

## **CHAPTER 9**

### **TRENCH BACKFILL/COMPACTION**

1. The first part of the text discusses the importance of maintaining accurate records of all transactions and activities related to the business.

2. This is followed by a detailed explanation of the various methods used to collect and analyze data.

# CHAPTER 9 BACKFILL/COMPACTION

## INDEX

Section	Topic	Page
9.1	General	9.1
9.2	Backfilling	9.2
9.3	Subbase	9.6
9.4	Foundation or Base Course	9.7
9.5	Trench Cover -- Subgrade	9.8
9.6	Trench Cover -- Asphalt	9.8
9.7	Permanent Alternative	9.9
9.8	Repair to Gravel Roads and Shoulders	9.10
9.9	Maintenance Period	9.11

1. *Introduction*

2. *Methodology*

3. *Results and Discussion*

4. *Conclusion*

5. *References*

6. *Appendix*

7. *Index*

8. *Table of Contents*

9. *Abstract*

10. *Summary*

11. *Notes*

12. *Footnotes*

13. *Endnotes*

14. *References*

15. *Appendix*

16. *Index*

17. *Table of Contents*

18. *Abstract*

19. *Summary*

20. *Notes*

21. *Footnotes*

22. *Endnotes*

23. *References*

24. *Appendix*

25. *Index*

26. *Table of Contents*

27. *Abstract*

28. *Summary*

29. *Notes*

30. *Footnotes*

31. *Endnotes*

32. *References*

33. *Appendix*

34. *Index*

35. *Table of Contents*

36. *Abstract*

37. *Summary*

38. *Notes*

39. *Footnotes*

40. *Endnotes*

41. *References*

42. *Appendix*

43. *Index*

44. *Table of Contents*

45. *Abstract*

46. *Summary*

47. *Notes*

48. *Footnotes*

49. *Endnotes*

50. *References*

51. *Appendix*

52. *Index*

53. *Table of Contents*

54. *Abstract*

55. *Summary*

56. *Notes*

57. *Footnotes*

58. *Endnotes*

59. *References*

60. *Appendix*

61. *Index*

62. *Table of Contents*

63. *Abstract*

64. *Summary*

65. *Notes*

66. *Footnotes*

67. *Endnotes*

68. *References*

69. *Appendix*

70. *Index*

71. *Table of Contents*

72. *Abstract*

73. *Summary*

74. *Notes*

75. *Footnotes*

76. *Endnotes*

77. *References*

78. *Appendix*

79. *Index*

80. *Table of Contents*

81. *Abstract*

82. *Summary*

83. *Notes*

84. *Footnotes*

85. *Endnotes*

86. *References*

87. *Appendix*

88. *Index*

89. *Table of Contents*

90. *Abstract*

91. *Summary*

92. *Notes*

93. *Footnotes*

94. *Endnotes*

95. *References*

96. *Appendix*

97. *Index*

98. *Table of Contents*

99. *Abstract*

100. *Summary*

101. *Notes*

102. *Footnotes*

103. *Endnotes*

104. *References*

105. *Appendix*

106. *Index*

107. *Table of Contents*

108. *Abstract*

109. *Summary*

110. *Notes*

111. *Footnotes*

112. *Endnotes*

113. *References*

114. *Appendix*

115. *Index*

116. *Table of Contents*

117. *Abstract*

118. *Summary*

119. *Notes*

120. *Footnotes*

121. *Endnotes*

122. *References*

123. *Appendix*

124. *Index*

125. *Table of Contents*

126. *Abstract*

127. *Summary*

128. *Notes*

129. *Footnotes*

130. *Endnotes*

131. *References*

132. *Appendix*

133. *Index*

134. *Table of Contents*

135. *Abstract*

136. *Summary*

137. *Notes*

138. *Footnotes*

139. *Endnotes*

140. *References*

141. *Appendix*

142. *Index*

143. *Table of Contents*

144. *Abstract*

145. *Summary*

146. *Notes*

147. *Footnotes*

148. *Endnotes*

149. *References*

150. *Appendix*

151. *Index*

152. *Table of Contents*

153. *Abstract*

154. *Summary*

155. *Notes*

156. *Footnotes*

157. *Endnotes*

158. *References*

159. *Appendix*

160. *Index*

161. *Table of Contents*

162. *Abstract*

163. *Summary*

164. *Notes*

165. *Footnotes*

166. *Endnotes*

167. *References*

168. *Appendix*

169. *Index*

170. *Table of Contents*

171. *Abstract*

172. *Summary*

173. *Notes*

174. *Footnotes*

175. *Endnotes*

176. *References*

177. *Appendix*

178. *Index*

179. *Table of Contents*

180. *Abstract*

181. *Summary*

182. *Notes*

183. *Footnotes*

184. *Endnotes*

185. *References*

186. *Appendix*

187. *Index*

188. *Table of Contents*

189. *Abstract*

190. *Summary*

191. *Notes*

192. *Footnotes*

193. *Endnotes*

194. *References*

195. *Appendix*

196. *Index*

197. *Table of Contents*

198. *Abstract*

199. *Summary*

200. *Notes*

201. *Footnotes*

202. *Endnotes*

203. *References*

204. *Appendix*

205. *Index*

206. *Table of Contents*

207. *Abstract*

208. *Summary*

209. *Notes*

210. *Footnotes*

211. *Endnotes*

212. *References*

213. *Appendix*

214. *Index*

215. *Table of Contents*

216. *Abstract*

217. *Summary*

218. *Notes*

219. *Footnotes*

220. *Endnotes*

221. *References*

222. *Appendix*

223. *Index*

224. *Table of Contents*

225. *Abstract*

226. *Summary*

227. *Notes*

228. *Footnotes*

229. *Endnotes*

230. *References*

231. *Appendix*

232. *Index*

233. *Table of Contents*

234. *Abstract*

235. *Summary*

236. *Notes*

237. *Footnotes*

238. *Endnotes*

239. *References*

240. *Appendix*

241. *Index*

242. *Table of Contents*

243. *Abstract*

244. *Summary*

245. *Notes*

246. *Footnotes*

247. *Endnotes*

248. *References*

249. *Appendix*

250. *Index*

251. *Table of Contents*

252. *Abstract*

253. *Summary*

254. *Notes*

255. *Footnotes*

256. *Endnotes*

