

# Reproducible Science Project

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# Chapter 1

## Introduction

This book is the final project for WILD6900. The book contains work and data from my MS thesis on post-fire debris flows.



## Chapter 2

# Create Database

This document will create a database for my MS Research Data.

The database will follow the following structure:

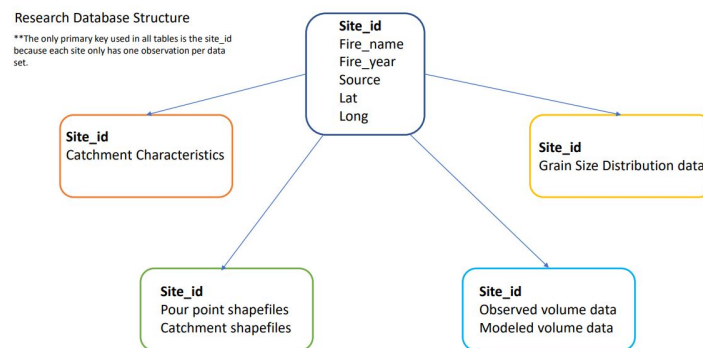


Figure 2.1: Database Structure

The data in this database is compiled from primary fieldwork and from data found in the literature. For each post-fire debris flow characterized, location, grain size, volume, and catchment characteristics are provided. Each debris flow fan is characterized once and therefore the site\_id for each fan is used as the Primary Key in all data sets in the database.

## 2.1 Step 1. Load packages and connect to the SQL database

```
# Load packages ####
```

```
library(DBI)  
library(RSQLite)
```

```
## Warning: package 'RSQLite' was built under R version 4.0.3
```

```
library(rlang)
```

```
## Warning: package 'rlang' was built under R version 4.0.3
```

```
# Establish database connection ####
```

```
debrisflow_db <- dbConnect(drv = RSQLite::SQLite(), "database/MS_research_db.db")
```

## 2.2 Step 2. Create DF\_Locations Table

```
dbExecute(debrisflow_db, "CREATE TABLE DF_locations (  
  Site_id varchar(50),  
  Fire varchar(50),  
  fire_year varchar(5),  
  Source varchar(50),  
  year_surveyed varchar(5),  
  Lat double,  
  long double, PRIMARY KEY (Site_id));  
")
```

```
DF_locations <- read.csv("DF_locations.csv", header = TRUE, stringsAsFactors = FALSE)
```

```
names(DF_locations)
```

```
dbWriteTable(debrisflow_db, "DF_locations", DF_locations, append= TRUE)
```

```
#Check table
```

```
dbGetQuery(debrisflow_db, "SELECT * FROM DF_locations LIMIT 10;")
```



### 2.3. STEP 3. CREATE CATCHMENT CHARACTERISTICS TABLE 9

##	Site_id	Fire	fire_year	Source	year_surveyed
## 1	Brianhead 1	Brianhead	2017 Primary Fieldwork		2020
## 2	Brianhead 2	Brianhead	2017 Primary Fieldwork		2020
## 3	Brianhead 3	Brianhead	2017 Primary Fieldwork		2020
## 4	Brianhead 3.2	Brianhead	2017 Primary Fieldwork		2020
## 5	Brianhead 4	Brianhead	2017 Primary Fieldwork		2020
## 6	Clay Springs 1	Clay Springs Fire	2012 Primary Fieldwork		2020
## 7	Clay Springs 2	Clay Springs Fire	2012 Primary Fieldwork		2020
## 8	Dairy Fork 1	Coal Hollow Fire	2018 Primary Fieldwork		2020
## 9	Dairy Fork 2	Coal Hollow Fire	2018 Primary Fieldwork		2020
## 10	Dollar Ridge 1	Dollar Ridge Fire	2018 Primary Fieldwork		2020
##	Lat	long			
## 1	37.74776	-112.7887			
## 2	37.74148	-112.7932			
## 3	37.72436	-112.7062			
## 4	NA	NA			
## 5	37.75856	-112.7941			
## 6	39.35653	-112.1648			
## 7	39.33334	-112.1507			
## 8	39.95080	-111.3493			
## 9	39.95397	-111.3477			
## 10	40.12092	-110.7446			

