



Planning and Community  
Development Department  
2880 International Circle  
Colorado Springs, Colorado 80910  
Phone: 719.520.6300  
Fax: 719.520.6695  
Website [www.elpasoco.com](http://www.elpasoco.com)

## DEVIATION REQUEST AND DECISION FORM

Updated: 6/26/2019

### PROJECT INFORMATION

Project Name : The Glen at Widefield Filing No 11  
Schedule No.(s) : 5522000009, 5522000007  
Legal Description : See Attached Document

### APPLICANT INFORMATION

Company : Glen Investment Group VIII, LLC  
Name : Ryan Watson  
☒ Owner ☐ Consultant ☐ Contractor  
Mailing Address : 3 Widefield Blvd, Colorado Springs, CO 80911  
  
Phone Number : 719-392-0194  
FAX Number :  
Email Address : [ryan@widefieldinvestmentgroup.com](mailto:ryan@widefieldinvestmentgroup.com)

### ENGINEER INFORMATION

Company : Kiowa Engineering Corp  
Name : Andrew McCord  
Colorado P.E. Number : 25057  
Mailing Address : 1604 South 21st Street, Colorado Springs, CO 80904-4208  
  
Phone Number : 719-630-7342  
FAX Number : 719-630-0406  
Email Address : [amccord@kiowaengineering.com](mailto:amccord@kiowaengineering.com)

### OWNER, APPLICANT, AND ENGINEER DECLARATION

To the best of my knowledge, the information on this application and all additional or supplemental documentation is true, factual and complete. I am fully aware that any misrepresentation of any information on this application may be grounds for denial. I have familiarized myself with the rules, regulations and procedures with respect to preparing and filing this application. I also understand that an incorrect submittal will be cause to have the project removed from the agenda of the Planning Commission, Board of County Commissioners and/or Board of Adjustment or delay review until corrections are made, and that any approval of this application is based on the representations made in the application and may be revoked on any breach of representation or condition(s) of approval.

Signature of owner (or authorized representative)

January 4th 2022

Date

Engineer's Seal, Signature  
And Date of Signature



**DEVIATION REQUEST** (Attach diagrams, figures, and other documentation to clarify request)

A deviation from the standards of or in Section **ECM 4.3.6.3** of the Engineering Criteria Manual (ECM) is requested.

Identify the specific ECM standard which a deviation is requested:

Minimum cover for storm sewer lines shall be 2 feet (2' measured perpendicularly to the finished road surface).

State the reason for the requested deviation:

Topographical Constraints were imposed on the original planned EDB by Public roadway improvements along Marksheffel Rd performed independently and without notice to the client or engineering team for Filing 11. This was done after preliminary grading approval, and the installation of a Temporary Sediment Control Basin which was provided as an interim facility. The adjacent public corridor was lifted several feet, including the side ditches which were the original discharge location for EDB 'D' of the approved Preliminary Grading & Erosion Control Agreement. As a result, the pipe system forebays and EDB had to be lifted 3 or 4 feet. This forced the lowest sections of the pipe system near the EDB to lie much closer to finish grade than originally planned. Also, over the interim period of original preliminary grading, a revised grading permit was submitted and approved which lifted much the overall site a foot or more. This helped the overall storm pipe system hydraulically, but those portions closest to the EDB would still require shallow cover of less than two feet to make a functional design.

Explain the proposed alternative and compare to the ECM standards (May provide applicable regional or national standards used as basis):

Proposing Alternate Storm Pipe (Class IV) at lower portions of the two main trunklines where topographic constraints limit the available depth of cover over storm pipe. The Criteria calls for Class II pipe typically, with 2' of cover. Depth of Cover in the design drawings is planned for some portions of the system to be at a depth of 1.1' in the worst instance to up to 1.8' (See attached Exhibits).

## LIMITS OF CONSIDERATION

(At least one of the conditions listed below must be met for this deviation request to be considered.)

- ☐ The ECM standard is inapplicable to the particular situation.
- ☒ Topography, right-of-way, or other geographical conditions or impediments impose an undue hardship and an equivalent alternative that can accomplish the same design objective is available and does not compromise public safety or accessibility.
- ☐ A change to a standard is required to address a specific design or construction problem, and if not modified, the standard will impose an undue hardship on the applicant with little or no material benefit to the public.

Provide justification:

Depth Adjustments Due to Public Improvement Project

US 24 Link Road Project impacted the subdivision's original outfall location such that several feet of outfall depth were no longer available for the site to use as a discharge point. At the time of the approved preliminary phase, the discharging channel and a temporary sediment basin were installed at the same location and depth as the planned EDB (Basin D).

The overall site was partially raised to improve pipe slopes as much as possible, and Class IV pipe is specified where granular cover, and street section can only provide between one to two feet of cover over Top Of Pipe (T.O.P.). The detention pond (EDB 'D') was reshaped and enlarged to partially accommodate this loss of depth. Minimal slopes were used at the outfall channel, outfall pipe, and at the trickle pan sections to partially accommodate the loss of depth. 6" Drops are still provided in design at both forebay inflow points, and the forebay designs meet all criteria.

See Attached Exhibits 'A' and 'B' for Class IV pipe locations planned with The Glen Filing 11 storm improvements.

## CRITERIA FOR APPROVAL

Per ECM section 5.8.7 the request for a deviation may be considered if the request is **not based exclusively on financial considerations**. The deviation must not be detrimental to public safety or surrounding property. The applicant must include supporting information demonstrating compliance with **all of the following criteria**:

The deviation will achieve the intended result with a comparable or superior design and quality of improvement.

Class IV Pipe will provide adequate structural integrity for the areas indicated as having less than two feet of cover material.

The pipes will meet AASHTO HS-20 Loading values.

Loads and Supporting Strength Tables with Geotechnical Engineer's Stamp is Attached as an appendix to this request.

The deviation will not adversely affect safety or operations.

