3/13/03

Exhibit For
Castle Rock, CO
8.1 m Earth Station
Earth Station ID#: CK-10

Compliance with FCC Report & Order (FCC96-377) for the 13.75 - 14.0 GHz Band
Analysis and Calculations

1. Background

This Exhibit is presented to demonstrate the extent to which PanAmSat satellite earth station planned for the Castle Rock, CO site is in compliance with FCC REPORT & ORDER 96-377. The potential interference from the earth station to US Navy shipboard radiolocation operations (RADAR) and the NASA space research activities in the 13.75 - 14.0 GHz Band is addressed in this exhibit. The parameters for the earth station are:

Table 1. Earth Station Characteristics

• Coordinates :	39 16 38 N, 104 48 23 W (NAD83) Antenna ID: CK-10
• Satellite Location for Earth Station:	PAS-8B (43^{o} W.L.) PAS-1R (45^{o} W.L.) Galaxy XI (91^{o} W.L.)
• Frequency Band: for uplink,	13.750-13.755 GHz and 13.99-14.0 GHz
• Polarizations:	Dual linear, V and H
• Emissions	750KF2D,
• Modulation	QPSK
• Maximum Required Uplink EIRP:	85 dBW for each Carrier 62.3 dBW/4 kHz worst case
• Transmit Antenna Characteristics	
Antenna Size/Gain:	8.1 meter / 59.5 dBi
Antenna Type/Model:	Vertex 8.1KPK

- RF power into Antenna Flange: 25.5 dBW or 2.8 dBW/4 kHz (Maximum)

- Elevation Angle: 13.0° @ 108.7° Az (43^{o} W.L.)
  14.5° @ 110.2° Az (45^{o} W.L.)
  42.3° @ 158.8° Az (91^{o} W.L.)

- Off-axis Side Lobe Antenna Gain: 32- 25*log(θ)

Because the above spectrum is shared with the Federal Government, coordination in this band requires resolution data pertaining to potential interference between the earth station and both Navy Department and NASA systems. Potential interference from the earth station could impact with the Navy and/or NASA systems in five areas. These areas are noted in FCC Report and Order 96-377 dated September 1996, and consist of (1) Radiolocation and radio navigation, (2) Data Relay Satellites, (3) Precipitation Radar, (4) Altimeters, and (5) Scatterometers.

Summary of Coordination Issues:

1) Potential Impact to Government Radiolocation (Shipboard Radar)
2) Potential Impact to NASA Data Relay Satellite Systems (TDRSS)
3) Potential Impact to NASA/NASDA Operations (Precipitation Radar)
4) Potential Impact to NASA Operations (Altimeters)
5) Potential Impact to NASA Operations (Scatterometers)

2.0 Potential Impact to Government Radiolocation (Shipboard Radar)

Radiolocation operations (RADAR) may occur anywhere in the 13.4 - 14 GHz frequency band aboard ocean going United States Navy ships. The Federal Communication Commission (FCC) order 96-377 allocates the top 250 MHz of this 600 MHz band to the Fixed Satellite Service (FSS) on a co-primary basis with the radiolocation operations and provides for an interference protection level of -167 dBW/m^2/4 kHz.

The closest distance to the shoreline from Castle Rock, CO earth station is approximately 1180 km southwest towards the Gulf of California and over 1300 km toward the Pacific Ocean near San Diego, CA.

The RADAR characteristics used for the calculations are presented in Table 2.

Table 2. RADAR Characteristics

Transmitter Parameters

Transmit Power*	250 kWatts
Frequency Range	13.4-14.0 GHz

Spectral Density Transmitted at the Tuned Frequency

Pulse Width**	0.5 μs	25.8 dBW/4kHz
Pulse Width**	1.0 μs	28.8 dBW/4kHz
Pulse Width**	2.0 μs	31.8 dBW/4kHz
Pulse Rate**		1200 pulses per second
Emission Characteristics		Sin(θ)/θ Roll-Off
Mode of Operation		Pulse Doppler Detection

