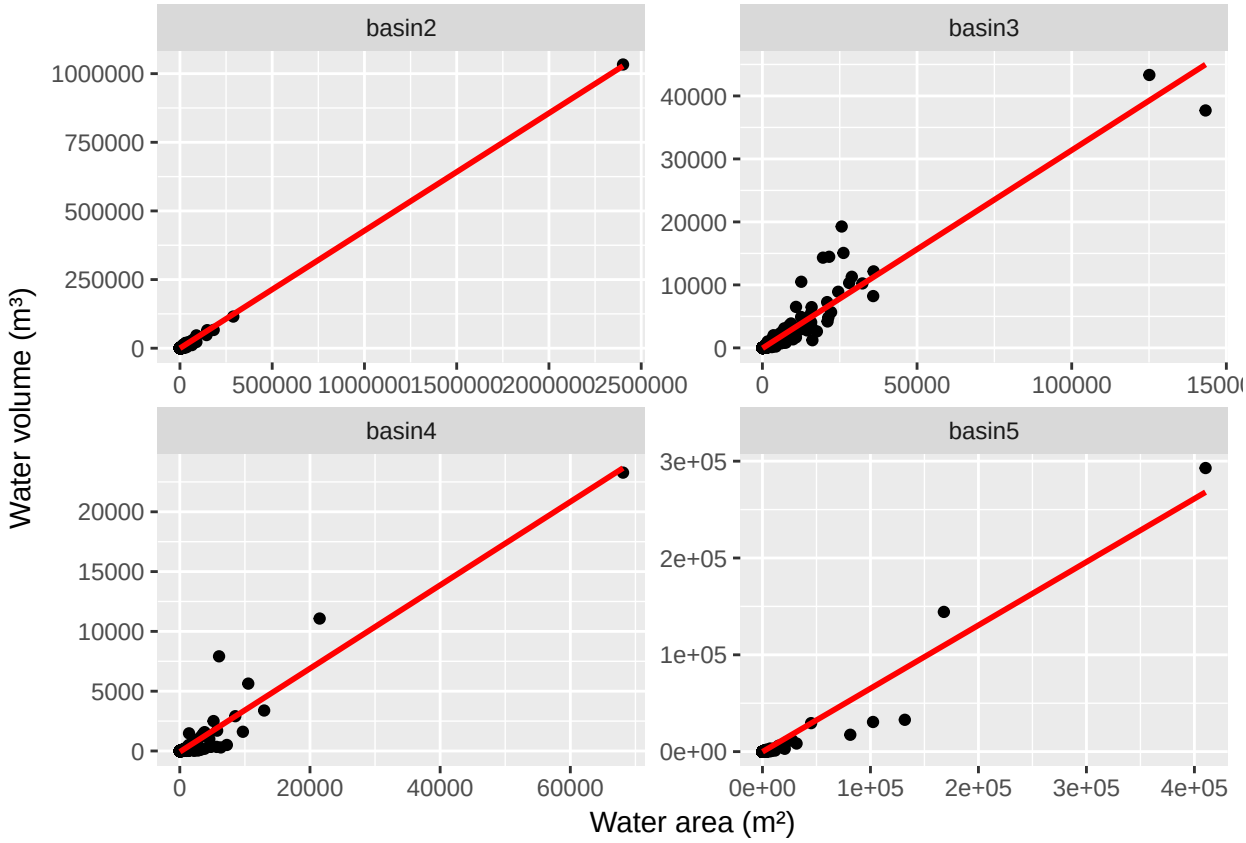
WDPM area volume scaling Notebook

Analysis of pond area-volume scaling from WDPM output for sub-basins at Camrose Creek. The sub-basins do not correspond to any other sub-basin delineation. They are simply regions which were determined by WDPM to drain to a common point. The pond volumes and areas were extracted from the WDPM files using the R function `WDPM_volume_area_scaling()`