There are no safety or operational impacts related to using Class IV pipe as an alternate.

The deviation will not adversely affect maintenance and its associated cost.

Class IV pipe does not create any additional maintenance concerns over Class III RCP.

The deviation will not adversely affect aesthetic appearance.

As the pipes are underground we anticipate no aesthetic concerns related to their use.

The deviation meets the design intent and purpose of the ECM standards.

The design intent is preserved by increasing the structural loading strength of pipes for the project where two feet of cover is not possible to attain.

The deviation meets the control measure requirements of Part I.E.3 and Part I.E.4 of the County's MS4 permit, as applicable.

Parts I.E.3 and I.E.4 of the MS4 Permit

The MS4 Permit Parts I.E.3 and I.E.4 are concerned with installation, erosion control, and ongoing maintenance of the subject improvements. We do not anticipate any additional measures beyond those planned within the current Erosion and Sedimentation Control Permitting and any updates made to the permit.

An Extended Detention basin (Basin D) is provided with Filing No 10 Construction, and enhanced with Filing 11 Construction as a permanent water quality facility.

**REVIEW AND RECOMMENDATION:**

**Approved by the ECM Administrator**

This request has been determined to have met the criteria for approval. A deviation from Section \_\_\_\_\_ of the ECM is hereby granted based on the justification provided.

┌

┐

└

┘

**Denied by the ECM Administrator**

This request has been determined not to have met criteria for approval. A deviation from Section \_\_\_\_\_ of the ECM is hereby denied.

┌

┐

└

┘

**ECM ADMINISTRATOR COMMENTS/CONDITIONS:**

--

## **1.1. PURPOSE**

The purpose of this resource is to provide a form for documenting the findings and decision by the ECM Administrator concerning a deviation request. The form is used to document the review and decision concerning a requested deviation. The request and decision concerning each deviation from a specific section of the ECM shall be recorded on a separate form.

## **1.2. BACKGROUND**

A deviation is a critical aspect of the review process and needs to be documented to ensure that the deviations granted are applied to a specific development application in conformance with the criteria for approval and that the action is documented as such requests can point to potential needed revisions to the ECM.

## **1.3. APPLICABLE STATUTES AND REGULATIONS**

Section 5.8 of the ECM establishes a mechanism whereby an engineering design standard can be modified when if strictly adhered to, would cause unnecessary hardship or unsafe design because of topographical or other conditions particular to the site, and that a departure may be made without destroying the intent of such provision.

## **1.4. APPLICABILITY**

All provisions of the ECM are subject to deviation by the ECM Administrator provided that one of the following conditions is met:

- The ECM standard is inapplicable to a particular situation.
- Topography, right-of-way, or other geographical conditions or impediments impose an undue hardship on the applicant, and an equivalent alternative that can accomplish the same design objective is available and does not compromise public safety or accessibility.
- A change to a standard is required to address a specific design or construction problem, and if not modified, the standard will impose an undue hardship on the applicant with little or no material benefit to the public.

## **1.5. TECHNICAL GUIDANCE**

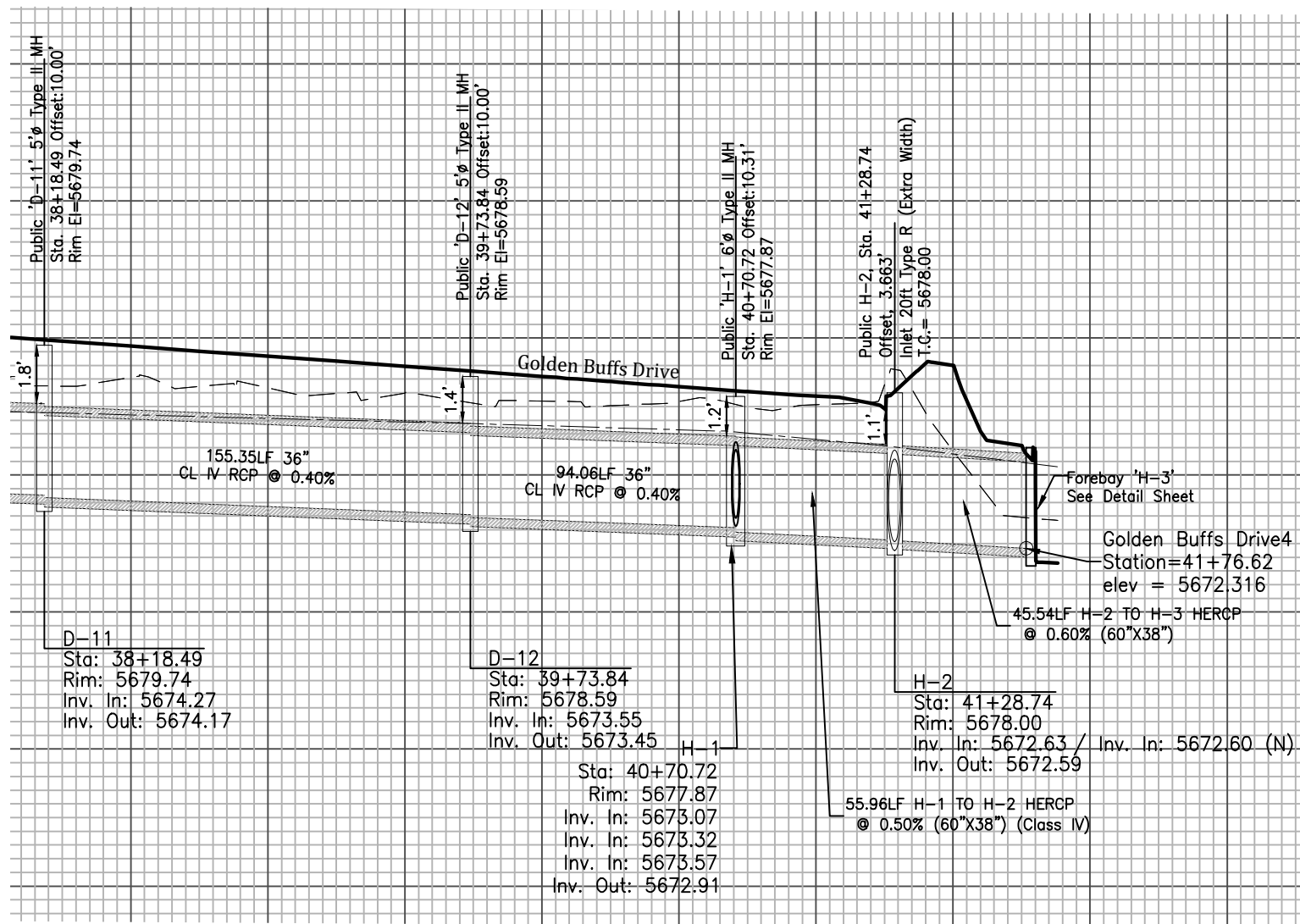
The review shall ensure all criteria for approval are adequately considered and that justification for the deviation is properly documented.