Antenna Parameters

Shape*	Circular and Parabolic
Physical Size*	1.5 m^2
Antenna Gain at 14 GHz*	44.3 dB
Antenna Motion*	360° Rotation in Detection Mode Track Mode after Target lock-on and Weapon-on
Effective Area of Antenna	
Main Beam*	1.0 m^2
Side Lobe Gain	-10.0 dB
Antenna height	51 feet

Receiver Parameters

Noise Figure*	8 dB
Doppler Filter for Mach 1	31 kHz
Interference Criteria	-167 dB (W/m^2/4 kHz)

The earth station's power flux density was calculated at the azimuths toward the closest points of the shoreline. Profiles were performed to determine the effects of earth bulge and terrain to a point in the Gulf of California and also the Pacific Ocean near San Diego. Because of the tremendous distance to the nearest shoreline additional profiles at other radials were deemed unnecessary. The signal flux density at these points on the shoreline, considering over-the-horizon loss are calculated as follows and shown in the Table below:

PFD = Antenna Feed Power density (dBW/4 kHz) + Antenna Off-Axis Gain (dBi) – Spread Loss (dBW-m^2) – Over-the-Horizon Losses (dB)

Azimuth Toward The Coast (degrees)	RF Power Density (dBW/4 kHz)	ES Gain (dBi)	Distance to Shoreline (km)	Pathloss (dB)	PFD at Shoreline (dBW/m2/ 4kHz)	Meets Interference Objective?
226 (Gulf of California)	2.8	-10.0	1183.0	162.2	-301.9	Yes
244 (Pacific Ocean at San Diego)	2.8	-10.0	1321.0	182.1	-322.7	Yes

These levels are in compliance with the interference criteria requirements of -167 dBW/m^2/4kHz for all azimuths. The profile data is attached in Annex 1.

3. Potential Impact to NASA's Data Relay Satellite System (TDRSS)

The geographic location of the PanAmSat earth station in Castle Rock, CO is outside the 390 km radius coordination contour surrounding NASA's White Sands, New Mexico ground station complex. Therefore, the TDRSS space-to-earth link will not be impacted by the PanAmSat earth station at the Castle Rock Site.

The TDRSS space-to-space link in the 13.772 to 13.778 GHz band is assumed to be protected if an earth station produces an EIRP less than or equal to 71 dBW/6 MHz in this band. The 8.1-meter earth station dish will have an EIRP of greater than 71 dBW in this bandwidth. A worst case EIRP of 85.0 dBW in 750 kHz bandwidth is planned for the earth station. This equates to an equivalent EIRP of 85.0 dBW/6 MHz. However, the Castle Rock earth station does not intend to operate in the 13.772-13.778 frequency band and consequently no interference to NASA TDRSS space-to-space links. Additionally, if the Castle Rock, CO earth station were to operate in the TDRSS 13.772 to 13.778 GHz Band the transmit power density would be lowered to 71 dBW/6 MHz.

4. Potential Impact to NASA/NASDA Operations (Precipitation Radar)

The Tropical Rain Measuring Mission (TRMM) Precipitation Radar (PR) operates at two frequencies 13793 and 13805 MHz with a bandwidth of 600 kHz at each frequency. The FCC Report and Order 96-377 grants NASA protection to the spacecraft borne sensors like those used for the TRMM in the 13.75 to 14.0 GHz band until January 1, 2001. The 8.1-meter antenna system will have an EIRP of 85 dBW.

The ITU-R SA. 1071 states that the recommended threshold of interference at the two TRMM frequencies is -150 dBW. The geographic location of the PanAmSat earth station antenna is outside the TRMM PR "ground truth" exclusion zones described in ITU-R SA. 1071. For the earth station antenna location, the antenna coupling to the space borne antenna

can be earth station sidelobe to TRMM PR sidelobe, and earth station side lobe to TRMM PR main beam. The coupling to the TRMM PR main beam is the worst case, therefore, it will be the one calculated. The calculation will be made for an overhead pass of the TRMM PR satellite having a ±17° cross-track scan. The calculation will be made for scan angles of 0°, 8.5° and 17°.

