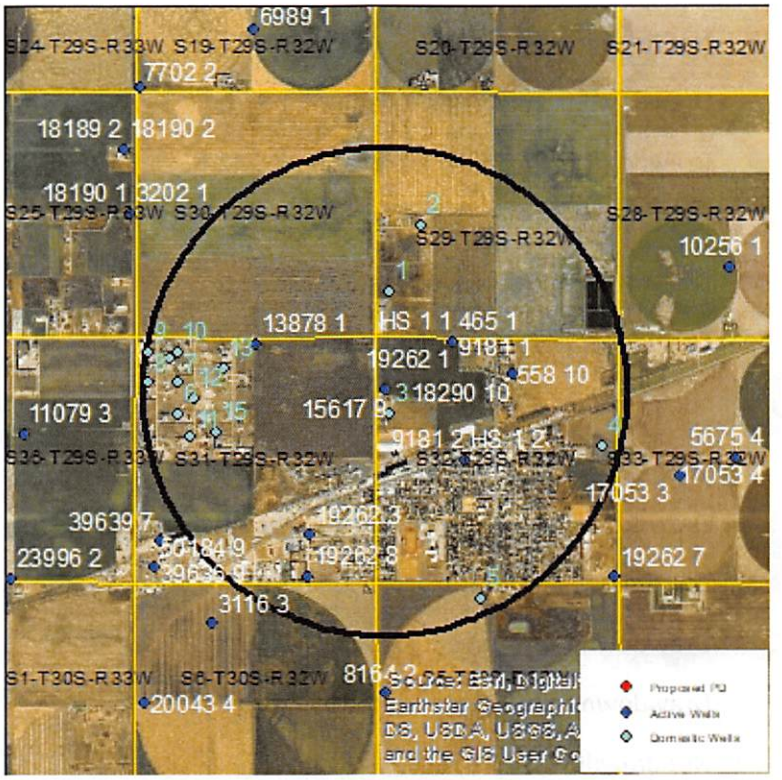
Evaluation of proposed move for Water Right Nos HS 1 and 9181

Proposed: Move water use authority from the southern well authorized by water right nos. HS 1 and 9181 to the well currently authorized under water right no. 15617.



Wells within 1 mile: HS1 & 9181 & 19262 ID1, 558 & 18290, 13878, 19262 ID8, and 15 domestic wells, numbered on the above map.

The saturated thickness at the proposed well location is estimated to be 328 ft, based upon the driller's log. Note that this thickness includes some Dakota formation. For saturated thicknesses greater than 200 ft, the maximum allowable Theis drawdown to neighboring critical wells is 4.0 ft.

50 year Theis Analysis: The following values were used to run the analysis:

S = 0.1349, T = 2451 ft^2/day

HS 1 & 9181 ID2: This well has not been used in more than 10 years, so no pumping was used to model aquifer effects at current well locations. This well will also not remain in effect under the proposal.

15617: $tp_{current}$ = 219 days (assumption based upon municipal wells being in operation for 60% of every day), $Q_{current}$ = 104 gpm, $tp_{proposed}$ = 59 days (based upon total authorized quantity being pumped at authorized rate with the average use of 69.4 AF continuing to be pumped from ID1), $Q_{proposed}$ = 1685 gpm

Theis drawdowns were calculated as follows:

HS1 & 465 & 9181 & 19262 ID1:

