FINAL DRAINAGE REPORT
FOR

McDOWELL MOUNTAIN MARKETPLACE

PREPARED FOR

McDOWELL MOUNTAIN MARKETPLACE, LLLP
6900 EAST 2ND STREET
SCOTTSDALE, ARIZONA 85251

PREPARED BY

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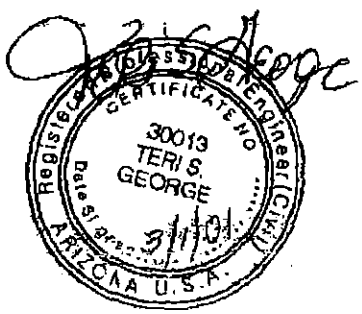

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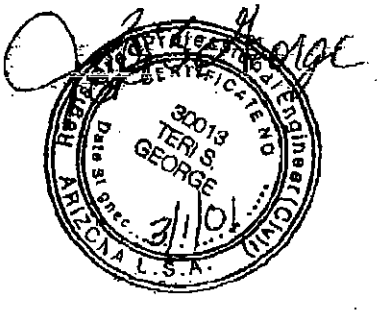

1.0 INTRODUCTION

This Final Drainage Report has been prepared under a contract from McDowell Mountain Marketplace, LLLP, Owner/Developer of the proposed commercial project at the southwest corner of Bell Road and Thompson Peak Parkway. This site will be part of the McDowell Mountain Ranch Master Planned Community. The purpose of this report is to provide the hydrologic and hydraulic analyses, required by the City of Scottsdale, to support the commercial lot development. Preparation of this report has been done in accordance with the procedures detailed in the City of Scottsdale's *Design Standards and Policies Manual, Chapter 2* (Reference 1).

The project site is located in the City of Scottsdale, in the northern portion of Section 5, Township 3 North, Range 5 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. More specifically, the site is located in Parcel R of the McDowell Mountain Ranch Master Planned Community and is bounded by Thompson Peak Parkway on the east, Bell Road on the north and a residential development on the south. With the development of this project and the site on the south, 100th Street will be built along the western project boundary. Access to the site will be provided along 100th Street, Thompson Peak Parkway and Bell Road. Figure 1, located in Appendix A, illustrates the location of the project site in relation to the City of Scottsdale's street system.

2.0 EXISTING DRAINAGE CONDITIONS

The proposed project site is a 17 acre undeveloped parcel, currently vacant, with significant native vegetation. The site has a general slope to the southwest of about 4.0 percent. Several natural drainage corridors transport offsite runoff through the project site.

As part of the McDowell Mountain Ranch Master Planned Community, storm water drainage is addressed in the *Master Drainage Report for McDowell Mountain Ranch Parcels "A" – "R"* prepared by Clouse Engineering (Reference 2). In its undeveloped condition, runoff generated upstream of the project site is conveyed through the project site by the historic drainage corridors. This runoff is conveyed onto the project site via five 30" concrete pipes under Bell Road.

The flood hazard zones determined in the area were derived from the *Scottsdale Area Drainage Master Study* prepared by Boyle Engineering Corp. (Reference 3). The study determines the ponding elevations caused by the canals and other obstructions in the area. The current published FEMA Flood Insurance Rate Map (FIRM) for this area, map number 04013C1265 E (Effective date December 3, 1993), shows the project site is entirely within flood hazard Zone X. Zone X is defined as "Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood". A copy of the FIRM is located in Appendix B.

3.0 PROPOSED DRAINAGE CONCEPT

The proposed drainage concept is presented in three parts: on-site drainage conveyance, off-site drainage conveyance, and on-site storm water retention. The hydrologic analysis is summarized in section 4.0 and the hydraulic analysis is summarized in section 5.0. See Exhibit A, located in the back pocket, for graphical illustration of the proposed drainage concept.

3.1 On-site Drainage Conveyance

The on-site drainage area is divided into 16 sub-basins. Runoff from these areas will enter the historic drainage corridors downstream via catch basins and storm drain. Curb openings will also be utilized to route flow from paved parking areas to the historic drainage corridors. Roof drains will be utilized to route flow to the paved parking areas and into the storm drain system.

3.2 Off-site Drainage Conveyance

Off-site drainage conveyance is addressed in the McDowell Mountain Ranch Master Drainage Report. Runoff from the off-site watershed to the north and east is routed through and around the project site via culvert crossings under Bell Road. Runoff crossing Bell Road east of Thompson Peak Parkway is diverted south along the east side of Thompson Peak Parkway. Runoff crossing Bell Road along the project's northern boundary is routed on-site via five 30" concrete pipes under Bell Road. This runoff, approximately 121 cfs, will be routed through the site by the storm drain system, and returned to its historic drainage corridor, Wash "G".