Plot pond volumes vs areas

```
graphFile <- "./WDPM_areas_vols.png"
outfile <- "./"
infile <- "./WDPM_water_patches.csv"
all <- read.csv(infile, stringsAsFactors = FALSE, header = TRUE)

p <- ggplot(all, aes(area, volume)) +
  geom_point() + xlab("Water area (m²)") +
  ylab("Water volume (m³)") +
  facet_wrap(~basin, ncol = 2, scales = "free") +
  geom_smooth(method = "lm", se = FALSE, colour = "red")
print(p)
```




```
ggsave(graphFile)
```

```
## Saving 6.5 x 4.5 in image
```

Fit linear regressions to points

```
all_basins <- unique(all$basin)
num_basins <- length(all_basins)
fit <- c(0)
for (i in 1:num_basins) {
  basin <- all[all$basin == all_basins[i],]
  # do lm
  fit <- lm(volume~area, basin)
  cat("basin:", all_basins[i],"\n")
  #pander(summary(fit))
  pander(fit)
}
```

basin: basin3

Table 1: Fitting linear model: volume ~ area

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-61.1	12.66	-4.825	1.513e-06
area	0.3144	0.002402	130.9	0

basin: basin4

Table 2: Fitting linear model: volume ~ area

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-74.16	18.47	-4.016	6.836e-05
area	0.3485	0.005305	65.7	8.6e-248

basin: basin5

Table 3: Fitting linear model: volume ~ area

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-159.1	22.74	-6.995	3.096e-12
area	0.6535	0.002935	222.6	0