Drawdown from current location = 2.31 ft

Drawdown from proposed location = 11.35 ft

Net drawdown = **9.0 ft**

558 & 18290: Drawdown from current location = 1.87 ft

Drawdown from proposed location = 8.42 ft

Net drawdown = **6.6 ft**

13878: Drawdown from current location = 1.80 ft

Drawdown from proposed location = 8.12 ft

Net drawdown = **6.3 ft**

19262 ID8: Drawdown from current location = 1.46 ft

Drawdown from proposed location = 6.40 ft

Net drawdown = **4.9 ft**

Domestic 1: Drawdown from current location = 2.13 ft

Drawdown from proposed location = 10.21 ft

Net drawdown = **8.1 ft**

Domestic 2: Drawdown from current location = 1.60 ft

Drawdown from proposed location = 7.14 ft

Net drawdown = **5.5 ft**

Domestic 3: Drawdown from current location = 3.93 ft

Drawdown from proposed location = 31.95 ft

Net drawdown = **28.0 ft**

Domestic 4: Drawdown from current location = 1.37 ft

Drawdown from proposed location = 5.99 ft

Net drawdown = **4.6 ft**

Domestic 5: Drawdown from current location = 1.35 ft

Drawdown from proposed location = 5.94 ft

Net drawdown = **4.6 ft**

Domestic 6:	Drawdown from current location = 1.43 ft
	Drawdown from proposed location = 6.26 ft
	Net drawdown = **4.8 ft**
Domestic 7:	Drawdown from current location = 1.43 ft
	Drawdown from proposed location = 6.28 ft
	Net drawdown = **4.8 ft**
Domestic 8:	Drawdown from current location = 1.32 ft
	Drawdown from proposed location = 5.81 ft
	Net drawdown = **4.5 ft**
Domestic 9:	Drawdown from current location = 1.31 ft
	Drawdown from proposed location = 5.76 ft
	Net drawdown = **4.4 ft**
Domestic 10:	Drawdown from current location = 1.42 ft
	Drawdown from proposed location = 6.23 ft
	Net drawdown = **4.8 ft**
Domestic 11:	Drawdown from current location = 1.47 ft
	Drawdown from proposed location = 6.41 ft
	Net drawdown = **4.9 ft**
Domestic 12:	Drawdown from current location = 1.50 ft
	Drawdown from proposed location = 6.58 ft
	Net drawdown = **5.1 ft**
Domestic 13:	Drawdown from current location = 1.64 ft
	Drawdown from proposed location = 7.33 ft
	Net drawdown = **5.7 ft**
Domestic 14:	Drawdown from current location = 1.39 ft
	Drawdown from proposed location = 6.11 ft
	Net drawdown = **4.7 ft**

Domestic 15: Drawdown from current location = 1.59 ft

Drawdown from proposed location = 7.06 ft

Net drawdown = **5.5 ft**

Net drawdown exceeds the drawdown allowance of 4.0 ft for all wells within a mile, so critical well evaluation is necessary.

Critical Well Evaluation:

HS 1 & 465 & 9181 & 19262 ID 1:

Water Column = 268 ft

DP = 9.03 ft

DE = 58.9 ft

DD = 10.29 ft (S = 0.1349, T = 18,334 gpd/ft, Q = 72 gpm, tp = 219 days, efficiency = 70%)

DT = 78.2 ft

Economic Drawdown Constraint (EDC) = 268 ft * 0.4 = 107.2 ft

Physical Drawdown Constraint (PDC) = 268 ft – 60 ft = 208 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 107.2 ft. Total drawdown of 78.2 ft is less than the maximum allowable drawdown, so this well is **not critical.**

558 & 18290:

Water Column = 322 ft

DP = 6.56 ft

DE = 58.9 ft

DD = 10.57 ft (S = 0.1349, T = 18,334 gpd/ft, Q = 74 gpm, tp = 219 days, efficiency = 70%)

DT = 76.0 ft

Economic Drawdown Constraint (EDC) = 322 ft * 0.4 = 128.8 ft

Physical Drawdown Constraint (PDC) = 322 ft – 60 ft = 262 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 128.8 ft. Total drawdown of 76.0 ft is less than the maximum allowable drawdown, so this well is **not critical.**

13878:

Water Column = 206 ft (saturated thickness from model. No driller's log is available.)

