184:HOH:O	2.20	0.41
1:B:66:ARG:HG3	2:B:163:PO4:O4	2.21	0.41
1:A:10:ALA:HB1	1:A:123:GLY:O	2.21	0.41
1:A:44:LEU:HD12	1:A:48:THR:HG22	2.02	0.40
1:A:81:SER:HB2	1:A:83:GLU:OE1	2.21	0.40

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

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	155/162 (96%)	135 (87%)	12 (8%)	8 (5%)	1	0
1	B	151/162 (93%)	138 (91%)	9 (6%)	4 (3%)	4	3
All	All	306/324 (94%)	273 (89%)	21 (7%)	12 (4%)	2	1

All (12) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	18	ASP
1	B	158	SER
1	A	24	PRO
1	A	25	SER
1	A	60	ALA
1	B	24	PRO
1	B	18	ASP
1	B	25	SER
1	A	56	LEU
1	A	128	ASP
1	A	26	ILE
1	A	102	GLY

5.3.2 Protein sidechains ⓘ

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	124/132 (94%)	107 (86%)	17 (14%)	3	3
1	B	121/132 (92%)	106 (88%)	15 (12%)	4	4
All	All	245/264 (93%)	213 (87%)	32 (13%)	4	4

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	GLU
1	A	4	VAL
1	A	6	VAL
1	A	18	ASP
1	A	33	TYR
1	A	42	VAL
1	A	47	THR
1	A	55	ASP
1	A	56	LEU
1	A	75	THR
1	A	78	ARG
1	A	93	ASP
1	A	120	ARG
1	A	129	THR
1	A	146	ASP
1	A	151	THR
1	A	152	LEU
1	B	4	VAL
1	B	9	LEU
1	B	33	TYR
1	B	34	ARG
1	B	36	ARG
1	B	56	LEU
1	B	59	SER
1	B	74	ASP
1	B	92	LEU
1	B	96	THR

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Mol	Chain	Res	Type
1	B	108	LEU
1	B	126	GLU
1	B	129	THR
1	B	145	THR
1	B	156	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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](#)

3 ligands are modelled in this entry.

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	$\# Z > 2$
2	PO4	B	163	-	4,4,4	1.03	0	6,6,6	0.52	0
2	PO4	A	164	-	4,4,4	1.25	0	6,6,6	0.52	0
2	PO4	A	163	-	4,4,4	1.14	0	6,6,6	0.48	0

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	163	PO4	3	0
2	A	164	PO4	1	0
2	A	163	PO4	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

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.