257. *References*

258. *Appendix*

259. *Index*

260. *Table of Contents*

261. *Abstract*

262. *Summary*

263. *Notes*

264. *Footnotes*

265. *Endnotes*

266. *References*

267. *Appendix*

268. *Index*

269. *Table of Contents*

270. *Abstract*

271. *Summary*

272. *Notes*

273. *Footnotes*

274. *Endnotes*

275. *References*

276. *Appendix*

277. *Index*

278. *Table of Contents*

279. *Abstract*

280. *Summary*

281. *Notes*

282. *Footnotes*

283. *Endnotes*

284. *References*

285. *Appendix*

286. *Index*

287. *Table of Contents*

288. *Abstract*

289. *Summary*

290. *Notes*

291. *Footnotes*

292. *Endnotes*

293. *References*

294. *Appendix*

295. *Index*

296. *Table of Contents*

297. *Abstract*

298. *Summary*

299. *Notes*

300. *Footnotes*

301. *Endnotes*

302. *References*

303. *Appendix*

304. *Index*

305. *Table of Contents*

306. *Abstract*

307. *Summary*

308. *Notes*

309. *Footnotes*

310. *Endnotes*

311. *References*

312. *Appendix*

313. *Index*

314. *Table of Contents*

315. *Abstract*

316. *Summary*

317. *Notes*

318. *Footnotes*

319. *Endnotes*

320. *References*

321. *Appendix*

322. *Index*

323. *Table of Contents*

324. *Abstract*

325. *Summary*

326. *Notes*

327. *Footnotes*

328. *Endnotes*

329. *References*

330. *Appendix*

331. *Index*

332. *Table of Contents*

333. *Abstract*

334. *Summary*

335. *Notes*

336. *Footnotes*

337. *Endnotes*

338. *References*

339. *Appendix*

340. *Index*

341. *Table of Contents*

342. *Abstract*

343. *Summary*

344. *Notes*

345. *Footnotes*

346. *Endnotes*

347. *References*

348. *Appendix*

349. *Index*

350. *Table of Contents*

351. *Abstract*

352. *Summary*

353. *Notes*

354. *Footnotes*

355. *Endnotes*

356. *References*

357. *Appendix*

358. *Index*

359. *Table of Contents*

360. *Abstract*

361. *Summary*

362. *Notes*

363. *Footnotes*

364. *Endnotes*

365. *References*

366. *Appendix*

367. *Index*

368. *Table of Contents*

369. *Abstract*

370. *Summary*

371. *Notes*

372. *Footnotes*

373. *Endnotes*

374. *References*

375. *Appendix*

376. *Index*

377. *Table of Contents*

378. *Abstract*

379. *Summary*

380. *Notes*

381. *Footnotes*

382. *Endnotes*

383. *References*

384. *Appendix*

385. *Index*

386. *Table of Contents*

387. *Abstract*

388. *Summary*

389. *Notes*

390. *Footnotes*

391. *Endnotes*

392. *References*

393. *Appendix*

394. *Index*

395. *Table of Contents*

396. *Abstract*

397. *Summary*

398. *Notes*

399. *Footnotes*

400. *Endnotes*

401. *References*

402. *Appendix*

403. *Index*

404. *Table of Contents*

405. *Abstract*

406. *Summary*

407. *Notes*

408. *Footnotes*

409. *Endnotes*

410. *References*

411. *Appendix*

412. *Index*

413. *Table of Contents*

414. *Abstract*

415. *Summary*

416. *Notes*

417. *Footnotes*

418. *Endnotes*

419. *References*

420. *Appendix*

421. *Index*

422. *Table of Contents*

423. *Abstract*

424. *Summary*

425. *Notes*

426. *Footnotes*

427. *Endnotes*

428. *References*

429. *Appendix*

430. *Index*

431. *Table of Contents*

432. *Abstract*

433. *Summary*

434. *Notes*

435. *Footnotes*

436. *Endnotes*

437. *References*

438. *Appendix*

439. *Index*

440. *Table of Contents*

441. *Abstract*

442. *Summary*

443. *Notes*

444. *Footnotes*

445. *Endnotes*

446. *References*

447. *Appendix*

448. *Index*

449. *Table of Contents*

450. *Abstract*

451. *Summary*

452. *Notes*

453. *Footnotes*

454. *Endnotes*

455. *References*

456. *Appendix*

457. *Index*

458. *Table of Contents*

459. *Abstract*

460. *Summary*

461. *Notes*

462. *Footnotes*

463. *Endnotes*

464. *References*

465. *Appendix*

466. *Index*

467. *Table of Contents*

468. *Abstract*

469. *Summary*

470. *Notes*

471. *Footnotes*

472. *Endnotes*

473. *References*

474. *Appendix*

475. *Index*

476. *Table of Contents*

477. *Abstract*

478. *Summary*

479. *Notes*

480. *Footnotes*

481. *Endnotes*

482. *References*

483. *Appendix*

484. *Index*

485. *Table of Contents*

486. *Abstract*

487. *Summary*

488. *Notes*

489. *Footnotes*

490. *Endnotes*

491. *References*

492. *Appendix*

493. *Index*

494. *Table of Contents*

495. *Abstract*

496. *Summary*

497. *Notes*

498. *Footnotes*

499. *Endnotes*

500. *References*

501. *Appendix*

502. *Index*

503. *Table of Contents*

504. *Abstract*

505. *Summary*

506. *Notes*

507. *Footnotes*

508. *Endnotes*

509. *References*

510. *Appendix*

511. *Index*

512. *Table of Contents*

513. *Abstract*

514. *Summary*

515. *Notes*

516. *Footnotes*

517. *Endnotes*

518. *References*

519. *Appendix*

520. *Index*

521. *Table of Contents*

522. *Abstract*

523. *Summary*

524. *Notes*

525. *Footnotes*

526. *Endnotes*

527. *References*

528. *Appendix*

529. *Index*

530. *Table of Contents*

531. *Abstract*

532. *Summary*

533. *Notes*

534. *Footnotes*

535. *Endnotes*

536. *References*

537. *Appendix*

538. *Index*

539. *Table of Contents*

540. *Abstract*

541. *Summary*

542. *Notes*

543. *Footnotes*