### 2.3 Step 3. Create Catchment Characteristics Table

```
dbExecute(debrisflow_db, "CREATE TABLE catchments (
    Site_id varchar(50),
    cat_area float,
    relief float,
    mean_cat_elev float,
    himod_perc float,
    himod_area float,
    slope23_perc float,
    sort_unsort char(10),
    clast_matrix char(10),
    strat char(10),
    boulder_perc float,
    dom_lith char(20),
    Lith_type char(20),
    X2yr_storm float,
    X100yr_storm float,
    Al203Ws float, Ca0Ws float, Fe203Ws float, K20Ws float, Mg0Ws float,
```

```

Na2OWs float, NWs float, P2O5Ws float, SiO2Ws float,
PctAlluvCoastWs float,
PctEolFineWs float, PctCarbResidWs float, PctNonCarbResidWs float,
PctSilicicWs float, CompStrgthWs float, Hydr1CondWs float,
AvgWetIndxWs float, ClayWs float, AgKffactWs float, PermWs float,
RckdepWs float, OmWs float, SandWs float, PctBl2011Ws float,
PctConif2011Ws float,
PctDecid2011Ws float, PctGrs2011Ws float, PctHay2011Ws float,
PctHbWet2011Ws float, PctMxFst2011Ws float, PctShrb2011Ws float,
Precip8110Ws float, RunoffWs float, Tmean8110Ws float, WtDepWs float

PRIMARY KEY (Site_id));
")

catchments <- read.csv("catchments.csv", header = TRUE, stringsAsFactors = FALSE)

names(catchments)

dbWriteTable(debrisflow_db, "catchments", catchments, append= TRUE)

#Check table
dbGetQuery(debrisflow_db, "SELECT * FROM catchments LIMIT 10;")

```

```

##          Site_id cat_area relief mean_cat_elev himod_perc himod_area
## 1    Brianhead 1      0.36   305          2631         54      0.19
## 2    Brianhead 2      2.98   744          2924         45      1.34
## 3    Brianhead 3      0.62   276          2832         81      0.50
## 4    Brianhead 3.2    0.62   276          2832         81      0.50
## 5    Brianhead 4      2.10   473          2575          8      0.17
## 6    Clay Springs 1    4.01   901          2269         36      1.44
## 7    Clay Springs 2    2.07  1029          2154          7      0.14
## 8    Dairy Fork 1     2.12   583          2141         63      1.34
## 9    Dairy Fork 2     1.01   309          1993         48      0.48
## 10   Dollar Ridge 1    0.15   225          2054         17      0.03
##      slope23_perc sort_unsort clast_matrix          strat boulder_perc GSD_Q
## 1          15.5   unsorted      clast not stratified         10      4
## 2          14.0   unsorted      matrix not stratified          5      5
## 3          13.0    sorted      matrix   stratified         10      4
## 4          13.0                   NA              NA
## 5          54.0   unsorted      matrix not stratified          3      4
## 6          65.0   unsorted      clast not stratified          5      4
## 7          56.0   unsorted      clast not stratified          3      3
## 8           5.0    sorted      matrix not stratified          5      3
## 9           3.0   unsorted      matrix not stratified          2      4
## 10         26.0    sorted      matrix not stratified         10      4