Table 2. Calculation Parameters for TRMM PR

The parameters for the calculation are:	
TRMM Range @ 0° Scan Angle:	350 km
TRMM Range @ 8.5° Scan Angle:	354 km
TRMM Range @ 17° Scan Angle:	366 km
TRMM Antenna Gain:	47.7 dBi
Earth Station Elevation Angle:	44.1°
8.1-meter Antenna Gain:	59.5 dBi
Earth Station Side Lobe Antenna Gain:	$32 - 25*\log(\theta)$ Where θ is the angle between the Earth Station antenna and the TRMM antenna.
FSL @ 350 km	166.3 dB
FSL @ 354 km	166.4 dB
FSL @ 366 km	166.7 dB

Table 3. TRMM PR Calculated Results

8.1 meter Antenna Transmit Power = 25.5 dBW or 24.5 dBW/600 kHz

Calculations at Elevation angle 44.1° (99^{o} W.L.)

Scan Angle	ES Antenna Gain	TRMM Gain	FSL	Power Received	Margin
0°	-9.4 dBi	47.7 dBi	166.3 dB	-103.5 dBW	- 46.5 dB
8.5°	-7.2 dBi	47.7 dBi	166.4 dB	-101.4 dBW	- 48.6 dB
17.0°	-4.4 dBi	47.7 dBi	166.7 dB	-98.8 dBW	- 51.2 dB

From the calculated results the earth station will not meet the interference criteria for an EIRP of 85 dBW. However, the Castle Rock, CO earth does not intend to operate in the TRMM frequency range and therefore no interference should occur.

5. Potential Impact to Altimeter Operations

There are two families of airborne radar altimeters operating in the 13.75 - 14.0 GHz band that are of concern with respect to interference from earth stations. They are the TOPEX-POSEIDON and the ERS-1/2. These radar altimeters are downward looking pulsed-radar installed on orbiting spacecraft. These systems are used to very precisely measure range from the satellite to the surface of the earth. In addition to the operational radar in this band,

a number of other systems are planned in the future. The parameters for the operational radar in this band are listed below.

Table 4. Altimeter Interference Criteria

Radar System	Frequency of Operation	Interference Criteria
TOPEX-POSEIDON (1)	13.60 GHZ ± 160 MHz	- 117 dBW/320 MHz
TOPEX-POSEIDON (2)	13.65 GHz ± 160 MHz	- 130 dBW/320 MHz
ERS -1/2	13.77 GHz ± 165 MHz	- 120 dBW/330 MHz

The orbiting spacecraft, with the radar altimeter, is assumed to be at an altitude of 800 km. The worst case slant range from earth station to the spacecraft is 1141.4 km at the elevation (44.1° for 99° W.L.) when the earth station main beam illuminates the spacecraft. This is the worst case alignment of the earth station antenna and the spacecraft radar antenna. It will occur when the spacecraft travels through the main beam circle formed by the earth station antenna. The time it takes the spacecraft to travel through this circle in space is a function of the 20-dB beam width of the earth station antenna (the 20-dB beam-width is used according to ITU Appendix S7 calculation methods) and the speed of the spacecraft. The spacecraft is traveling at 6.5 km/sec and the 20-dB beam width of the 8.1-meter antenna is estimated to be 0.45°. The diameter of the circle in space formed by the 8.1-meter antenna is 9.0 km at a range of 1141.4 km. The spacecraft will pass through the beam width of the earth station's antenna at the elevation (44.1°) in approximately 1.4 seconds. During this time, there may be a small blip of noise introduced into the radar display but it would be so transitory it may go unnoticed.

The availability requirement for the NASA altimeter data is 95%, which assumes that the associated individual outages are brief and randomly dispersed over all observation times and areas. If the outage were due to only one earth station the 95% availability would not be a problem. However, the outage caused by the earth station and other causes such as intense rainfall must be accounted for in determining the net availability of the system. Because the earth station interference will occur in a predictable manner for a given area it cannot be considered random. However, because of its predictability and relatively short time duration, it should have very little impact on the operation of present radar systems, and processing circuits and/or procedures can be designed in future systems to minimize the effect of the interference from single or multiple earth stations.