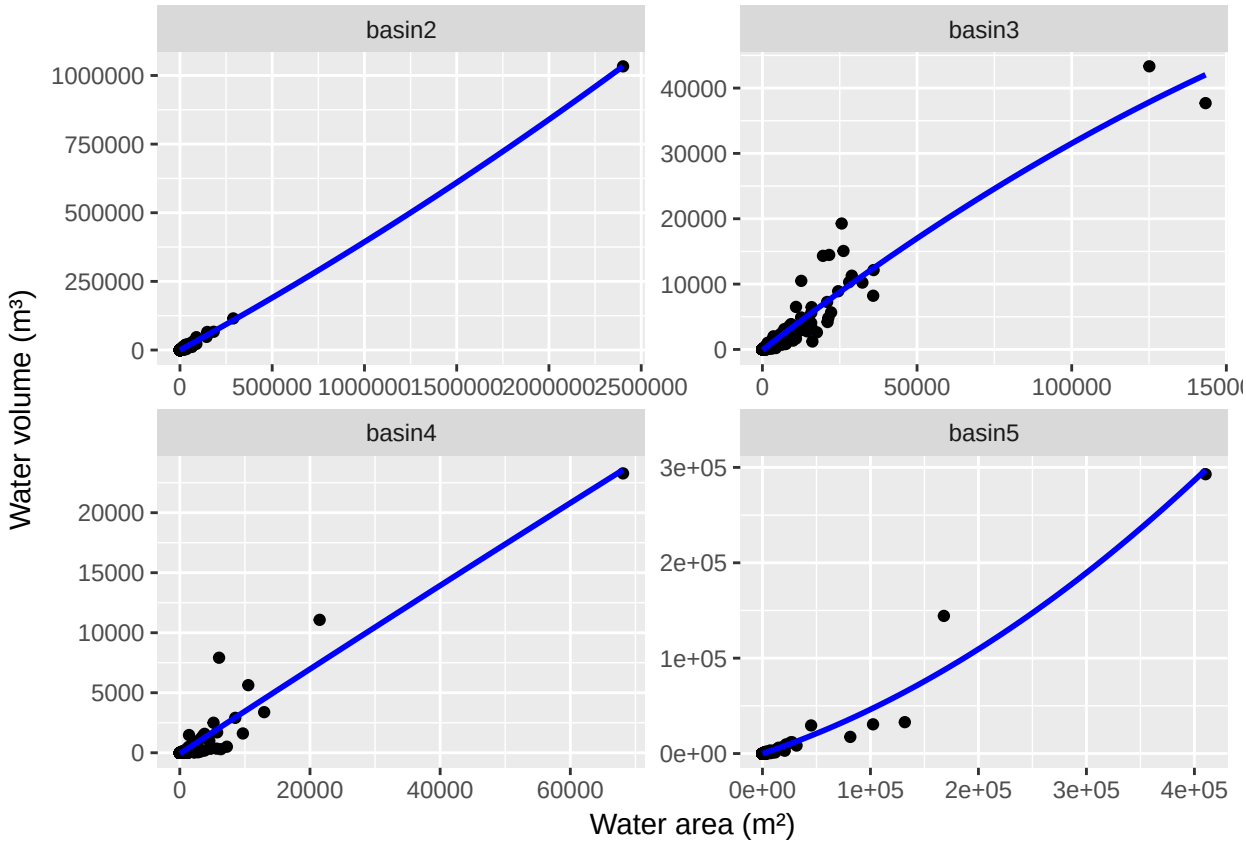
basin: basin2

Table 4: Fitting linear model: volume ~ area Plot with second order polynomial

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-70.45	3.417	-20.62	4.026e-93
area	0.4281	0.0001694	2527	0

```
p <- ggplot(all, aes(area, volume)) +
  geom_point() + xlab("Water area (m²)") +
  ylab("Water volume (m³)") +
  facet_wrap(~basin, ncol = 2, scales = "free") +
```

```
  geom_smooth(method = "lm", formula = y~x+I(x^2), se = FALSE, colour = "blue")
print(p)
```



Fit second order polynomial

```
all_basins <- unique(all$basin)
num_basins <- length(all_basins)
fit <- c(0)
for (i in 1:num_basins) {
  basin <- all[all$basin == all_basins[i],]
  fit <- lm(volume~area+I(area^2), basin)
  cat("basin:", all_basins[i],"\n")
  pander(fit)
}
```

basin: basin3

Table 5: Fitting linear model: volume ~ area + I(area^2)

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-97.46	12.63	-7.719	1.903e-14
area	0.3679	0.005162	71.27	0
I(area^2)	-5.156e-07	4.447e-08	-11.59	4.66e-30

basin: basin4

Table 6: Fitting linear model: volume ~ area + I(area^2)

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-76.98	19.42	-3.963	8.482e-05
area	0.3545	0.01381	25.66	3.547e-93
I(area^2)	-1.068e-07	2.265e-07	-0.4714	0.6375

basin: basin5

Table 7: Fitting linear model: volume ~ area + I(area^2)

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-65.66	18.19	-3.611	0.0003089
area	0.379	0.006151	61.61	0
I(area^2)	8.434e-07	1.748e-08	48.24	0

basin: basin2

Table 8: Fitting linear model: volume ~ area + I(area^2)

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-50.62	2.868	-17.65	5.042e-69
area	0.3676	0.0007714	476.6	0
I(area^2)	2.611e-08	3.276e-10	79.71	0

Value of r^2 is not greatly improved by using second-order polynomial, and there is still a large negative intercept. Therefore, refit without intercept.

```
all_basins <- unique(all$basin)
num_basins <- length(all_basins)
fit <- c(0)
for (i in 1:num_basins) {
  basin <- all[all$basin == all_basins[i],]
  # do lm
  fit <- lm(volume~area-1, basin)
  cat("basin:", all_basins[i],"\n")
  pander(fit)
}
```

basin: basin3

Table 9: Fitting linear model: volume ~ area - 1

	Estimate	Std. Error	t value	Pr(>|t|)
area	0.3124	0.002377	131.4	0

basin: basin4

Table 10: Fitting linear model: volume ~ area - 1

	Estimate	Std. Error	t value	Pr(>|t|)
area	0.3443	0.00528	65.22	1.141e-246

basin: basin5

Table 11: Fitting linear model: volume ~ area - 1

	Estimate	Std. Error	t value	Pr(>|t|)
area	0.6521	0.002946	221.4	0

basin: basin2

Table 12: Fitting linear model: volume ~ area - 1

	Estimate	Std. Error	t value	Pr(>|t|)
area	0.428	0.0001718	2492	0