Runoff generated along Thompson Peak Parkway flows to the south away from the project site. Runoff generated along Bell Road flows west and is intercepted by catch basins approximately 950 feet west of Thompson Peak. These catch basins are on-grade, and therefore only intercept approximately 6.6 cfs of the total 24.5 cfs at that point according to *Basis of Design Report for Bell Road Improvement District #I3704* prepared by Kaminski-Hubbard Engineering (Reference 4). The intercepted flow will be routed through the project site via storm drain system to Wash "G". Flowby continues west down Bell Road away from the project site. Runoff generated along the 100th Street half street adjacent to the project will be routed to Wash "G" by catch basin. The condominium project directly south of McDowell Mountain Marketplace is routing approximately 14.6 cfs to Wash "G" by way of an existing wash corridor along the southern property line. This flow is addressed in the *Cachet at McDowell Mountain Ranch, Phase II* report by Rick Engineering (Reference 5).

3.3 On-site Storm Water Retention

The City of Scottsdale has waived retention requirements if the post-developed runoff from the site does not exceed the pre-developed historic runoff rate entering Wash "G", and runoff has been included in a storage facility downstream. According to the McDowell Mountain Ranch Master Drainage Report, the pre-development 100-year runoff entering Wash "G" immediately downstream of the project site totals 282 cfs. This includes 230 cfs from the off-site watershed and 52 cfs generated within the project boundaries. In post-development condition, 109 cfs from off-site is diverted down Thompson Peak Parkway with 121 cfs routed through the project site. Post-development on-site runoff is approximately 142 cfs. This includes 14.6 cfs from the development directly south of McDowell Mountain Marketplace. Thus, runoff entering Wash "G" has been decreased by approximately 19 cfs. Furthermore, historic runoff from Wash "G" has been included in the Bureau of Reclamation retention area behind the Central Arizona Project dike downstream.

4.0 HYDROLOGIC ANALYSIS

The hydrologic analysis for this study has been prepared in accordance with the City of Scottsdale's *Design Standards and Policies Manual, Chapter 2.* Peak flows for the site were computed using the Rational Method. Time of concentration was calculated using the velocities from Figure 2.2-14. The intensities were then determined from the I-D-F curves, included in Appendix C. The following establishes the Rational Method equation and the basic input data required:

$$Tc = (L/V)/60$$
$$Q = C_{wt}IA$$

Where:

Q = Peak Flow (cfs)
C_{wt} = weighted runoff coefficient relating runoff to rainfall
I = average rainfall intensity in inches/hour, lasting for T_c
A = the contributing drainage area in acres (from Exhibit A)
T_c = time of concentration (min.)
L = drainage length (ft.)
V = minimum velocity of stormwater in street flowing at curb height (fps)

A weighted C coefficient was used for each sub-basin. The weighted C value was determined by using a 100-year C coefficient of 0.95 for paved areas and 0.31 for NAOS areas.

A summary of peak flows for the 10-year (Q_{10}), 50-year (Q_{50}), and 100-year storm (Q_{100}) events is shown below in Table 4.1. Appendix C contains the detailed calculation sheets that establish the input data and estimated peak flow values for drainage areas.

SUMMARY OF PEAK FLOWS
Table 4.1

Sub-basin Designation	Q_{10} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)	Sub-basin Designation	Q_{10} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
1	3.3	5.2	6.2	9	0.4	0.6	0.7
2	2.7	4.3	5.1	10	9.6	15.3	18.1
3	3.7	5.9	7.0	11	0.5	0.7	0.9
4	6.1	9.7	11.4	12	6.1	9.7	11.5
5	8.6	13.7	16.2	13	6.0	9.6	11.3
6	5.1	8.2	9.7	14	2.0	3.2	3.8
7	7.6	12.2	14.4	15	1.9	3.1	3.7
8	4.8	7.6	9.0	16	1.0	1.6	1.8

5.0 HYDRAULIC ANALYSIS

The hydraulic analyses of the proposed storm water management facilities have been completed according to the City of Scottsdale's *Design Standards and Policies Manual, Chapter 2* and the *Drainage Design Manual for Maricopa County, Arizona, Volume II* (Reference 6).

Haestad Method's FlowMaster computer program (Reference 7) was used to analyze the flow depth for runoff generated along 100th Street. FlowMaster uses Manning's equation to establish flow depths for a user defined channel section. Flow depth along 100th Street was determined to be approximately 0.28 feet for the 100-year storm event. Detailed calculation and data sheets are included in Appendix D.

The on-site catch basins were sized using the weir and orifice equations with a 50% clogging factor. Flow depth at the grate inlets was analyzed using both equations. The analysis resulting in the greater flow depth was used for the water surface elevation determination. Detailed calculation and data sheets are included in Appendix D.

The HEC-12 computer software program by SMF Engineering (Reference 8) was utilized to size the off-site catch basin on 100th Street. The opening was sized to intercept the 100-year peak discharge. The water depths calculated by the HEC-12 program include the 2 inch gutter depression for the sump condition. Table 5.1 summarizes inlet type and size along with water surface elevations at each inlet. Detailed calculation and data sheets are located in Appendix D.