544. *Endnotes*

545. *References*

546. *Appendix*

547. *Index*

548. *Table of Contents*

549. *Abstract*

550. *Summary*

551. *Notes*

552. *Footnotes*

553. *Endnotes*

554. *References*

555. *Appendix*

556. *Index*

557. *Table of Contents*

558. *Abstract*

559. *Summary*

560. *Notes*

561. *Footnotes*

562. *Endnotes*

563. *References*

564. *Appendix*

565. *Index*

566. *Table of Contents*

567. *Abstract*

568. *Summary*

569. *Notes*

570. *Footnotes*

571. *Endnotes*

572. *References*

573. *Appendix*

574. *Index*

575. *Table of Contents*

576. *Abstract*

577. *Summary*

578. *Notes*

579. *Footnotes*

580. *Endnotes*

581. *References*

582. *Appendix*

583. *Index*

584. *Table of Contents*

585. *Abstract*

586. *Summary*

587. *Notes*

588. *Footnotes*

589. *Endnotes*

590. *References*

591. *Appendix*

592. *Index*

593. *Table of Contents*

594. *Abstract*

595. *Summary*

596. *Notes*

597. *Footnotes*

598. *Endnotes*

599. *References*

600. *Appendix*

601. *Index*

602. *Table of Contents*

603. *Abstract*

604. *Summary*

605. *Notes*

606. *Footnotes*

607. *Endnotes*

608. *References*

609. *Appendix*

610. *Index*

611. *Table of Contents*

612. *Abstract*

613. *Summary*

614. *Notes*

615. *Footnotes*

616. *Endnotes*

617. *References*

618. *Appendix*

619. *Index*

620. *Table of Contents*

621. *Abstract*

622. *Summary*

623. *Notes*

624. *Footnotes*

625. *Endnotes*

626. *References*

627. *Appendix*

628. *Index*

629. *Table of Contents*

630. *Abstract*

631. *Summary*

632. *Notes*

633. *Footnotes*

634. *Endnotes*

635. *References*

636. *Appendix*

637. *Index*

638. *Table of Contents*

639. *Abstract*

640. *Summary*

641. *Notes*

642. *Footnotes*

643. *Endnotes*

644. *References*

645. *Appendix*

646. *Index*

647. *Table of Contents*

648. *Abstract*

649. *Summary*

650. *Notes*

651. *Footnotes*

652. *Endnotes*

653. *References*

654. *Appendix*

655. *Index*

656. *Table of Contents*

657. *Abstract*

658. *Summary*

659. *Notes*

660. *Footnotes*

661. *Endnotes*

662. *References*

663. *Appendix*

664. *Index*

665. *Table of Contents*

666. *Abstract*

667. *Summary*

668. *Notes*

669. *Footnotes*

670. *Endnotes*

671. *References*

672. *Appendix*

673. *Index*

674. *Table of Contents*

675. *Abstract*

676. *Summary*

677. *Notes*

678. *Footnotes*

679. *Endnotes*

680. *References*

681. *Appendix*

682. *Index*

683. *Table of Contents*

684. *Abstract*

685. *Summary*

686. *Notes*

687. *Footnotes*

688. *Endnotes*

689. *References*

690. *Appendix*

691. *Index*

692. *Table of Contents*

693. *Abstract*

694. *Summary*

695. *Notes*

696. *Footnotes*

697. *Endnotes*

698. *References*

699. *Appendix*

700. *Index*

701. *Table of Contents*

702. *Abstract*

703. *Summary*

704. *Notes*

705. *Footnotes*

706. *Endnotes*

707. *References*

708. *Appendix*

709. *Index*

710. *Table of Contents*

711. *Abstract*

712. *Summary*

713. *Notes*

714. *Footnotes*

715. *Endnotes*

716. *References*

717. *Appendix*

718. *Index*

719. *Table of Contents*

720. *Abstract*

721. *Summary*

722. *Notes*

723. *Footnotes*

724. *Endnotes*

725. *References*

726. *Appendix*

727. *Index*

728. *Table of Contents*

729. *Abstract*

730. *Summary*

731. *Notes*

732. *Footnotes*

733. *Endnotes*

734. *References*

735. *Appendix*

736. *Index*

737. *Table of Contents*

738. *Abstract*

739. *Summary*

740. *Notes*

741. *Footnotes*

742. *Endnotes*

743. *References*

744. *Appendix*

745. *Index*

746. *Table of Contents*

747. *Abstract*

748. *Summary*

749. *Notes*

750. *Footnotes*

751. *Endnotes*

752. *References*

753. *Appendix*

754. *Index*

755. *Table of Contents*

756. *Abstract*

757. *Summary*

758. *Notes*

759. *Footnotes*

760. *Endnotes*

761. *References*

762. *Appendix*

763. *Index*

764. *Table of Contents*

765. *Abstract*

766. *Summary*

767. *Notes*

768. *Footnotes*

769. *Endnotes*

770. *References*

771. *Appendix*

772. *Index*

773. *Table of Contents*

774. *Abstract*

775. *Summary*

776. *Notes*

777. *Footnotes*

778. *Endnotes*

779. *References*

780. *Appendix*

781. *Index*

782. *Table of Contents*

783. *Abstract*

784. *Summary*

785. *Notes*

786. *Footnotes*

787. *Endnotes*

788. *References*

789. *Appendix*

790. *Index*

791. *Table of Contents*

792. *Abstract*

793. *Summary*

794. *Notes*

795. *Footnotes*

796. *Endnotes*

797. *References*

798. *Appendix*

799. *Index*

800. *Table of Contents*

801. *Abstract*

## CHAPTER 9 - BACKFILL/COMPACTION

### 9.1 GENERAL

No pavement cuts will be permitted for any County roadway granted probationary acceptance or overlaid within the previous 5 years. Emergency repairs for broken pipes, cables etc. will be allowed according to the requirements of Chapter 10. If a contractor makes a cut into new pavement as defined in this paragraph which is not an emergency cut, the contractor or owner of the infrastructure shall be liable for additional costs as defined in Chapter 10.