```

## 2.3. STEP 3. CREATE CATCHMENT CHARACTERISTICS TABLE 11

##	Vol_Q	dom_lith	Lith_type	X2yr_storm	X100yr_storm	Al203Ws	CaOWs	Fe203Ws
## 1	4	volcanic	igneous	5.09	15.48	12.23	9.80	4.82
## 2	5	volcanic	igneous	5.33	16.07	11.88	10.54	4.70
## 3	4	volcanic	igneous	4.92	15.10	14.86	3.73	5.62
## 4	NA	volcanic	igneous	4.92	15.10	NA	NA	NA
## 5	3	Limestone	sedimentary	4.63	14.33	9.45	15.46	3.85
## 6	3	Limestone	sedimentary	3.28	10.18	10.56	4.92	8.33
## 7	2	Limestone	sedimentary	3.15	9.93	10.56	4.92	8.33
## 8	3	mudstone	sedimentary	3.35	10.77	6.91	17.10	2.57
## 9	2	mudstone	sedimentary	3.33	10.71	6.57	18.32	2.50
## 10	3	sandstone	sedimentary	2.75	9.20	6.80	18.60	2.63
##	K2OWs	MgOWs	Na2OWs	NWs	P2O5Ws	SiO2Ws	PctAlluvCoastWs	PctEolFineWs
## 1	2.63	2.53	2.74	0.03	0.16	55.38075	0.00	0
## 2	2.57	2.57	2.63	0.04	0.16	54.27291	0.00	0
## 3	3.17	2.03	3.60	0.03	0.18	64.69118	0.00	0
## 4	NA	NA	NA	NA	NA	NA	NA	NA
## 5	2.16	3.04	1.84	0.04	0.14	46.56477	0.00	0
## 6	2.15	2.41	1.05	0.17	0.14	54.65962	64.51	0
## 7	2.15	2.41	1.05	0.17	0.14	54.65962	64.51	0
## 8	1.54	3.12	0.93	0.12	0.18	41.36917	0.00	0
## 9	1.54	3.59	0.90	0.11	0.18	39.28827	0.00	0
## 10	1.53	3.51	1.02	0.11	0.19	39.05255	0.02	0
##	PctCarbResidWs	PctNonCarbResidWs	PctSilicicWs	CompStrgthWs	HydrlCondWs			
## 1	0.00	28.13	71.87	70.24	0.03			
## 2	0.00	13.77	86.23	70.42	0.03			
## 3	0.00	0.00	100.00	72.66	0.04			
## 4	NA	NA	NA	NA	NA			
## 5	0.00	45.32	54.68	71.26	0.03			
## 6	12.08	23.41	0.00	30.00	3.77			
## 7	12.08	23.41	0.00	30.00	3.77			
## 8	0.00	100.00	0.00	76.74	0.02			
## 9	0.00	100.00	0.00	77.29	0.03			
## 10	0.00	99.98	0.00	79.03	0.02			
##	AvgWetIndxWs	ClayWs	AgKffactWs	PermWs	RckdepWs	OmWs	SandWs	PctBl2011Ws
## 1	310.24	34.97	0	1.21	147.05	0.76	22.76	1.09
## 2	317.89	31.03	0	2.51	145.97	0.64	28.55	4.62
## 3	349.50	35.00	0	1.20	147.06	0.76	22.57	0.04
## 4	NA	NA	NA	NA	NA	NA	NA	NA
## 5	300.02	32.94	0	1.88	146.50	0.70	25.67	4.26
## 6	431.81	20.43	0	6.93	123.86	0.93	37.31	0.39
## 7	431.81	20.43	0	6.93	123.86	0.93	37.31	0.39
## 8	338.03	22.87	0	4.70	108.43	0.56	38.65	0.00
## 9	296.74	22.23	0	4.73	108.81	0.67	38.79	0.03
## 10	262.52	20.38	0	6.06	101.72	1.31	36.53	9.20
##	PctConif2011Ws	PctDecid2011Ws	PctGrs2011Ws	PctHay2011Ws	PctHbWet2011Ws			
## 1	56.23	1.82	0.18	0.00	0			