In order to calculate the interference level to the altimeter radar, we will assume that the side lobe gain toward the earth station antenna is -10 dB. Since the earth stations signal is narrow band compared to the RADAR bandwidth, the signals will be totally captured by the radar receiver. The following parameters are used in the calculation:

FSL for Antenna @ elevation (44.1°):	176.4 dB
Atmospheric Absorption:	0.5 dB
EIRP 8.1-meter Antennas:	85 dBW

Table 5. Altimeter Calculated Results

Earth Station for 85 dBW @ Elevation 44.1°

Radar Receiver	Interference Level	Margin
TOPEX-POSEIDON (1)	- 101.9 dBW	- 15.1 dB
TOPEX-POSEIDON (2)	- 101.9 dBW	- 28.1 dB
ERS-1/2	- 101.9 dBW	- 18.1 dB

The comparison of these levels to the interference criteria indicates that there may be interference coupled to the altimeters at an EIRP of 85 dBW. However, even if the Castle Rock, CO earth station generates some interference to the altimeters, the net result will not prevent the 95 % availability of the RADAR data.

For example, if the earth station interfered with a satellite altimeter at the minimum elevation angle (44.1°), a very unlikely condition, the total outage time would be 1.4 seconds. This would occur in a period of two hours which would mean the earth station would reduce the availability of the altimeter data by 0.019% which would still allow for a data availability of 99.981% versus the required 95%. This would be the extreme worst case since the probability of the satellite passing through the main beam of the earth station antenna in the same orbit is very unlikely.

The Castle Rock, CO Site location of the earth station places them outside the TOPEX-POSEIDON critical exclusion zone as defined in the ITU-R Recommendation SA. 1071. The range of operational elevation look angles for the proposed earth station is 13° (43^{o} W.L.) to 44.1^{o} for 99^{o} W.L. These elevation angles are below the 71°-elevation angle limitation required until January 1, 2001 in ITU-R Recommendation SA-1071.

6. Potential Impact to NASA Scatterometer Operations

Scatterometers are spacecraft borne RADAR type devices that measure the near surface vector winds over the ocean. Wind data over the oceans is considered a critical parameter in the determination of weather patterns and global climate. The overall availability requirement of the scatterometer system is similar to the altimeter radar. That is, some data loss is tolerable when interference signals exceed interference thresholds. The scatterometers can lose 1% of the ocean data from interference occurring systematically or 5% when the interference is occurring randomly. The scatterometers operate at a center frequency of 13995 MHz ± 1.44 MHz. There are two types of antenna modes of operation, fan beam and spot beam. For fan beam the aggregate interference threshold is - 174 dBW/2 kHz, for spot beam - 155 dBW/10 kHz. ITU-R SA. 1071 Recommendation states that to protect scatterometers using fan beams from unacceptable interference until 1 January 2000, FSS earth stations should not exceed an EIRP density toward the scatterometer orbit over the oceans of 25 dBW in any 2 kHz band between **13.99356 GHz and 13.99644 GHz**. The earth station at the Castle Rock, CO site could produce an EIRP of greater than 25 dBW in the scatterometer frequency band. **However, the earth station at Castle Rock, CO requires the use of carriers between 13990 and 14000 MHz. Since the protection date of 1 January 2000 has long passed it is assumed that the new frequency agile NEXTSCAT system is available and will not be susceptible to interference from this earth station.**

Coordination Issue Result Summary and Conclusions

The results of the analysis and calculations performed in this exhibit indicate that compatible operation between the earth station at Castle Rock, CO Site and the US Navy and NASA systems is possible if certain operational precautions are taken. These precautions involve avoidance of certain frequency ranges by the earth station so that interference will not occur to NASA operations. Table 6 provides the frequency ranges to be avoided.

Table 6. Excluded Frequency Range for Castle Rock, CO Earth Station

System	Frequency Restriction MHz
TRMM PR	13,792.7 – 13,793.3
TRMM PR	13,804.7 – 13,805.7

PanAmSat will avoid the above listed frequencies from their earth station operations under high power conditions.