DP = 6.32 ft

DE = 61.3 ft

DD = 0 ft (well has been inoperable for nearly 10 years)

DT = 67.6 ft

Economic Drawdown Constraint (EDC) = 206 ft * 0.4 = 82.4 ft

Physical Drawdown Constraint (PDC) = 206 ft – 60 ft = 146 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 82.4 ft. Total drawdown of 67.6 ft is less than the maximum allowable drawdown, so this well is **not critical.**

19262 ID 8:

Water Column = 303 ft

DP = 4.94 ft

DE = 61.3 ft

DD = 18.74 ft (S = 0.1481, T = 20,736 gpd/ft, Q = 148 gpm, tp = 219 days, efficiency = 70%)

DT = 85.0 ft

Economic Drawdown Constraint (EDC) = 303 ft * 0.4 = 121.2 ft

Physical Drawdown Constraint (PDC) = 303 ft – 60 ft = 243 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 121.2 ft. Total drawdown of 85.0 ft is less than the maximum allowable drawdown, so this well is **not critical.**

Domestic 1:

Water Column = 87 ft

DP = 8.08 ft

DE = 65.7 ft

DT = 73.8 ft

Economic Drawdown Constraint (EDC) = 87 ft * 0.4 = 34.8 ft

Physical Drawdown Constraint (PDC) = 87 ft – 20 ft = 67 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 34.8 ft. Total drawdown of 73.8 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 2:

Water Column = 133 ft

DP = 5.54 ft

DE = 65.7 ft

DT = 71.2 ft

Economic Drawdown Constraint (EDC) = 133 ft * 0.4 = 53.2 ft

Physical Drawdown Constraint (PDC) = 133 ft – 20 ft = 113 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 53.2 ft. Total drawdown of 71.2 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 3:

Water Column = 12 ft

DP = 28.0 ft

DE = 58.9 ft

DT = 86.9 ft

Total drawdown is greater than the water column, so this well **is critical.** It is likely that this well is no longer in use.

Domestic 4:

Water Column = 109 ft

DP = 4.63 ft

DE = 58.9 ft

DT = 63.5 ft

Economic Drawdown Constraint (EDC) = 109 ft * 0.4 = 43.6 ft

Physical Drawdown Constraint (PDC) = 109 ft – 20 ft = 89 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 43.6 ft. Total drawdown of 63.5 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 5:

Water Column = 66 ft

DP = 4.59 ft

DE = 54.4 ft

DT = 59.0 ft

Economic Drawdown Constraint (EDC) = 66 ft * 0.4 = 26.4 ft

Physical Drawdown Constraint (PDC) = 66 ft – 20 ft = 46 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 26.4 ft. Total drawdown of 59.0 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 6:

Water Column = 44 ft

DP = 4.83 ft

DE = 61.3 ft

DT = 66.1 ft

Total drawdown is greater than the water column, so this well **is critical.**

Domestic 7:

Water Column = 95 ft

DP = 4.85 ft

DE = 61.3 ft

DT = 66.2 ft

Economic Drawdown Constraint (EDC) = 95 ft * 0.4 = 38.0 ft

Physical Drawdown Constraint (PDC) = 95 ft – 20 ft = 75 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 38.0 ft. Total drawdown of 66.2 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 8:

Water Column = 72 ft

DP = 4.48 ft

DE = 61.3 ft

DT = 66.2 ft

Economic Drawdown Constraint (EDC) = 72 ft * 0.4 = 28.8 ft

Physical Drawdown Constraint (PDC) = 72 ft – 20 ft = 52 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 28.8 ft. Total drawdown of 66.2 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 9:

Water Column = 73 ft

DP = 4.45 ft

DE = 61.3 ft

DT = 65.8 ft

Economic Drawdown Constraint (EDC) = 73 ft * 0.4 = 29.2 ft

Physical Drawdown Constraint (PDC) = 73 ft – 20 ft = 53 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 29.2 ft. Total drawdown of 65.8 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 10:

Water Column = 74 ft

DP = 4.81 ft

DE = 61.3 ft

DT = 66.1 ft

Economic Drawdown Constraint (EDC) = 74 ft * 0.4 = 29.6 ft

Physical Drawdown Constraint (PDC) = 74 ft – 20 ft = 54 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 29.6 ft. Total drawdown of 66.1 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 11:

Water Column = 74 ft

DP = 4.94 ft

DE = 61.3 ft

DT = 66.2 ft

Economic Drawdown Constraint (EDC) = 74 ft * 0.4 = 29.6 ft

Physical Drawdown Constraint (PDC) = 74 ft – 20 ft = 54 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 29.6 ft. Total drawdown of 66.2 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 12:

Water Column = 75 ft

DP = 5.08 ft

DE = 61.3 ft

DT = 66.4 ft

Economic Drawdown Constraint (EDC) = 75 ft * 0.4 = 30.0 ft

Physical Drawdown Constraint (PDC) = 75 ft – 20 ft = 55 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 30.0 ft. Total drawdown of 66.4 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 13:

Water Column = 77 ft

DP = 5.69 ft

DE = 61.3 ft

DT = 67.0 ft

Economic Drawdown Constraint (EDC) = 77 ft * 0.4 = 30.8 ft

Physical Drawdown Constraint (PDC) = 77 ft – 20 ft = 57 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 30.8 ft. Total drawdown of 67.0 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 14:

Water Column = 74 ft

DP = 4.72 ft

DE = 61.3 ft

DT = 66.0 ft

Economic Drawdown Constraint (EDC) = 74 ft * 0.4 = 29.6 ft

Physical Drawdown Constraint (PDC) = 74 ft – 20 ft = 54 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 29.6 ft. Total drawdown of 66.0 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Domestic 15:

Water Column = 86 ft

DP = 5.48 ft

DE = 61.3 ft

DT = 66.8 ft

Economic Drawdown Constraint (EDC) = 86 ft * 0.4 = 34.4 ft

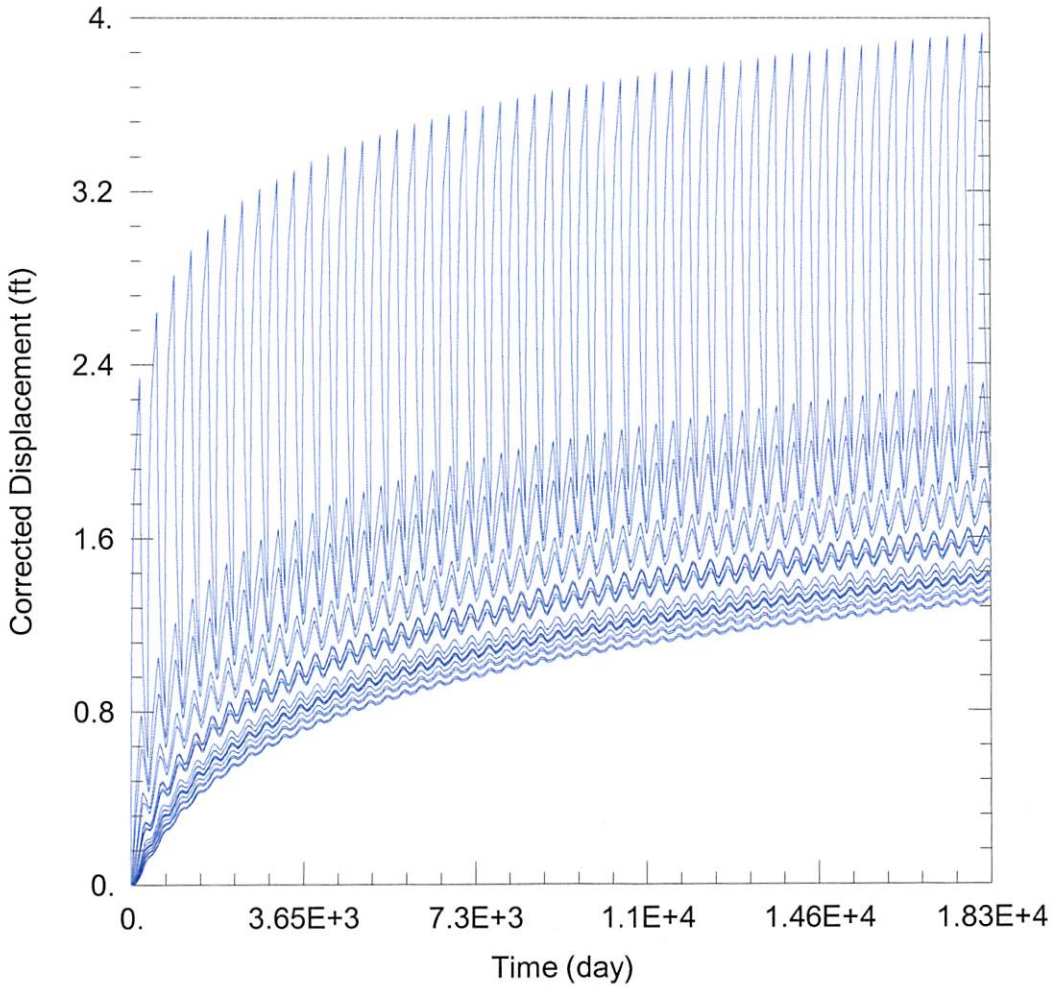
Physical Drawdown Constraint (PDC) = 86 ft – 20 ft = 66 ft