## 2	52.72	6.22	1.87	0.00	0	
## 3	43.61	19.17	0.19	0.00	0	
## 4	NA	NA	NA	NA	NA	
## 5	62.20	3.78	1.00	0.00	0	
## 6	33.24	2.27	13.81	0.42	0	
## 7	33.24	2.27	13.81	0.42	0	
## 8	15.68	61.01	0.00	0.00	0	
## 9	43.59	34.90	0.00	0.00	0	
## 10	46.11	5.33	0.06	0.11	0	
##	PctMxFst2011Ws	PctShrb2011Ws	Precip8110Ws	RunoffWs	Tmean8110Ws	WtDepWs
## 1	39.61	1.00	756.61	30.00	4.62	182.88
## 2	31.22	3.27	859.86	30.21	3.35	182.88
## 3	31.50	4.98	690.55	38.65	3.77	182.88
## 4	NA	NA	NA	NA	NA	NA
## 5	25.00	3.59	776.01	30.11	4.23	182.88
## 6	0.01	49.59	404.38	29.00	8.96	182.88
## 7	0.01	49.59	404.38	29.00	8.96	182.88
## 8	0.00	23.31	572.16	248.00	6.99	182.88
## 9	0.21	21.21	565.32	248.00	6.84	182.88
## 10	1.24	37.45	519.64	57.78	5.03	181.97

## 2.4 Step 4. Create Grain Size Distribution Table

```
dbExecute(debrisflow_db, "CREATE TABLE GSD (
    Site_id varchar(50),
    subD16 float,
    subD50 float,
    subD84 float,
    D84B float,
    surD16 float,
    surD50 float,
    surD84 float,
    subD50range float,
    sub_var float,
    sur_var float,
    PRIMARY KEY (Site_id));
")

GSD <- read.csv("GSD_data.csv", header = TRUE, stringsAsFactors = FALSE)

names(GSD)
```

```
dbWriteTable(debrisflow_db, "GSD", GSD, append= TRUE)
```

```
#Check table
```

```
dbGetQuery(debrisflow_db, "SELECT * FROM GSD LIMIT 10;")
```

```
##           Site_id subD16 subD50 subD84   D84B surD16 surD50 surD84 subD50range
## 1   Brianhead 1    1.81  12.71  33.94 1116.0  13.67  30.08  50.59         3.72
## 2   Brianhead 2    1.00  12.40  54.62  527.0  11.58  30.29  51.53         6.82
## 3   Brianhead 3    0.33  11.85  55.86  537.5  12.15  40.99  74.31        40.22
## 4   Brianhead 3.2    NA    NA    NA    NA    NA    NA    NA         NA
## 5   Brianhead 4    1.68  21.61  58.63  820.0  19.30  31.65  53.75         5.05
## 6   Clay Springs 1    1.08  10.51  40.23  380.0  11.43  40.23  72.48         1.40
## 7   Clay Springs 2   13.15  32.95  58.78    NA  16.96  26.36  43.17         NA
## 8   Dairy Fork 1    2.62  13.97  57.36  540.0    6.63  20.95  38.26         3.37
## 9   Dairy Fork 2    0.90   4.78  13.58  490.0    2.00   8.25  19.30         NA
## 10  Dollar Ridge 1    0.53   6.88  56.88  860.0   19.21  32.26  55.90         0.43
##      sub_var sur_var
## 1      4.23    1.89
## 2      5.77    2.15
## 3      7.40    2.61
## 4      NA     NA
## 5      5.13    1.48
## 6      5.22    2.66
## 7      2.16    1.35
## 8      4.45    2.53
## 9      3.92    3.27
## 10     6.75    1.54
```