**NOTE: All road surface street cuts shall require the use of C.L.S.M. (Controlled Low Strength Material) for backfill, or an alternative approved by the County Engineer prior to issuance of R.D.W. use permit. Variances from this requirement shall be on a case-by-case basis.**

- 9.1.1 Existing pavement shall be cut so the joint line between existing and replacement pavement is straight and neat -- i.e. within 5° of vertical and free from horizontal irregularities. All cuts shall be by saw or blade. The cut depth shall be full depth to permit pavement removal without damage to remaining pavement. In the case of concrete removal, it shall be by full panel only per existing control joints.
- 9.1.2 Removed pavement shall be hauled away and disposed of in a proper manner (recycle or waste facility).
- 9.1.3 Base course material should be removed and stockpiled off of the road surface area for reuse during backfilling if it meets specifications. If not, it is to be hauled away from the R.D.W. and disposed of in a proper manner.
- 9.1.4 Sub-base material is to be stockpiled parallel to the trench alignment, in such a manner that encroachment upon the non-disturbed portion of the roadway and/or pedestrian walkways is kept to a minimum.
- 9.1.5 Safety standards relating to the shoring and stabilization of trench sidewalls should be maintained as prescribed by appropriate safety regulatory agencies (OSHA, State of Colorado). No open holes may be left overnight or unattended. All areas must be backfilled if unattended. Type III barricades will be required if construction area is in or within 10 feet of the roadway.
- 9.1.6 The trench for such construction shall not be opened for a distance of more than three hundred (300) feet at any one time, unless specifically authorized by the County Engineer or his designated representative.
- 9.1.7 The trench width shall be confined to those minimum dimensions, which will permit proper installation and acceptable pipe loading, as established by current acceptable engineering practices and all OSHA requirements.
- 9.1.8 No street cuts should be left in an open condition overnight, except for the portion necessary to commence work the following morning. Warning signs, barricades and lights, all in conformance with the Manual of Uniform Traffic Control Devices (MUTCD), shall be used in areas where trenching operations are in public roadways. All work shall have flashing lights used with warning signs and

barricades. All such barricades, signs and warning devices shall be installed in accordance with the M.U.T.C.D. Type IV barricades will be required in or within 10 feet of the traffic area.

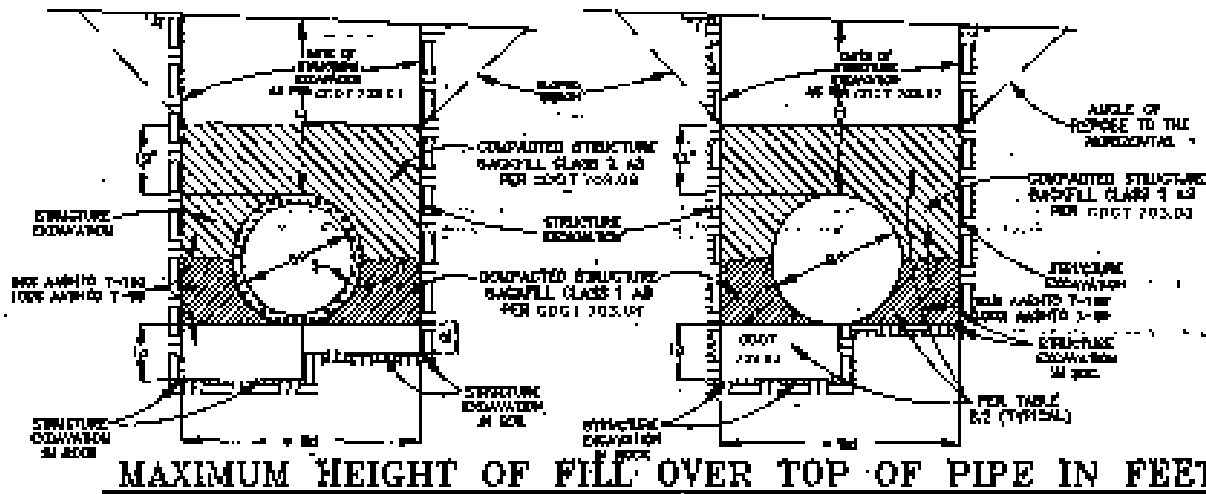
- 9.1.9 In trenching across the road, no more than one-half (1/2) of the traveled way is to be closed to traffic at one time, which requires the use of a traffic signal or flaggers. The trenched roadway shall be completely backfilled and a suitable driving surface restored before trenching the other half of the road. Final pavement restoration can be accomplished at one time when the utility installation or repair work is complete within a maximum of five working days for the permanent surface replacement.
- 9.1.10 Closure of any street (only by approval of the Douglas County Board of Commissioners), road approaches, or other access points will not normally be permitted. Upon trenching across such facilities, steel running plates, planks or other safe methods shall be used to provide for traffic to enter or leave the road or adjacent property. Refer also to Section 10.6.1 and 10.6.2.
- 9.1.11 Access to private driveways shall be provided at all times except during working hours when construction operations prohibit provision of such access.
- 9.1.12 Free access must be provided at all times to fire hydrants.
- 9.1.13 When, during the progress of the work, any excavation is to be made in County easements through private property, the contractor shall notify the property owners at least 24 hours in advance of beginning work or in accordance with right-of-way easements which set forth ingress/egress requirements.  
  
The Contractor shall take precautions to limit the removal of or damage to existing pavements, sidewalks, curbs, lawns, shrubbery, trees, hedges, walls, fences, buildings or other existing improvements to the least practicable amounts and shall replace or restore such improvements to their original location and condition after the excavation has been backfilled and compacted.
- 9.1.14 It shall be the responsibility of the contractor to appraise himself of all specific conditions contained in private easements. He shall perform all of his work in accordance with the stipulations contained therein.
- 9.1.15 Where trenching excavation occurs within the roadway surface, the minimum allowable remaining pavement sections shall not be less than four feet (4') (not including the curb and gutter or concrete pavement) unless it is part of a monolithic concrete pavement section which shall be full panel or stone.
- 9.1.16 All road surface cuts, if granted by special permission by the County, shall be a minimum of five feet (5') in width on all asphalt cuts and full panel (or stone) replacement on all concrete or curb and gutter cuts.
- 9.1.17 All scheduled road closures must be approved by the Board of County Commissioners. All emergency road closures shall be per Chapter 10 of this manual.