## **1.6. LIMITS OF APPROVAL**

Whether a request for deviation is approved as proposed or with conditions, the approval is for project-specific use and shall not constitute a precedent or general deviation from these Standards.

## **1.7. REVIEW FEES**

A Deviation Review Fee shall be paid in full at the time of submission of a request for deviation. The fee for Deviation Review shall be as determined by resolution of the BoCC.



DEVELOPER:

**W**  
WIDEFIELD  
Investment Group  
3 WIDEFIELD BOULEVARD  
COLORADO SPRINGS, CO 80911

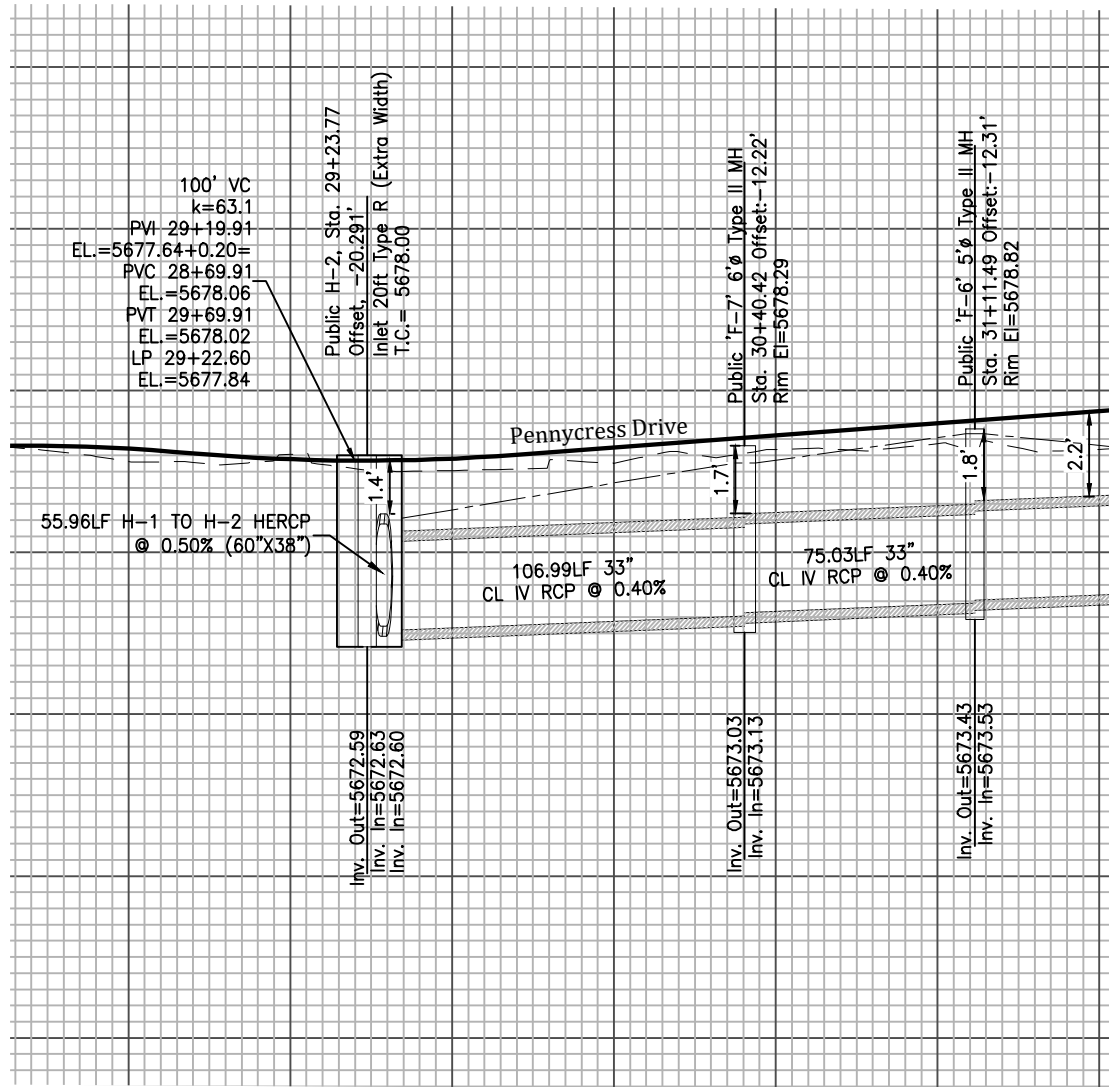
PREPARED BY:

**Kiowa**  
Engineering Corporation  
1604 South 21st Street  
Colorado Springs, Colorado 80904  
(719) 630-7342

## THE GLEN AT WIDEFIELD FILING NO 11 Shallow Storm Sewer (use Class IV RCP)

Kiowa Project No. 19016  
April 15, 2021

Exhibit 'A'