Summary of Inlet Type & Size
Table 5.1

Concentration Point	Catch Basin Type	Gutter Rim Elev. (ft)	10-yr Depth (ft)	100-yr Depth (ft)	10-yr WS Elev. (ft)	100-yr WS Elev. (ft)
1	COP 1569-1/3' Wing	1587.73	0.27	0.41	1587.83	1587.97
2	MAG 535-'F'	1600.00	0.33	0.51	1600.33	1600.51
3	MAG 535-'F'	1596.85	0.41	0.63	1597.26	1597.48
5	MAG 535-'F'	1598.90	0.72	1.24	1599.62	1600.14
6	MAG 535-'F'	1599.87	0.51	0.78	1600.38	1600.65
7	MAG 535-'F'	1599.05	0.67	1.02	1599.72	1600.07
10	MAG 535-'F'	1605.20	0.78	1.54	1605.98	1606.74
15	MAG 535-'F'	1588.50	0.26	0.41	1588.76	1588.91
16	MAG 535-'F'	1596.75	0.17	0.25	1596.92	1597.00

* All catch basins are in sump condition.

The storm drain system was sized using Haestad Method's StormCad computer program (Reference 9). The storm drain system was sized to convey the 10-year flow with the hydraulic grade line at least 0.5 feet below any rim or gutter elevation. The 100-year flow was also analyzed to ensure the hydraulic grade line remains below the ponding elevation at the inlets. The storm drain system conveying the off-site flow from north of Bell Road through the site was sized for the 100-year storm event. The condominium site to the south of McDowell Mountain Marketplace provided a stub to an existing storm drain system to drain the southeast corner of the

project site. This system was also analyzed to ensure adequate capacity. Detailed calculation and data sheets are included in Appendix D.

FlowMaster was used to establish the minimum criteria for the small channel connecting the culvert outlet under Bell Road and the culvert entrance for the storm drain that will convey this flow through the project site. It was determined that the channel must be at least 4.5 feet in depth with 3:1 side slopes. Furthermore, the channel must be approximately 25 feet wide with at least a 2% longitudinal slope. These parameters were established based on a natural channel.

Flow depth at the culvert entrance downstream of the channel was established by analyzing the weir depth into the drop structure. Haestad Method's CulvertMaster computer program (Reference 10) was used to perform this analysis. This program uses the broad crested weir equation to establish weir depths. The flow depth at the culvert entrance was found to be 3.61 feet above the weir into the drop structure for the 100-year storm event. The weir depth was used to establish minimum channel depth allowing at least 0.5 feet of freeboard for the 100-year storm event. Using StormCad, the water surface elevation at the culvert entrance within the drop structure was determined to be 1597.93 for the 100-year storm event. Detailed calcualtion and data sheets are included in Appendix D.

CulvertMaster was also used to analyze the culvert at the southwest corner of the project site. The existing CMP culverts will be extended with the 100th Street improvements. CulvertMaster was used to establish the head water depth at the inlet, and to ensure sufficient capacity to convey the required flow. Headloss at the bend/manhole was also taken into consideration while establishing the headwater depth. The head water depth was determined to be 1587.70. This head water depth was then used as the downstream condition for the analyses to determine if the upstream wash can convey the required flow. The Army Corps of Engineer's HEC-RAS (Reference 11) computer program was used for these analyses. Flow entering the channel includes 14.6 cfs from the condominium site to the south, and 16.6 cfs (Sub-basins 8, 9, 11 and 13) from McDowell Mountain Marketplace for the 100-year storm event. Pre-development flow entering this wash from the project site totaled approximately 11.3 cfs for the 100-year storm event. Detailed calculation and data sheets are included in Appendix D and E. HEC-RAS cross section locations are shown on Exhibit A, located in the back pocket.

6.0 CONCLUSIONS

Based on the results of this study, it can be concluded that:

- The site can be developed in accordance with City of Scottsdale's *Design Standards and Policies Manual, Chapter 2.*
- The site can be developed such that the prerequisites for waived retention can be met.
- The finish floor elevations are set a minimum 12 inches above the 100-year water surface elevation.

7.0 REFERENCES

1) City of Scottsdale's *Design Standards and Policies Manual, Chapter 2*, July, 1996
2) *Master Drainage Report for McDowell Mountain Ranch Parcels "A" – "R"*, Clouse Engineering, November 1993.
3) *Scottsdale Area Drainage Master Study* prepared by Boyle Engineering Corp., December, 1986
4) *Basis of Design Report for Bell Road Improvement District #13704*, Kaminski-Hubbard Engineering, December 1993.
5) *Cachet at McDowell Mountain Ranch, Phase 2*, Rick Engineering, March 2000.
6) *Drainage Design Manual for Maricopa County, Arizona, Volume II*, January 1996.
7) Haestad Methods FlowMaster PE, Version 6.0
8) SMF (Scott, Meyer, Ferguson) Pavement Drainage Program, HEC-12, Version 2.11
9) Haestad Method's StormCad, Version 4.1.1
10) Haestad Methods CulvertMaster version 1.0
11) U.S. Army Corps of Engineer's HEC-RAS, Version 2.2