## 9.2 BACKFILLING

- 9.2.1 The permittee shall advise the Engineering Division of the trench backfill date at the time the Engineering Division is notified that construction will take place. A minimum of 24 hours advance notification is required. Normally, backfill will take place on the same day of trenching; if this is not the case, the Engineering Division must be given the same prior notice as required for the initial trenching.
- 9.2.2 The bottom of the trench shall be prepared to provide a firm foundation for the pipe or facility in accordance with the bedding conditions specified by the geotechnical engineer or Special District for the type of pipe or facility to be installed. The subgrade of the trench shall be kept free of standing water. Where the trench subgrade material is found to be unsuitable and does not afford a solid foundation, the contractor shall excavate to such depth as necessary to construct a stable foundation. A stable foundation shall be constructed by placing crushed rock or other approved granular material under the pipe.
- 9.2.3 Backfilling shall be so placed that the pipe will not be displaced or damaged. Backfilling to a depth of one foot maximum over the crown of the pipe shall be made with granular soil or sand as required by the Douglas County Engineer or his field representative.
- 9.2.4 Immediately after the facility authorized by the permit has been placed in the trench, the trench shall be backfilled with approved material, which is free of humus, vegetable or other organic matter, frozen material, clods, sticks and debris and contains no stones having a dimension greater than three (3) inches. Said material shall be filled to an elevation which will allow placing the pavement base and wearing surface according to Figure 9.1.
- Compaction test reports shall be required daily and all fill over one foot in elevation shall require a tester on site during backfill operation.
- When, in the opinion of the Douglas County Engineer or his representative, the excavated material is unsuitable for backfill, this material shall be hauled away and granular backfill material satisfactory to the Douglas County Engineer shall be used.
- 9.2.5 The subgrade shall conform to the lines, grades and cross sections as shown on the approved plans. The backfill material shall be compacted in successive layers not to exceed eight (8") inches thick and shall be finished and maintained in a smooth compacted condition. The completed surface shall be free from rutting or other objectionable irregularities.
- 9.2.6 Within the roadway area, trench compaction shall be in accordance with AASHTO T99 or T180 as required in Section 203.11 of the CDOT Standard Specifications. See Table 8.2. Compaction tests must be performed by a Geotechnical Engineer and shall be a minimum of every 250 feet along the trench and every one foot in elevation. Testing intervals may be increased at the discretion of the Chief County Inspector.

# RIGID PIPE

# FLEXIBLE PIPE



**MAXIMUM HEIGHT OF FILL OVER TOP OF PIPE IN FEET**

**REINFORCED CONCRETE**

Bd In.	Bd ft.	MIN. RIGID SPREAD R-1000 (MINIMUM 50% COMPACTED)			
		II	IV	V	VI
12	4.00	18	25	30	36
15	4.50	20	28	34	40
18	5.00	22	30	36	42
21	5.50	24	32	38	44
24	6.00	26	34	40	46
27	6.50	28	36	42	48
30	7.00	30	38	44	50
33	7.50	32	40	46	52
36	8.00	34	42	48	54
39	8.50	36	44	50	56
42	9.00	38	46	52	58
45	9.50	40	48	54	60
48	10.00	42	50	56	62
51	10.50	44	52	58	64
54	11.00	46	54	60	66
57	11.50	48	56	62	68
60	12.00	50	58	64	70
63	12.50	52	60	66	72
66	13.00	54	62	68	74
69	13.50	56	64	70	76
72	14.00	58	66	72	78
75	14.50	60	68	74	80
78	15.00	62	70	76	82
81	15.50	64	72	78	84
84	16.00	66	74	80	86
87	16.50	68	76	82	88
90	17.00	70	78	84	90
93	17.50	72	80	86	92
96	18.00	74	82	88	94
99	18.50	76	84	90	96
102	19.00	78	86	92	98
105	19.50	80	88	94	100
108	20.00	82	90	96	102
111	20.50	84	92	98	104
114	21.00	86	94	100	106
117	21.50	88	96	102	108
120	22.00	90	98	104	110
123	22.50	92	100	106	112
126	23.00	94	102	108	114
129	23.50	96	104	110	116
132	24.00	98	106	112	118
135	24.50	100	108	114	120
138	25.00	102	110	116	122
141	25.50	104	112	118	124
144	26.00	106	114	120	126
147	26.50	108	116	122	128
150	27.00	110	118	124	130
153	27.50	112	120	126	132
156	28.00	114	122	128	134
159	28.50	116	124	130	136
162	29.00	118	126	132	138
165	29.50	120	128	134	140
168	30.00	122	130	136	142
171	30.50	124	132	138	144
174	31.00	126	134	140	146
177	31.50	128	136	142	148
180	32.00	130	138	144	150
183	32.50	132	140	146	152
186	33.00	134	142	148	154
189	33.50	136	144	150	156
192	34.00	138	146	152	158
195	34.50	140	148	154	160
198	35.00	142	150	156	162
201	35.50	144	152	158	164
204	36.00	146	154	160	166
207	36.50	148	156	162	168
210	37.00	150	158	164	170
213	37.50	152	160	166	172
216	38.00	154	162	168	174
219	38.50	156	164	170	176
222	39.00	158	166	172	178
225	39.50	160	168	174	180
228	40.00	162	170	176	182
231	40.50	164	172	178	184
234	41.00	166	174	180	186
237	41.50	168	176	182	188
240	42.00	170	178	184	190
243	42.50	172	180	186	192
246	43.00	174	182	188	194
249	43.50	176	184	190	196
252	44.00	178	186	192	198
255	44.50	180	188	194	200
258	45.00	182	190	196	202
261	45.50	184	192	198	204
264	46.00	186	194	200	206
267	46.50	188	196	202	208
270	47.00	190	198	204	210
273	47.50	192	200	206	212
276	48.00	194	202	208	214
279	48.50	196	204	210	216
282	49.00	198	206	212	218
285	49.50	200	208	214	220
288	50.00	202	210	216	222
291	50.50	204	212	218	224
294	51.00	206	214	220	226
297	51.50	208	216	222	228
300	52.00	210	218	224	230
303	52.50	212	220	226	232
306	53.00	214	222	228	234
309	53.50	216	224	230	236
312	54.00	218	226	232	238
315	54.50	220	228	234	240
318	55.00	222	230	236	242
321	55.50	224	232	238	244
324	56.00	226	234	240	246
327	56.50	228	236	242	248
330	57.00	230	238	244	250
333	57.50	232	240	246	252
336	58.00	234	242	248	254
339	58.50	236	244	250	256
342	59.00	238	246	252	258
345	59.50	240	248	254	260
348	60.00	242	250	256	262
351	60.50	244	252	258	264
354	61.00	246	254	260	266
357	61.50	248	256	262	268
360	62.00	250	258	264	270
363	62.50	252	260	266	272
366	63.00	254	262	268	274
369	63.50	256	264	270	276
372	64.00	258	266	272	278
375	64.50	260	268	274	280
378	65.00	262	270	276	282
381	65.50	264	272	278	284
384	66.00	266	274	280	286
387	66.50	268	276	282	288
390	67.00	270	278	284	290
393	67.50	272	280	286	292
396	68.00	274	282	288	294
399	68.50	276	284	290	296
402	69.00	278	286	292	298
405	69.50	280	288	294	300
408	70.00	282	290	296	302
411	70.50	284	292	298	304
414	71.00	286	294	300	306
417	71.50	288	296	302	308
420	72.00	290	298	304	310
423	72.50	292	300	306	312
426	73.00	294	302	308	314
429	73.50	296	304	310	316
432	74.00	298	306	312	318
435	74.50	300	308	314	320
438	75.00	302	310	316	322
441	75.50	304	312	318	324
444	76.00	306	314	320	326
447	76.50	308	316	322	328
450	77.00	310	318	324	330
453	77.50	312	320	326	332
456	78.00	314	322	328	334
459	78.50	316	324	330	336
462	79.00	318	326	332	338
465	79.50	320	328	334	340
468	80.00	322	330	336	342
471	80.50	324	332	338	344
474	81.00	326	334	340	346
477	81.50	328	336	342	348
480	82.00	330	338	344	350
483	82.50	332	340	346	352
486	83.00	334	342	348	354
489	83.50	336	344	350	356
492	84.00	338	346	352	358
495	84.50	340	348	354	360
498	85.00	342	350	356	362
501	85.50	344	352	358	364
504	86.00	346	354	360	366
507	86.50	348	356	362	368
510	87.00	350	358	364	370
513	87.50	352	360	366	372
516	88.00	354	362	368	374
519	88.50	356	364	370	376
522	89.00	358	366	372	378
525	89.50	360	368	374	380
528	90.00	362	370	376	382
531	90.50	364	372	378	384
534	91.00	366	374	380	386
537	91.50	368	376	382	388
540	92.00	370	378	384	390
543	92.50	372	380	386	392
546	93.00	374	382	388	394
549	93.50	376	384	390	396
552	94.00	378	386	392	398
555	94.50	380	388	394	400
558	95.00	382	390	396	402
561	95.50	384	392	398	404
564	96.00	386	394	400	406
567	96.50	388	396	402	408
570	97.00	390	398	404	410
573	97.50	392	400	406	412
576	98.00	394	402	408	414
579	98.50	396	404	410	416
582	99.00	398	406	412	418
585	99.50	400	408	414	420
588	100.00	402	410	416	422