DEVELOPER:

**W**  
WIDEFIELD  
Investment Group  
3 WIDEFIELD BOULEVARD  
COLORADO SPRINGS, CO 80911

PREPARED BY:

**Kiowa**  
Engineering Corporation  
1604 South 21st Street  
Colorado Springs, Colorado 80904  
(719) 630-7342

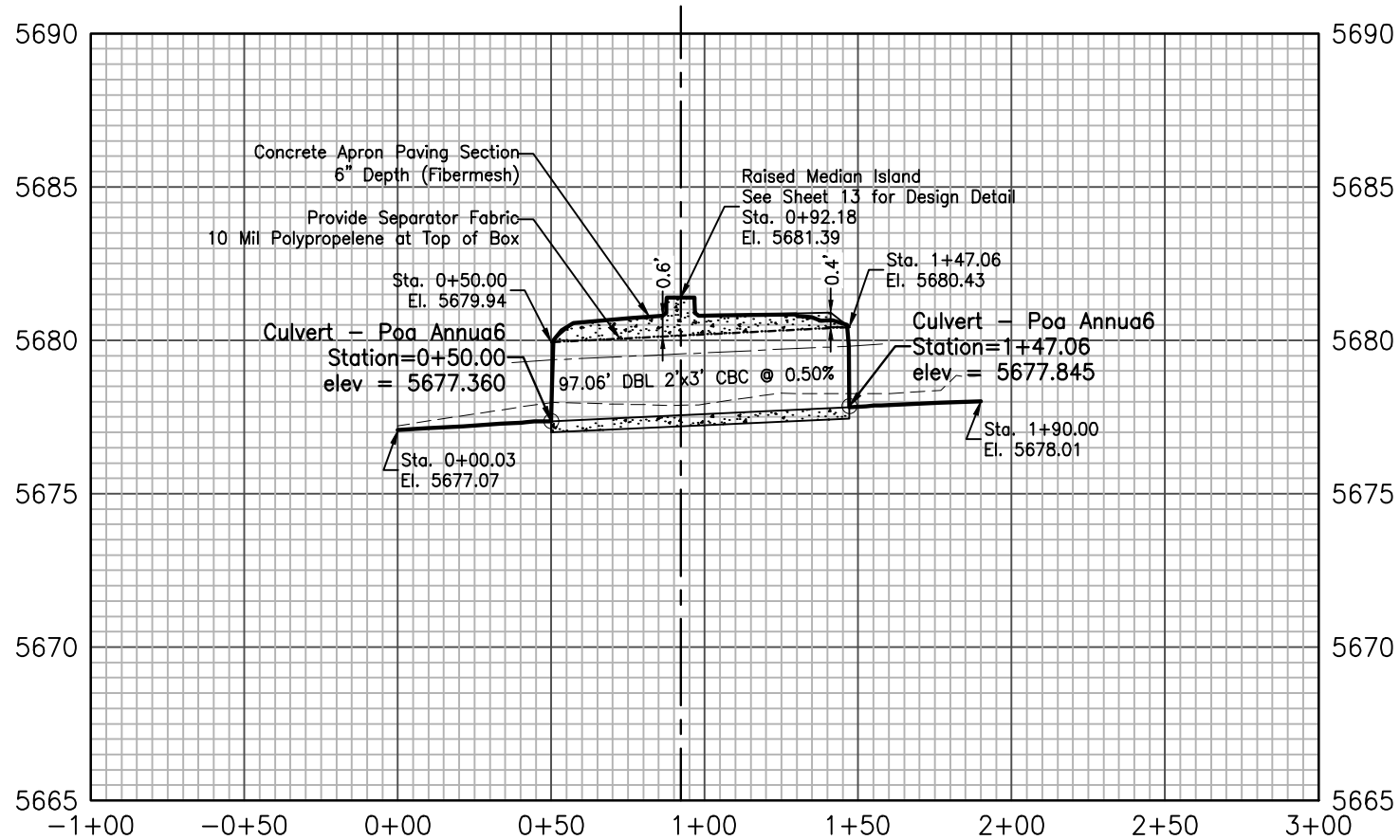
## THE GLEN AT WIDEFIELD FILING NO 11 Shallow Storm Sewer (use Class IV RCP)

Kiowa Project No. 19016  
April 15, 2021

Exhibit 'B'



# Culvert - Poa Annua



DEVELOPER:

**W**  
WIDEFIELD  
Investment Group  
3 WIDEFIELD BOULEVARD  
COLORADO SPRINGS, CO 80911

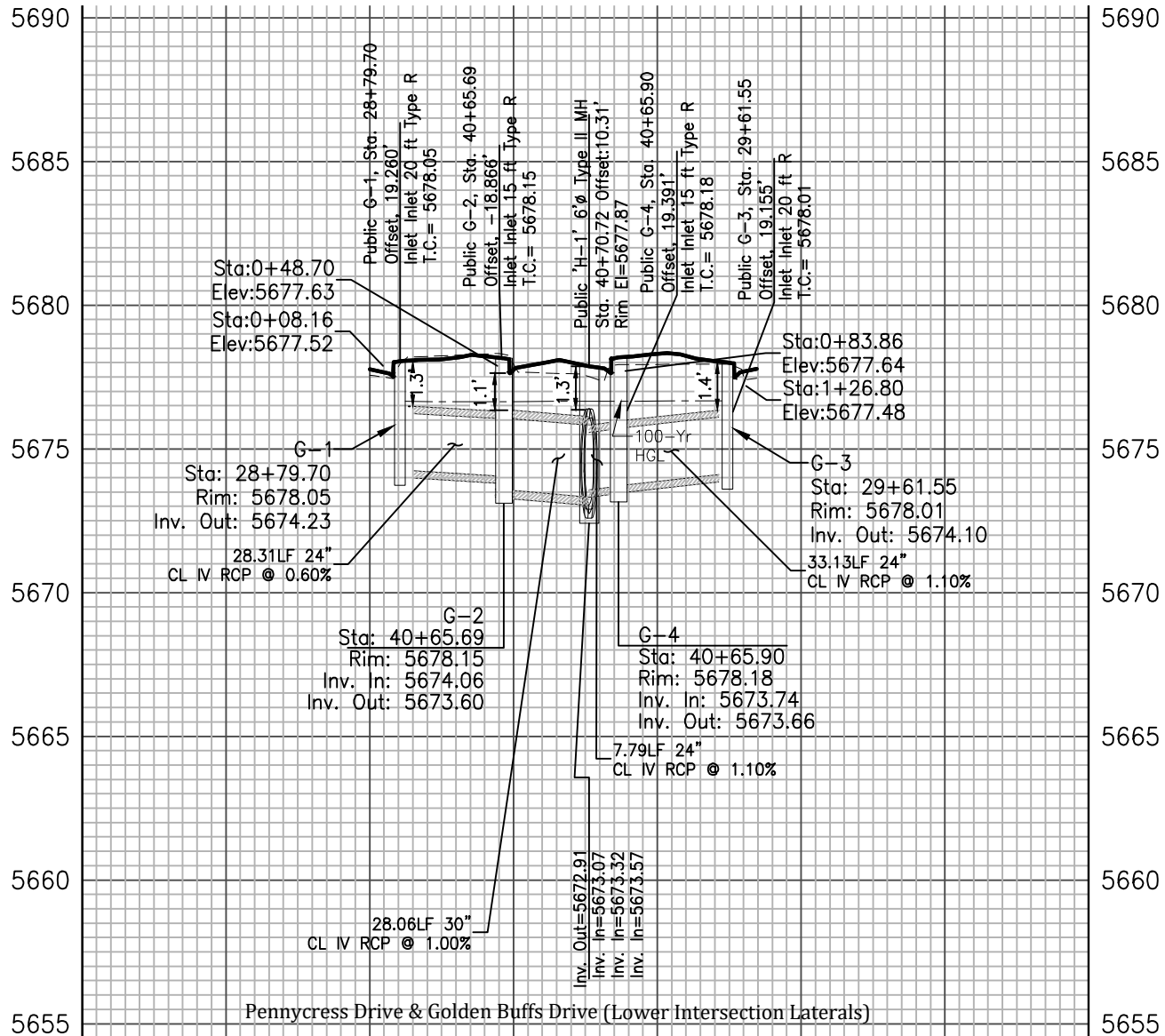
PREPARED BY:

**Kiowa**  
Engineering Corporation  
1604 South 21st Street  
Colorado Springs, Colorado 80904  
(719) 630-7342

THE GLEN AT WIDEFIELD FILING NO 11  
Shallow Cover Storm Sewer (at Box Culvert)

Kiowa Project No. 19016  
October 5, 2021

Exhibit 'D'



DEVELOPER:

**W**  
WIDEFIELD  
Investment Group  
3 WIDEFIELD BOULEVARD  
COLORADO SPRINGS, CO 80911

PREPARED BY:

**Kiowa**  
Engineering Corporation  
1604 South 21st Street  
Colorado Springs, Colorado 80904  
(719) 630-7342

## THE GLEN AT WIDEFIELD FILING NO 11 Shallow Storm Sewer (use Class IV RCP)

Kiowa Project No. 19016  
October 5, 2021

Exhibit 'C'

# VIVID Engineering Group, Inc.

---



1053 Elkton Drive, Colorado Springs, CO 80907

**September 21, 2021** (Rev.1-December 10, 2021)

Michael J. Kahnke  
Sr. Civil Engineering Technician  
Kiowa Engineering Corp.  
1604 South 21<sup>st</sup> Street  
Colorado Springs, CO 80904-4208  
[mkahnke@kiowaengineering.com](mailto:mkahnke@kiowaengineering.com)

**Subject: RCP Pipe Class Calculations (Shallow Pipe Cover Areas), Pennycress Drive (33 and 36 inch diam. Pipe) and Golden Bluffs Drive (24 inch diam. Pipe), The Glen at Widefield, Filing 11**

**VIVID Project No.: D21-2-440**

Attached are results of calculations and published tables indicating adequacy of use of 33 and or 36 inch diameter Class IV RCP below Pennycress Drive and 24 inch pipe below Golden Bluffs Drive, for areas of less than 2 feet of available cover. Should you have any questions concerning the attached information, please contact the undersigned at 719.896.4356.

**Sincerely,**

A handwritten signature in blue ink, "William J. Barreire", is written over a circular blue professional engineer seal. The seal contains the text "COLORADO REGISTERED", "WILLIAM J. BARREIRE", "32045", and "PROFESSIONAL ENGINEER". The date "12-10-2021" is stamped in the center of the seal.