Note: Can still transmit at TRMM PR frequencies (13,792.7 – 13,793.3 MHz) since the protection date expires on January 1, 2001.

The calculations indicate that the interference objectives are exceeded for the airborne scatterometers operating at 13,993.56 – 13,996.44. However, the protection date of 1/1/2000 has passed and alternative systems should be available.

The NASA altimeter data availability requirement of 95 % will not be degraded by the Castle Rock, CO earth station operations.

No interference to NASA's Data relay Satellite Systems (TDRSS) space-to-earth operations from the Castle Rock, CO earth station will occur.

No interference to US Navy RADAR operations from the Castle Rock, CO site earth station should occur.

ANNEX 1 – Over-the Horizon Loss Calculations

Pathloss Calculation

Path data for case # 1	CR CK 10		GULF OF CA	
Latitude	39 16 38.0		31 31 25.0	
Longitude	104 48 23.0		113 45 59.0	
Antenna Center Agl	16.01 ft.	4.88 m.	50.99 ft.	15.54 m.
Site Elevation Amsl	6877.01 ft.	2096.01 m.	0.00 ft.	0.00 m.
Antenna Center Amsl	6893.02 ft.	2100.89 m.	50.99 ft.	15.54 m.
Effective Antenna Ht ...	16.01 ft.	4.88 m.	50.99 ft.	15.54 m.
Horizon Distance	13.97 mi.	22.47 km.	23.10 mi.	37.16 km.
Horizon Elevation Amsl .	8928.39 ft.	2721.24 m.	3241.37 ft.	987.92 m.
Ray Crossover Angle	190.04 mr.			
Terrain Delta Ht	1712.08 ft.	521.82 m.		
Effective Distance	590.43 mi.	950.00 km.		
Pathlength	736.03 mi.	1184.27 km.		
Azimuth	226.01 deg.		40.82 deg.	
Frequency	12950 MHz			
K Factor	1.33 (K)			

Radio Climate Phrase ... Continental Temperate Climate
Type of Path ..... Irregular Terrain
Free Space Path Loss ... 176.1 dB Atmospheric Loss ... 24.685 dB
Diff. Loss .... 3100.3 dB (3276.4 dB) Tropo. Loss ...170.9 dB (347.0 dB)
Terrain data type ..... 1.0 ARC Second

Losses	L-Fspl	Sigma	Controlling Propagation Mode	
338.3 dB	162.2 dB	3.7 dB	20. %	Troposcattering
332.2 dB	156.1 dB	4.4 dB	1. %	Troposcattering
328.8 dB	152.7 dB	5.0 dB	0.1 %	Troposcattering
326.0 dB	149.8 dB	5.5 dB	0.01 %	Troposcattering
325.4 dB	149.3 dB	5.6 dB	0.0025%	Troposcattering

The OH loss calculations considered a terrain profile of 2371 points.
The list below shows the highest point in each fiftieth of the path length.