**RCF DESIGN CRITERIA:**

Safety Factor = 1.33 on UH,  
and Weight = 120 lb. per cu. ft.  
Load Factor = 1.0  
Bedding = Class B (modified)

Note: Where trench width  
exceeds transition to embankment  
condition, H<sub>1</sub> height for  
protected pipe (Standard  
U-503-RD) are shown.

All UH<sub>1</sub> values shown must be maintained  
over time.

**STEEL - 2 3/8" x 1/2" CORRUGATIONS**

Bd In.	Bd ft.	H <sub>1</sub> ABOVE TOP OF PIPE IN FEET					
		1-16	20	24	28	32	40
42	4-7	.064	.064	.064	.064	.064	.064
54	7-30	.078	.078	.078	.078	.078	.078
60	8-00	.078	.078	.078	.078	.109	.109
66	8-50	.078	.078	.109	.109	.138	.138
72	8-00	.078	.109	.109	.138	.168	.168
78	8-50	.109	.138	.138	.168		
84	10-00	.109	.138	.168			

**SP DESIGN CRITERIA:**  
3" x 1" CORRUGATIONS: 60 to 84 Pipe  
(must be .064" thick (16 gauge) to H = 40 ft.)

Soil Weight = 120 lb. per cu. ft.  
Safety Factor for Spun Strength = 2.00  
Bending Stress Limit = 1/3 Yield Strength  
Load Factor (Backfill) = 95% Standard  
County AASHTO  
T 89 (K-0.80)

**LEGEND:**  
H = Height of fill over top of pipe  
Bd = Inside diameter of pipe  
abd = Trench width  
s = Bed thickness of pipe  
r = Radius replacing most excavation for cost to place  
interior pipe, uniformly compacted to allow  
operation of the pipe machine and provide a smooth  
firm surface.  
a = Loose granular bedding, as follows:  
45° or more = 24" max. = 1/2" deep  
45° - 27° = 18" max. = 1/2" deep  
27° - 20° = 12" max. = 1/2" deep  
20° or less = 6" max. = 1/2" deep

**STANDARD NOTES:**  
CON. TOP & BOTTOM: Bd = Bd max  
CLAY & SAND: SD = STANDARD BUDGET MIXTURE  
(NO SILE CUTTERS)

Bedding material for SD: Must be Structural Backfill  
Class 1  
Bedding material for RCF: Must be Structural Backfill  
Class 1

**GENERAL NOTES:**  
All work shall be done in accordance with the Standard  
Specifications applicable to the project.

Minimum cover for protected pipe shall be 2 feet.

Changes in design criteria



## NOTES:

1. This trench patching detail specifies requirements in addition to those specified in the latest edition of the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction.
2. A construction traffic control plan shall be submitted to and approved by Douglas County prior to issuance of construction permits in the County right-of-way.
3. Trench shall be braced or sheeted as necessary for the safety of the workers and protection of other utilities or structures in accordance with applicable local, state and federal safety regulations.
4. The trench width shall be confined to those minimum dimensions, which will permit proper installation and acceptable pipe loading, as established by current local, state and federal safety regulations.
5. At the discretion of the Douglas County Inspector, the pavement may be required to be saw-cut back to maintain a straight edge.
6. Backfill compaction requirements: Minimum density will be determined in accordance with AASHTO T 99 or T 180 as defined by CDOT Standard Specifications Section 203.11 and CDOT 703.03. Except for CLSM.
7. Full depth asphalt can be used as an alternative to base course. A ratio of 3 inches base course to 1 inch of asphalt shall be used in the substitution.
8. A temporary hot-mix asphalt patch, 4" minimum depth (see Section 9.01) will be required for a street curb if a permanent hot-mix asphalt patch cannot be applied for any reason, after construction is completed.
9. Pavement edges shall be saw-cut straight to within 5 degrees of vertical. Edges shall be tack coated prior to patching.
10. If existing street is paved with fabric, a "TEE" trench shall be required. The Contractor shall carefully saw cut and remove the layer of asphalt above the fabric a minimum of 12" back from the edge of the trench.
11. Minimum cover for prefabricated pipe shall be 2 feet.
12. Changes in design criteria will require compensating change in pipe design.
13. When pipe sewer is to be extended or replaced with pipe of different material, the connections shall conform to the detail shown on plans or be approved.
14. Spacing for multiple pipe sewer installations shall be 1/2" inside diameter or span, or 3" maximum.
15. TRENCH INSTALLATION:
  - a. Trenches over 5 feet in depth shall be either shored or the trench walls shall be sloped to the angle of repose. If sloped, the bottom of the slope shall be a minimum of 1 foot above the top of the pipe.
  - b. Shoring will be required when the bottom of the slope is more than 3 feet above the bottom of the trench. Shoring shall extend a minimum of 1 foot above the bottom of the slope.
  - c. Timber sheeting or shoring may be cut off 1 foot above the top of the pipe after backfilling is complete.