William (Bill) J. Barreire, PE  
Senior Geotechnical Engineer

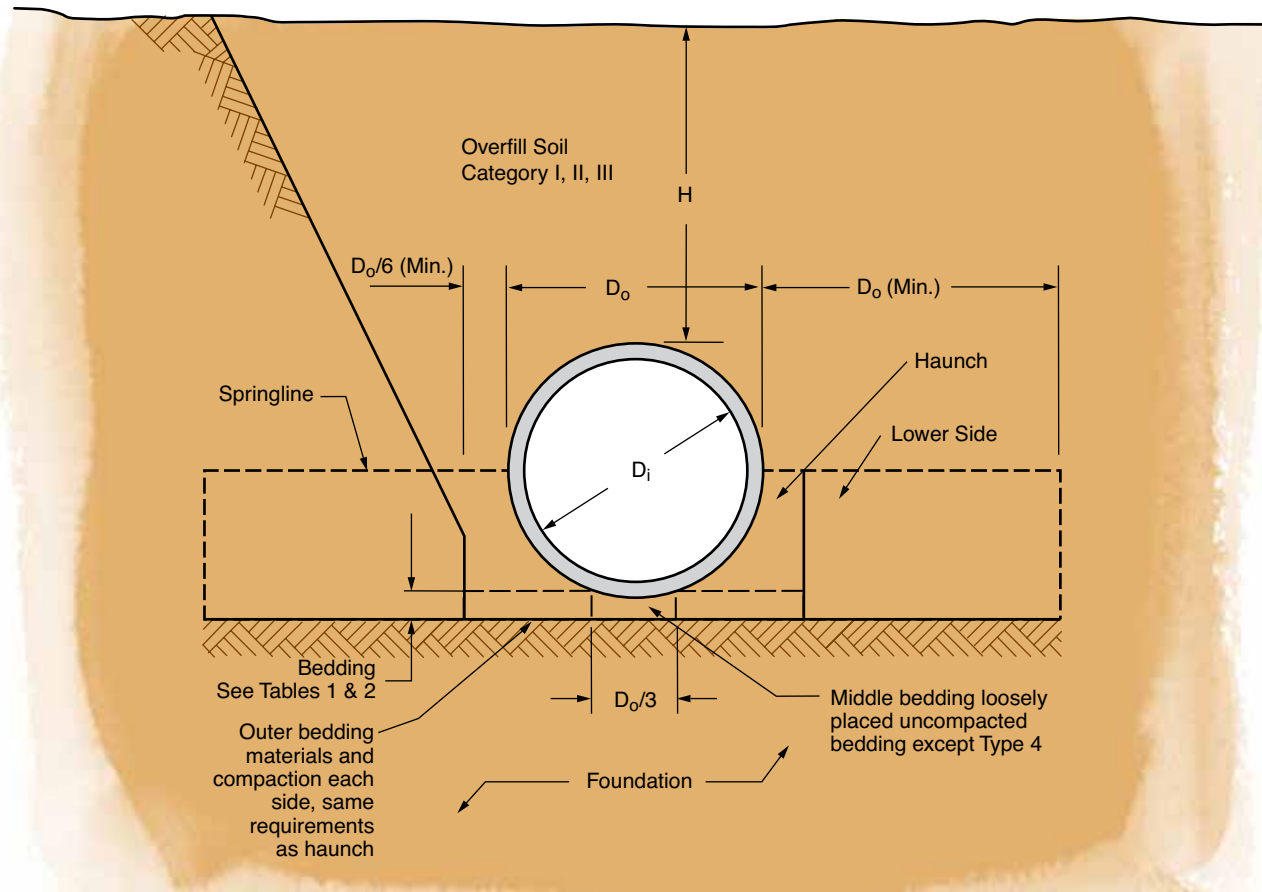
**FOR CONCRETE PIPE**

**LRFD FILL HEIGHT TABLES**



## Standard Trench/Embankment Installation

Concrete pipe should be installed in accordance with the AASHTO LRFD Bridge Construction Specifications, Section 27 or ASTM C1479. Figure 1 shows the basic pipe and soil terminology.



There are four types of Standard Installations, each with its own soil and compaction requirements. Type 1 bedding provides the most support using highly compacted granular material, while Type 4 provides for less support allowing the use of silts and clay soils with little or no compaction. These four choices provide flexibility and versatility for the designer and contractor, as well as performance and economy for the owner that are not available with other types of pipe.

The soil and compaction requirements are provided in Table 1. Table 2 shows the equivalent soil designations per the Unified Soil Classification System (USCS) and AASHTO.

To facilitate your selection of the proper reinforced concrete pipe using the most beneficial Standard Installation for the conditions at the site, fill height tables are provided on the following pages. The required 0.01 inch crack D-Loads in units of lbs per linear foot per foot of diameter are provided numerically and the class of pipe per ASTM C76 (AASHTO M 170) meeting this requirement is designated by color of the cell.

**Table 1: Standard Installation Soils and Minimum Compaction Requirements**

Installation Type	Bedding Thickness	Haunch and Outer Bedding	Lower Side
Type 1	D <sub>o</sub> /24 minimum, not less than 3" (75 mm) If rock foundation, use D <sub>o</sub> /12 minimum, not less than 6" (150 mm)	95% Category I	90% Category I, 95% Category II, or 100% Category III
Type 2	D <sub>o</sub> /24 minimum, not less than 3" (75 mm) If rock foundation, use D <sub>o</sub> /12 minimum, not less than 6" (150 mm)	90% Category I or 95% Category II	85% Category I, 90% Category II, or 95% Category III
Type 3	D <sub>o</sub> /24 minimum, not less than 3" (75 mm) If rock foundation, use D <sub>o</sub> /12 minimum, not less than 6" (150 mm)	85% Category I, 90% Category II, or 95% Category III	85% Category I, 90% Category II, or 95% Category III
Type 4	No bedding required except if rock foundation, use D <sub>o</sub> /12 minimum, not less than 6" (150 mm)	No compaction required, except if Category III, use 85%	No compaction required, except if Category III, use 85%

Reference: ASCE 15-98, "Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD)", 1998.

**Table 3: Reinforced Pipe Classes for 0.01 inch Crack Per ASTM C 76 (lbs/ft/ft)**

Class I	≤ 800
Class II	≤ 1000
Class III	≤ 1350
<b>Class IV</b>	<b>≤ 2000</b>
Class V	≤ 3000
Special Design	> 3000

**D-load Requirement for Class IV pipe**

**NOTES:**

1. Compaction and soil symbols – i.e. "95% Category I" refers to Category I soil material with a minimum Standard Proctor compaction of 95%. See Table 2 for equivalent Modified Proctor values.
2. Soil in the outer bedding, haunch, and lower side zones shall be compacted to at least the same compaction as the majority of soil in the overfill zone.