Dist. (km.)	Elev. (m.)	Obstr. (m.)	K=Inf. Clrnce. (m.)	K= 1.33 Clrnce. (m.)	Dist. (km.)	Elev. (m.)	Obstr. (m.)	K=Inf. Clrnce. (m.)	K= 1.33 Clrnce. (m.)
0.00	2096.0	4.9	0.0	0.0	593.48	2072.0	0.0	-1016.2	-21692.7
22.47	2721.2	0.0	-659.9	-2199.4	618.49	1859.7	0.0	-847.9	-21483.5
27.36	2821.9	0.0	-769.1	-2635.6	660.56	1749.4	0.0	-811.7	-21212.3
49.36	2798.4	0.0	-784.4	-4088.2	664.07	1715.6	0.0	-784.1	-21155.6
83.15	2979.8	0.0	-1025.3	-6424.3	709.23	1828.0	0.0	-976.0	-20844.1
105.20	3127.7	0.0	-1212.0	-7906.4	733.85	1941.1	0.0	-1132.4	-20624.7
140.04	3959.2	0.0	-2104.9	-10728.7	754.47	2219.5	0.0	-1447.1	-20569.9
142.50	3024.7	0.0	-1174.7	-9929.1	768.55	2274.6	0.0	-1527.1	-20368.3
168.54	3202.7	0.0	-1398.6	-11494.1	782.65	1867.1	0.0	-1144.4	-19680.7
199.05	3121.7	0.0	-1371.3	-12935.8	809.35	1932.8	0.0	-1257.1	-19151.4
216.77	3334.1	0.0	-1615.0	-13982.8	852.23	1823.7	0.0	-1223.5	-17910.8
257.20	3114.8	0.0	-1466.8	-15528.0	852.73	1750.4	0.0	-1151.0	-17822.9
269.05	3577.3	0.0	-1950.2	-16471.1	882.03	710.7	0.0	-163.0	-15883.7
284.36	2621.9	0.0	-1021.7	-16112.1	900.23	419.9	0.0	95.8	-14983.2
326.87	2562.7	0.0	-1037.4	-17564.6	924.01	371.4	0.0	102.4	-14079.1
332.81	2417.6	0.0	-902.8	-17613.7	970.62	604.8	0.0	-213.0	-12442.1
362.03	2012.0	0.0	-548.6	-18102.8	994.46	914.4	0.0	-564.6	-11696.0
383.84	1965.6	0.0	-540.6	-18658.6	1000.55	973.2	0.0	-634.1	-11474.3
411.63	1970.6	0.0	-594.5	-19349.7	1023.40	853.0	0.0	-554.2	-10263.0
434.47	1979.6	0.0	-643.8	-19854.6	1060.00	857.1	0.0	-622.7	-8391.0

460.83	1807.6	0.0	-518.2	-20178.0	1075.77	704.3	0.0	-497.7	-7380.9
497.16	1777.1	0.0	-551.6	-20696.4	1104.28	592.4	0.0	-436.0	-5644.9
508.12	2129.1	0.0	-922.9	-21183.4	1133.85	396.4	0.0	-292.0	-3663.6
536.55	2329.3	0.0	-1173.2	-21667.6	1147.11	987.9	0.0	-906.9	-3420.8
565.50	2245.9	0.0	-1140.7	-21775.6	1162.42	134.3	0.0	-80.3	-1578.2
570.49	2253.1	0.0	-1156.8	-21805.9	1184.27	0.0	15.5	0.0	0.0

Pathloss Calculation

Path data for case # 2	CR CK 10		SAN DIEGO	
Latitude	39 16 38.0		33 22 29.1	
Longitude	104 48 23.0		117 35 37.3	
Antenna Center Agl	16.01 ft.	4.88 m.	50.99 ft.	15.54 m.
Site Elevation Amsl	6877.01 ft.	2096.01 m.	0.00 ft.	0.00 m.
Antenna Center Amsl	6893.02 ft.	2100.89 m.	50.99 ft.	15.54 m.
Effective Antenna Ht ...	16.01 ft.	4.88 m.	50.99 ft.	15.54 m.
Horizon Distance	0.28 mi.	0.46 km.	12.50 mi.	20.12 km.
Horizon Elevation Amsl .	6949.68 ft.	2118.16 m.	2656.82 ft.	809.76 m.
Ray Crossover Angle	232.19 mr.			
Terrain Delta Ht	2462.16 ft.	750.43 m.		
Effective Distance	590.43 mi.	950.00 km.		
Pathlength	821.54 mi.	1321.85 km.		
Azimuth	244.09 deg.		56.51 deg.	
Frequency	12950 MHz			
K Factor	1.33 (K)			

Radio Climate Phrase ... Continental Temperate Climate
Type of Path ..... Irregular Terrain
Free Space Path Loss ... 177.1 dB Atmospheric Loss ... 27.553 dB
Diff. Loss .... 3712.9 dB (3890.0 dB) Tropo. Loss ...190.7 dB (367.8 dB)
Terrain data type ..... 1.0 ARC Second

Losses	L-Fspl	Sigma	Controlling Propagation Mode	
359.1 dB	182.1 dB	3.7 dB	20. %	Troposcattering
353.0 dB	176.0 dB	4.4 dB	1. %	Troposcattering
349.6 dB	172.6 dB	5.0 dB	0.1 %	Troposcattering
346.8 dB	169.7 dB	5.5 dB	0.01 %	Troposcattering
346.2 dB	169.1 dB	5.6 dB	0.0025%	Troposcattering

The OH loss calculations considered a terrain profile of 2818 points.
The list below shows the highest point in each fiftieth of the path length.