## 2.5 Step 5. Create Volume Data Table

```
dbExecute(debrisflow_db, "CREATE TABLE volume (
    obsVol_min varchar(50),
    obsVol float,
    obsVol_max float,
    G08_vol2yr_min float,
    G08_vol2yr float,
    G08_vol2yr_max float,
    G08_vol100yr_min float,
    G08_vol100yr float,
    G08_vol100yr_max float,
    G14_vol2yr_min float,
```

```

        G14_vol2yr float,
        G14_vol2yr_max float,
        G14_vol100yr_min float,
        G14_vol100yr float,
        G14_vol100yr_max float,
        PRIMARY KEY (Site_id));
    ")

volume <- read.csv("DF_Volume_data.csv", header = TRUE, stringsAsFactors = FALSE)

names(volume)

dbWriteTable(debrisflow_db, "volume", volume, append= TRUE)

#Check table
dbGetQuery(debrisflow_db, "SELECT * FROM volume LIMIT 10;")

```

##	Site_id	obsVol_min	obsVol	obsVol_max	G08_vol2yr_min	G08_vol2yr
## 1	Brianhead 1	73.1250	97.50	131.6250	117.86806	943.4712
## 2	Brianhead 2	468.7500	625.00	843.7500	503.77232	4032.4298
## 3	Brianhead 3	1350.0000	1800.00	2430.0000	218.57784	1749.5996
## 4	Brianhead 3.2	399.0000	532.00	718.2000	711.47298	5694.9633
## 5	Brianhead 4	1141.8750	1522.50	2055.3750	1363.30468	10912.5299
## 6	Clay Springs 1	140.2500	187.00	252.4500	680.62099	5448.0095
## 7	Clay Springs 2	130.5000	174.00	234.9000	310.77948	2487.6247
## 8	Dairy Fork 1	27.1875	36.25	48.9375	204.96535	1640.6388
## 9	Dairy Fork 2	993.7500	1325.00	1788.7500	78.84295	631.0960
## 10	Dollar Ridge 1	5250.0000	7000.00	9450.0000	13357.70775	106921.3564
##	G08_vol2yr_max	G08_vol100yr_min	G08_vol100yr	G08_vol100yr_max	G14_vol2yr_min	
## 1	7551.986	76.98279	616.2063	4932.404	110.01438	
## 2	32277.459	324.97765	2601.2735	20821.813	805.88558	
## 3	14004.615	142.36557	1139.5608	9121.579	136.56922	
## 4	45585.157	477.27337	3820.3199	30579.632	174.91993	
## 5	87349.007	1027.20720	8222.2481	65814.729	973.26510	
## 6	43608.423	518.32663	4148.9294	33209.976	548.34744	
## 7	19912.115	229.43772	1836.5271	14700.424	444.47567	
## 8	13132.442	151.40054	1211.8810	9700.463	131.13507	
## 9	5051.588	60.46193	483.9656	3873.888	30.44355	
## 10	855848.674	9922.14946	79421.5369	635727.224	5614.71204	
##	G14_vol2yr	G14_vol2yr_max	G14_vol100yr_min	G14_vol100yr	G14_vol100yr_max	
## 1	880.6066	7048.789	211.70029	1694.5484	13563.960	
## 2	6450.6861	51634.316	1563.94325	12518.5351	100204.225	
## 3	1093.1641	8750.198	261.71595	2094.8972	16768.540	
## 4	1400.1411	11207.386	330.79300	2647.8223	21194.411	
## 5	7790.4703	62358.577	1666.82324	13342.0348	106795.903	

## 6	4389.2300	35133.455	937.94561	7507.7565	60095.604
## 7	3557.7917	28478.233	782.87071	6266.4642	50159.718
## 8	1049.6666	8402.024	230.64137	1846.1617	14777.544
## 9	243.6845	1950.565	52.04251	416.5727	3334.443
## 10	44942.7880	359743.149	9598.77383	76833.0868	615008.054





## Chapter 3

# Literature

Here is a review of existing methods.



## Chapter 4

# Methods

We describe our methods in this chapter.



## Chapter 5

# Applications

Some *significant* applications are demonstrated in this chapter.

### 5.1 Example one

### 5.2 Example two



## Chapter 6

# Final Words

We have finished a nice book.