**Table 2: Equivalent USCS and AASHTO Soil Classifications for Standard Installation Soil Designations**

Representative Soil Types			Percent Compaction	
SIDD	USCS	AASHTO	Standard Proctor	Modified Proctor
Gravelly Sand (Category I)	SW, SP, GW, GP	A1, A3	100 95 90 85 80 61	95 90 85 80 75 59
Sandy Silt (Category II)	GM, SM, ML, Also GC, SC with less than 20% passing #200 sieve	A2, A4	100 95 90 85 80 49	95 90 85 80 75 46
Silty Clay (Category III)	CL, MH, GC, SC	A5, A6	100 95 90 85 80 45	90 85 80 75 70 40
Not Allowed for Haunch or Bedding	CH	A7	100 95 90 45	90 85 80 40

Reference: ASCE 15-98, "Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD)", 1998.



The following Fill Height Tables have been developed by the American Concrete Pipe Association (ACPA) using the indirect design method in accordance with Section 12.10.4.3 of the AASHTO LRFD Bridge Design Specification, 7th Edition, 2014.

**Fill Height Tables are based on:**

1.  $\gamma_s = 120$  pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A Type 1 installation requires greater soil stiffness from the surrounding soils than the Type 2, 3, and 4 installations, and is thus harder to achieve. Therefore, field verification of soil properties and compaction levels should be performed.

**D-Load (lb/ft/ft) for Type 1 Bedding**

Class I	Class IV
Class II	Class V
Class III	Special Design

Fill Height in Feet														
Pipe Size (in)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
12	1612	1399	888	695	633	620	635	661	544	603	662	721	780	839
15	1546	1344	856	673	614	602	617	644	532	589	646	704	761	818
18	1462	1307	836	660	604	593	608	634	526	583	639	696	752	809
21	1309	1281	823	653	598	588	604	630	525	581	637	693	749	805
24	1287	1262	814	648				629	527	583	638	694	750	805
27	1442	1264	815	653	599	591	608	634	530	586	642	697	753	809
30	1581	1272	819	660	605	598	615	640	535	591	646	702	758	814
33	1443	1222	798	651	599	596	615	641	541	597	653	709	765	821
36	1329	1187	780	643	595	595	616	643	547	603	660	716	772	829
42	1151	1099	745	627	587	591	613	641	553	609	665	721	778	834
48	1019	961	713	614	582	589	612	641	560	616	673	729	785	841
54	969	919	689	604	578	589	613	643	569	625	681	737	794	850
60	994	890	670	596	577	590	615	646	578	634	691	747	804	860
66	946	865	657	589	576	592	618	651	588	644	701	758	814	871
72	881	844	647	584	578	595	622	656	598	655	712	769	826	883
78	827	823	637	582	579	597	625	659	606	663	720	777	834	892
84	782	805	629	580	580	600	628	664	615	672	729	786	843	901
90	744	789	622	580	582	603	632	668	712	681	738	795	853	910
96	712	749	616	580	585	606	637	673	718	690	747	805	862	920
102	685	723	623	587	592	614	645	682	727	774	757	814	872	929
108	662	711	629	595	600	623	654	691	736	783	766	824	882	940
114	642	715	636	603	609	631	663	700	745	793	842	834	892	950
120	625	720	642	609	617	640	672	709	755	802	852	844	903	961
126	611	726	649	617	625	649	681	719	764	812	862	913	913	971
132	599	731	651	625	634	658	690	728	774	822	872	924	976	983
138	589	736	645	633	643	667	699	738	784	832	883	934	987	994
144	580	742	651	642	652	676	709	747	794	843	893	945	998	1052

Class III or IV Pipe

**Fill Height Tables are based on:**

1.  $\gamma_s = 120$  pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition -  
this gives conservative results in comparison to trench conditions

**D-Load (lb/ft/ft) for Type 2 Bedding**

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Fill Height in Feet														
Pipe Size (in)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
12	1492	1322	880	727	694	705	741	788	704	781	858	934	1011	1087
15	1434	1272	851	707	676	688	724	771	691	843	841	915	990	1065
18	1358	1240	834	697	668	680	717	763	688	837	835	909	983	1056
21	1220	1218	824	692	665	678	715	762	689	839	836	909	983	1056
24	1202	1203	818	690	Class III Pipe			764	694	844	841	915	988	1062
27	1344	1205	819	694	668	684	721	768	696	846	842	915	989	1062
30	1471	1213	823	701	674	690	727	773	699	850	845	919	992	1065
33	1347	1168	805	693	669	688	727	773	704	855	850	923	996	1069
36	1244	1137	789	687	665	687	728	775	710	861	856	929	1003	1076
42	1084	1059	759	673	659	685	726	773	715	867	861	933	1006	1079
48	966	935	732	663	655	684	726	774	722	874	867	940	1013	1085
54	923	899	712	655	654	685	728	777	731	884	876	948	1021	1094
60	948	875	696	650	654	688	731	781	740	894	885	958	1031	1103
66	906	855	687	646	655	691	736	787	750	906	896	969	1041	1114
72	850	837	679	643	658	696	741	793	761	918	907	980	1053	1126
78	802	820	672	642	660	697	744	796	768	925	913	986	1059	1131
84	763	805	665	641	661	700	747	799	775	932	920	993	1065	1138
90	730	791	660	641	664	703	750	803	863	940	927	999	1072	1144
96	703	756	655	642	666	706	754	807	867	948	934	1006	1078	1151
102	679	734	662	649	674	714	761	814	875	1019	941	1013	1086	1158
108	660	723	668	657	681	721	769	822	882	1027	949	1021	1093	1165
114	643	729	675	665	689	729	776	830	890	1036	1016	1028	1100	1172
120	629	734	682	670	697	737	784	837	898	1044	1024	1036	1108	1180
126	617	740	689	678	705	744	792	845	905	1053	1032	1097	1115	1187
132	607	745	691	686	712	752	800	853	913	1061	1039	1105	1171	1195
138	599	751	686	694	720	760	808	861	921	1070	1047	1112	1178	1203
144	592	757	692	701	728	768	816	869	929	1079	1055	1120	1186	1253