REFERENCE: Douglas County Drainage Manual and Colorado Department of Transportation "M" Standards

## TRENCHING DETAIL NOTES



DOUGLAS COUNTY  
9.5

Issued: \_\_\_\_\_

Revised: 7-95

Drawing No.  
FIGURE 9.1b

- 9.2.7 Use of an approved controlled low slump material (flowfill, shrinkcrete, flashfill or equivalent) for backfill of trenches may be allowed with prior approval of the County Engineer. All controlled low slump material (CLSM) must have a 28-day strength of 60 - 100 psi, and a maximum slump of three and one-half inches (3.5").

### 9.3 SUBBASE

The term "subbase", for the purpose of trench backfill discussion shall refer to the CDDT Class 1 or Class 2 material that is part of a structural pavement design. There may or may not be a subbase in the pavement section. If there is none, the base course is all CDDT Class 6 aggregate base course.

- 9.3.1 Subbase material shall conform to the lines, grades, cross-sections and thickness shown on the approved plans and shall be finished and maintained in an acceptable condition at least one day's progress in advance of base construction.
- 9.3.2 Subbase material shall be well mixed, free of organic matter and lumps or balls of clay, and shall consist of sound aggregate particles and suitable filler or binding materials which when placed and compacted will result in a firm, dense, unyielding foundation. Subbase material need not be crushed but may be of the pit run variety providing it is graded within the following limits:

**TABLE 9.1  
GRADATION OF SUBBASE MATERIAL**

Standard Size of Sieve	Percentage of Weight Passing Sieve
2 1/2 inch	100
2 inch	95 - 100
#4	30 - 60
#200	5 - 15
Liquid Limit	35 maximum
Plastic Limit	6 maximum

- 9.3.3 Deviations from the gradation limits above will be permitted on approval by the County Engineer or his representative for unpaved roads where it can be adequately demonstrated that the proposed subbase material can fulfill the intent of these specifications.
- 9.3.4 Subbase shall be deposited and spread, without particle segregation in loose layers not to exceed 6 inches in depth. Each layer shall be thoroughly and individually compacted to 95% proctor (AASHTO T 99) density. Wetting or aerating and rolling of the material shall be required when ordered by the Douglas County Engineer or his representative. Subbase shall not be placed on soft, spongy, or

frozen subgrade or other subgrade, the stability of which, in the opinion of the Douglas County Engineer or his representative, is unsuitable.

#### 9.4 FOUNDATION FOR BASE COURSE

9.4.1 Base material shall conform to the lines, grades, cross-sections, and thickness shown on the approved plans and shall be finished and maintained in an acceptable condition at least one day's progress in advance of placing prime coat.

9.4.2 Base material shall consist of hard, durable particles or fragments of stone or gravel crushed to the required size and a AP-filler of sand or other finely divided mineral matter. When produced from gravel, not less than 60% by weight of the aggregate retained on a No. 4 sieve shall consist of particles having at least one fractured face. Base material shall be free from vegetable matter and lumps or balls of clay and which when placed and compacted will result in a firm, dense, unyielding foundation. Base material shall meet the following grading requirements:

**TABLE 9.2  
GRADATION OF LIMITS OF BASE MATERIAL**

Standard Size of Sieve	Percentage of Weight Passing Sieve
3/4 inch	100
#4	30 - 65
#10	25 - 55
#200	3 - 12
Liquid Limit	25 maximum
Plastic Limit	6 maximum

9.4.3 Base material shall be deposited and spread without particle segregation in loose layers not to exceed six inches in depth. Each layer shall be thoroughly and individually compacted to 95% proctor (AASHTO T 180) density. Wetting or watering and rolling of the material shall be required as ordered by the County Engineer or his representative following review of all field test results. No base course shall be placed upon a soft, spongy or frozen subgrade or subbase or other subgrade, the stability of which, in the opinion of the Douglas County Engineer, is unsuitable.

9.4.4 Deviation from the gradation limits may be permitted by the Douglas County Engineer on unpaved roads provided it can be unequivocally demonstrated that the subbase material is not conducive to rutting, raveling or forming a soft yielding surface in the presence of moisture. Compaction equipment must be on the job site before excavation is started. Compaction equipment must be capable of compacting within the trench width limits to avoid bridging the ditch.

- 9.4.5 If the existing base course is untreated, it shall normally be replaced with CDOT Class 6 aggregate base material and compacted in layers not to exceed six inches. The resulting total compacted base thickness shall be eight inches or to the thickness of the removed base plus two inches. If the existing base material is asphalt treated aggregate it shall be replaced by a minimum of 3" of acceptable asphalt base or the existing base thickness plus 1", whichever is greater. A replacement 2" thick asphalt surface wearing course shall also be used when replacing asphalt treated aggregate.

Note: For the purpose of replacing a full depth asphalt pavement section, the top 2" may be considered the wearing course, with the remainder being the base course.

## 9.5 TRENCH COVER -- SUBGRADE

- 9.5.1 After the backfill has been made and compacted as specified, it shall be cut and trimmed to the required depth and cross section. Trench cover subgrade shall be free of all rock over 2 1/2 inches in size. It shall have a compaction of 95 percent or more, by standard tests, see Table B.2, at the time of constructing curb, gutter, sidewalk, pavement and/or other permanent trench cover structure.
- 9.5.2 All excess excavated material shall be removed and disposed of outside the legal limits of the R.O.W. as the work progresses, unless the approval of the Douglas County Engineer is obtained for disposal of the material within the legal limits of the R.O.W. All parts of the roadway and various structures disturbed shall be restored to a condition equal to that which existed before starting the work.

## 9.6 TRENCH COVER -- ASPHALT

### 9.6.1 Temporary

#### 9.6.1.1 Temporary Trench Cover

All trenches across traffic lanes, where it becomes necessary to remove any existing surfacing or pavement, shall be provided with temporary trench cover.