Dist. (km.)	Elev. (m.)	Obstr. (m.)	K=Inf. Clrnce. (m.)	K= 1.33 Clrnce. (m.)	Dist. (km.)	Elev. (m.)	Obstr. (m.)	K=Inf. Clrnce. (m.)	K= 1.33 Clrnce. (m.)
0.00	2096.0	4.9	0.0	0.0	672.39	1767.0	0.0	-726.9	-26479.0
0.46	2118.2	-0.2	-17.8	-53.3	713.77	2048.3	0.0	-1073.5	-26668.7
21.42	2813.4	0.0	-746.3	-2389.3	716.12	2275.2	0.0	-1304.0	-26884.2
48.81	2816.8	0.0	-792.9	-4457.0	742.03	2100.7	0.0	-1170.5	-26542.5
68.00	2925.6	0.0	-932.0	-5959.6	768.43	1816.1	0.0	-927.5	-26005.9
94.98	2907.8	0.0	-956.8	-7828.6	814.24	1963.1	0.0	-1146.8	-25520.6
114.21	2945.8	0.0	-1025.1	-9158.8	836.46	1950.0	0.0	-1168.7	-25111.5
144.01	4154.5	0.0	-2280.8	-12283.4	871.03	1733.8	0.0	-1007.0	-24163.8
173.39	3394.4	0.0	-1567.1	-13310.0	892.83	1770.7	0.0	-1078.4	-23666.7
211.09	3192.6	0.0	-1424.7	-15251.6	925.10	1723.3	0.0	-1081.9	-22726.2
221.68	3185.7	0.0	-1434.5	-15816.5	932.70	2487.8	0.0	-1858.3	-23262.5
263.15	3965.5	0.0	-2279.7	-18709.0	968.83	1017.8	0.0	-445.4	-20614.4
269.61	3902.7	0.0	-2227.1	-18957.0	980.73	557.8	0.0	-4.1	-19732.7
295.93	4046.7	0.0	-2412.6	-20316.2	1019.32	677.6	0.0	-184.8	-18370.2
317.65	3644.1	0.0	-2044.3	-20855.3	1056.05	856.1	0.0	-421.3	-16974.2
344.03	2894.2	0.0	-1336.1	-21173.9	1061.78	1388.1	0.0	-962.2	-17246.2
371.36	2353.0	0.0	-838.0	-21653.4	1107.67	359.1	0.0	-5.7	-13995.9
397.80	2058.1	0.0	-584.8	-22261.9	1121.55	983.6	0.0	-652.1	-13899.6
425.67	1625.5	0.0	-196.1	-22692.2	1160.36	1472.2	0.0	-1201.9	-12252.2
468.93	1584.0	0.0	-222.9	-23809.0	1178.59	1641.4	0.0	-1399.9	-11357.0
500.61	1598.0	0.0	-286.9	-24531.2	1191.07	946.1	0.0	-724.3	-9910.2
524.41	1718.8	0.0	-445.2	-25106.0	1225.66	3069.9	0.0	-2902.6	-9855.2

```
553.83  1778.0     0.0  -550.8-25634.4 1249.71   959.4     0.0  -830.1 -6146.8
572.07  2276.0     0.0 -1077.6-26371.9 1293.05   763.9     0.0  -702.9 -2898.8
581.89  2160.7     0.0  -977.8-26369.4 1301.73   809.8     0.0  -762.5 -2306.9
612.80  1888.0     0.0  -753.9-26377.2 1321.85     0.0    15.5     0.0     0.0
635.77  1904.4     0.0  -806.5-26529.0
```