**Fill Height Tables are based on:**

1.  $\gamma_s = 120$  pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition -  
this gives conservative results in comparison to trench conditions

**D-Load (lb/ft/ft) for Type 3 Bedding**

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Fill Height in Feet														
Pipe Size (in)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
12	1518	1369	947	817	805	838	896	964	902	1000	1098	1196	1294	1392
15	1459	1318	916	794	783	815	872	939	880	975	1070	1165	1260	1355
18	1384	1285	897	781	772	804	860	926	870	963	1057	1150	1243	1337
21	1247	1263	886	775	767	799	855	921	867	959	1051	1144	1236	1329
24	1229	1248	879	772				920	868	960	1051	1143	1235	1327
27	1372	1251	881	778				925	872	963	1055	1147	1238	1330
30	1500	1260	887	786	777	812	868	933	878	970	1061	1153	1245	1337
33	1378	1218	871	780	775	813	871	936	886	978	1070	1162	1254	1345
36	1276	1189	857	776	774	815	875	941	895	987	1079	1172	1264	1356
42	1119	1113	829	765	770	815	875	942	903	995	1087	1179	1271	1363
48	1004	992	808	758	770	817	879	946	913	1005	1097	1189	1281	1373
54	963	958	791	753	771	822	884	953	926	1018	1109	1201	1293	1385
60	991	937	778	751	775	828	891	961	939	1031	1123	1216	1308	1400
66	952	920	772	751	779	835	900	970	954	1046	1138	1231	1323	1416
72	898	905	768	751	786	843	909	981	969	1062	1154	1247	1340	1433
78	853	890	762	752	790	847	913	985	977	1070	1162	1255	1348	1440
84	816	878	758	754	794	852	918	991	986	1079	1171	1263	1355	1448
90	786	866	755	756	798	857	924	996	1076	1088	1180	1272	1364	1456
96	760	833	753	759	803	862	930	1003	1083	1097	1189	1281	1373	1464
102	739	814	761	769	813	872	939	1012	1092	1174	1198	1290	1382	1473
108	722	805	770	778	822	882	949	1022	1102	1184	1208	1299	1391	1482
114	708	813	779	788	832	892	959	1032	1112	1194	1277	1309	1400	1492
120	696	821	788	796	842	902	969	1042	1121	1203	1287	1319	1410	1501
126	687	829	798	806	852	912	979	1052	1131	1213	1297	1382	1420	1511
132	679	837	802	816	863	922	989	1062	1141	1223	1307	1391	1477	1521
138	673	845	800	826	873	932	999	1072	1152	1233	1317	1401	1487	1531
144	669	853	808	837	883	943	1010	1082	1162	1244	1327	1411	1497	1583

**Fill Height Tables are based on:**

1.  $\gamma_s = 120$  pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition -  
this gives conservative results in comparison to trench conditions

**D-Load (lb/ft/ft) for Type 4 Bedding**

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Fill Height in Feet														
Pipe Size (in)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
12	1579	1481	1111	1032	1071	1154	1264	1383	1372	1521	1671	1820	1969	2119
15	1519	1426	1073	998	1036	1116	1221	1336	1326	1616	1612	1756	1899	2042
18	1443	1391	1050	978	1015	1093	1195	1307	1297	1580	1576	1715	1854	1994
21	1306	1366	1035	966	994	1070	1168	1288	1279	1557	1552	1688	1825	1961
24	1288	1349	1025	959	994	1070	1168	1276	1267	1541	1535	1670	1804	1938
27	1431	1352	1025	960	993	1068	1165	1271	1259	1531	1524	1657	1790	1922
30	1560	1360	1029	965	995	1070	1166	1270	1254	1524	1517	1648	1780	1911
33	1437	1316	1010	955	988	1064	1160	1264	1252	1520	1512	1642	1773	1903
36	1336	1285	993	947	982	1060	1157	1260	1251	1518	1509	1639	1768	1898
42	1181	1211	966	935	976	1057	1153	1256	1252	1518	1508	1636	1764	1892
48	1068	1090	941	927	973	1056	1152	1255	1257	1522	1511	1638	1765	1892
54	1029	1058	925	921	973	1058	1154	1257	1264	1529	1516	1642	1768	1894
60	1059	1038	912	918	975	1062	1158	1261	1273	1538	1523	1649	1774	1899
66	1021	1022	906	917	978	1066	1163	1266	1282	1548	1532	1657	1781	1906
72	969	1008	902	917	984	1072	1169	1272	1292	1559	1541	1666	1790	1914
78	927	996	899	920	990	1079	1176	1280	1303	1570	1551	1675	1799	1923
84	893	986	898	925	997	1086	1184	1288	1315	1582	1562	1686	1810	1933
90	866	978	898	931	1004	1094	1192	1296	1408	1595	1574	1697	1820	1944
96	844	948	899	936	1012	1102	1201	1305	1417	1608	1585	1708	1831	1955
102	826	932	911	949	1024	1115	1214	1318	1429	1685	1597	1720	1843	1966
108	812	927	923	962	1037	1128	1226	1330	1441	1698	1609	1732	1855	1978
114	801	938	935	975	1050	1141	1239	1343	1454	1712	1682	1745	1867	1990
120	793	949	947	986	1063	1154	1252	1356	1467	1726	1694	1757	1879	2002
126	786	960	959	999	1076	1167	1265	1369	1480	1740	1707	1823	1892	2014
132	782	971	967	1013	1090	1180	1278	1382	1493	1754	1720	1836	1952	2027
138	779	982	968	1026	1103	1194	1292	1395	1506	1769	1733	1848	1965	2040
144	778	994	980	1039	1116	1207	1305	1409	1519	1783	1746	1861	1978	2095