- 9.6.1.2 A temporary patch of cold mix shall be placed on all pavement surface cuts immediately after backfilling has been completed and shall be removed at the time a permanent patch is made.

- 9.6.1.3 Minimum requirements for temporary trench cover shall be well compacted surfacing material conforming to "Road Mixed Asphalt Surfacing Material" of the CDOT Standard Specifications and shall match the existing asphalt or concrete thickness, but shall not be less than four inches (4") thick. The mineral aggregate shall, with a tolerance of 5 percent, conform to the grading specified for 3/8 inch maximum aggregate. Bituminous binder to be mixed with the mineral aggregate shall be liquid asphalt, Grade MC-3000 and shall be between 5 1/2 percent and 6 percent by weight of the dry mineral aggregate.

- 9.6.1.4 Temporary trench cover surfacing material shall be stockpiled on the job site and shall be placed within six hours after completion of trench backfill and compaction.
- 9.6.1.5 Temporary trench cover shall be properly maintained until permanent trench cover is placed.
- 9.6.1.5 Trench covered with temporary surfacing will be considered as open to traffic.
- 9.6.1.7 The surface of the temporary repaving shall be smooth and at the same level as the adjacent undisturbed paved area.

**9.6.2 Permanent**

Unless otherwise specified, the replacement of pavement shall be as follows:

- 9.6.2.1 In the areas where the wearing surface is asphalt concrete, replace the pavement with a Full Depth asphalt paving of a minimum thickness of four (4") inches but in all cases to a thickness of the old surface plus base course plus one (1") inch.
- 9.6.2.2 In areas where the wearing surface is Portland cement concrete, replace the pavement with concrete pavement conforming to the requirements of the governing authority. Said concrete pavement replacement shall be of the same depth as the original pavement, but not less than six inches thick on alleys or residential streets, nor less than eight inches on major or secondary streets and highways.
- 9.6.2.3 In areas where the wearing surface is other than asphalt concrete or Portland cement concrete, replace the pavement and base in kind. Said surface replacement shall be of materials and thickness conforming to the requirements of the governing authority.

**9.7 PERMANENT ALTERNATIVE**

- 9.7.1 Where original surface was Portland cement concrete; Portland cement concrete shall be placed to a thickness of six inches or the thickness of the removed pavement, whichever is greater.
- 9.7.2 Where original surface was asphalt concrete, bituminous treatment or mix, or oil mat: Asphalt concrete shall be compacted in layers not to exceed three (3") inches to a total compacted thickness of four (4") inches or the thickness of the removed pavement plus 1", whichever is greater. On oil mat surfaces or substandard asphalt surfaces, an overlay of Class "EX" asphalt pavement 1 1/2 inches thick shall be placed across the entire traffic lane disturbed by the trench and shall be finished as set forth below.
  - 9.7.2.1 Immediately prior to placing the wearing surface, the abutting pavement edges shall be neatly cut (See Section 8.11).

- 9.7.2.2 The existing pavement shall be cleaned, removing all loose material and coated with hot liquid asphalt (Grade AC-10) or asphalt emulsion applied cold (Grade CSS-1h) to ensure a bond with the new asphalt surfacing.
- 9.7.2.3 The restored pavement shall be finished to a smooth riding surface and to the grade of the surrounding undisturbed pavement.
- 9.7.2.4 Pavement replacement shall commence not more than seven (7) working days after backfilling, unless the Douglas County Engineer permits otherwise.
- 9.7.3 In the event the trench edges fall in the wheel traveling portion of a traffic lane, existing or proposed, the applicant shall extend the finish surface paving to a point deemed satisfactory by the County Engineer, or his field representative. Finish surface paving shall be performed in such a manner as to provide a crown slope equal to that existing prior to excavation, with no ponding of run off surface water either over the trench or at the joints between the new and original surfaces.
- 9.7.4 When road surface damage involves more than one traffic lane, a full width paving lift may be required. Individual jobs may require negotiations with the Division of Road and Bridge, at the discretion of the Director of Public Works, for partial participation in the cost of a full width overlay.
- 9.7.5 See Figure 9.1 for details of trench backfill and asphalt surface repair.

## **9.8 REPAIR TO GRAVEL ROADS AND SHOULDERS**

### **9.8.1 Restoration of Unpaved Areas**

- 9.8.1.1 Where the original surface was crushed rock or gravel for the wearing surface and foundation material, Class 5 aggregate base course shall be used as replacement material. It shall be placed to a compacted thickness minimum of eight (8) inches or the thickness of the removed material plus two (2) inches, whichever is greater. See Table 8.2.
- 9.8.1.2 **Compaction**  
In the area from the R.O.W. line (fence line/property line) to a point five (5) feet outside of the roadside ditch flowline, all trenches shall be backfilled with excavated material and compacted to 90% standard compaction, or to the density of the existing ground, whichever is greater.
- 9.8.1.3 In all other areas not referred to in Section 9.8.1.2 above, including the gravel road, the shoulders and the roadside ditch to a point five (5) feet outside of the flowline, all trench compaction shall be in conformance with Figure 9.1 of these standards.

**9.8.1.4 Erosion Control**

During construction and after the trench is backfilled and compacted, erosion protection shall be provided per the Douglas County Storm Drainage Design and Technical Criteria Manual.

**9.9 MAINTENANCE PERIOD**

- 9.9.1 For a period of one year following the backfilling of any trench in the County R.O.W. and/or the permanent patching of the paved surface, the applicant shall be responsible for the condition of said trench backfill and pavement patches. During that time the applicant shall, at his own cost, upon request from the Douglas County Engineer, repair to the County Engineer's satisfaction any of the said patches which become settled, cracked, broken, or otherwise faulty. Settlement of the replaced road surface of one-half (1/2") inch or more within a six (6') foot straight edge shall constitute evidence of improperly compacted backfill material. If test results do not meet the standards for compaction as set forth in Sections 8.2 thru 8.5, the contractor shall be responsible for repairs or replacement to meet these standards. Settlement of 3/8 inch or greater with a six (6') foot straight edge will be cause for repair in the case of settlement or replacement in the case of unsatisfactory workmanship.
- 9.9.2 All inspection costs shall be borne by the permittee. Such costs shall be based on a schedule of charges on file in the office of the Douglas County Engineer.
- 9.9.3 The permittee shall notify the Douglas County Engineer in writing upon completion of work accomplished under the provisions of the permit.