The EDC is more conservative than the PDC, so the maximum allowable drawdown is 34.4 ft. Total drawdown of 66.8 ft is greater than the maximum allowable drawdown, so this well **is critical.**

Conclusion:

All 15 domestic wells located within 1 mile of the proposed point of diversion are critical wells. None of these wells are drilled as deep as the other, non-critical wells in the area. These other wells appear to be drilled into Dakota formation. All domestic wells in the area are going to lose more than 40% of their water column over the next 25 years, which will diminish their pumping capacity.

Please note that this analysis was performed under the condition that the proposed well operates under its fully authorized rate and quantity. It is highly unlikely that this well can perform under those conditions. It is likely that the well-to-well effect on each of the active domestic wells can be lowered so that it is under the maximum allowable Theis drawdown level of 4.0 ft by limiting the rate and/or quantity of the proposed well to a more reasonable level.



WELL TEST ANALYSIS

Data Set: C:\Users\trevora\Documents\2019_moves\HS1_9181\HS1_9181 Current.aqt
Date: 06/07/19 Time: 14:40:21

PROJECT INFORMATION

Company: GMD 3
Project: HS1 & 9181 ID2
Location: Haskell County
Test Well: HS1 & 9181 ID2

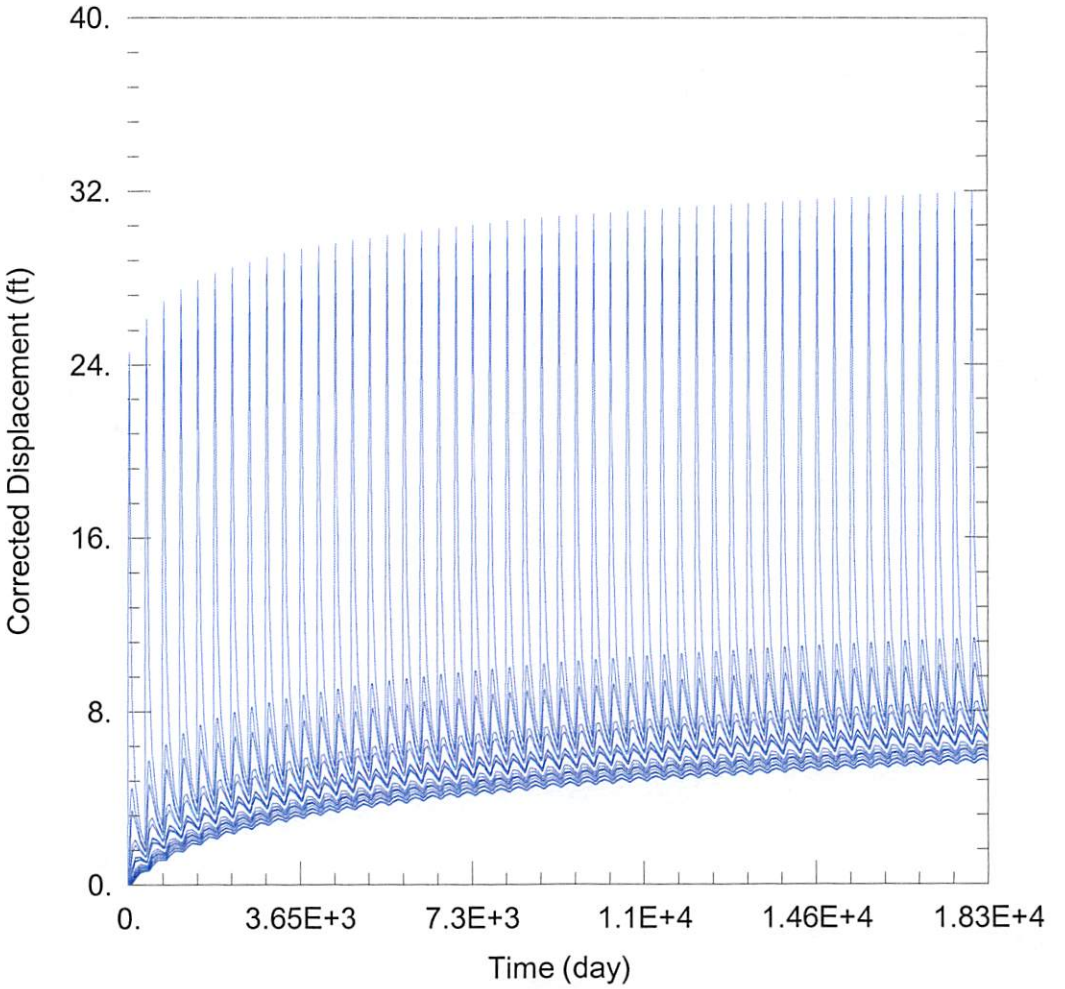
WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Proposed PD	-15305	222583

Observation Wells

Well Name	X (ft)	Y (ft)
▫	-15305	222583
▫ HS1 & 465 & 9181 & 19262	-13802	223658
▫ 558 & 18290	-12521	222930
▫ 13878	-18120	223614
▫ 19262 ID3	-16922	219468
▫ 19262 ID8	-16975	218576
▫ Domestic 1	-15211	224750
▫ Domestic 2	-14493	226181
▫ Domestic 3	-15213	222094
▫ Domestic 4	-10566	221402
▫ Domestic 5	-13208	218097
▫ Domestic 6	-19797	222094
▫ Domestic 7	-19795	222760



WELL TEST ANALYSIS

Data Set: C:\Users\trevora\Documents\2019_moves\HS1_9181\HS1_9181 Proposed.aqt
Date: 06/07/19 Time: 14:40:00

PROJECT INFORMATION

Company: GMD 3
Project: HS1 & 9181 ID2
Location: Haskell County
Test Well: HS1 & 9181 ID2

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Proposed PD	-15305	222583

Observation Wells

Well Name	X (ft)	Y (ft)
▫	-15305	222583
▫ HS1 & 465 & 9181 & 19262	-13802	223658
▫ 558 & 18290	-12521	222930
▫ 13878	-18120	223614
▫ 19262 ID3	-16922	219468
▫ 19262 ID8	-16975	218576
▫ Domestic 1	-15211	224750
▫ Domestic 2	-14493	226181
▫ Domestic 3	-15213	222094
▫ Domestic 4	-10566	221402
▫ Domestic 5	-13208	218097
▫ Domestic 6	-19797	222094
▫ Domestic 7	-19795	222760